Valuation Methods in Renewable Energy Investments: An Explanatory Mixed-Methods Study among German and Swiss Investment Professionals

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ABSTRACT

This research aims to evaluate the currently applied valuation approaches in practice among German and Swiss professional investors for renewable energy (RE) projects based on an explanatory, sequential, mixed-methods (MM) research approach, compared to existing financial theory. It additionally explores associated influencing factors, key equity value drivers, and 'best practice' approaches and/or improvements in order to propose a revised valuation approach specifically for such investments. The inferences (INFs) taken are obtained by integrating quantitative (QUAN) results from a survey of 111 practitioners with qualitative (QUAL) findings through in-depth interviews with 16 purposefully selected individuals from the pool of participants from the previous QUAN phase to explore those results in more detail.

The results and findings were both reassuring and surprising while still detecting a certain gap between theory and practice. As main research outcomes, it can be illustrated that both systematic and unsystematic risks are relevant for performing valuations of such investments. More specifically, for the former, political and market risks are the most important risk components, and for the latter, weather-related volume risk is most important. Risk preferences and subsequently valuation are clearly influenced by experienced materialisation of risk. Discounted cash flow (DCF)-based valuation is state of the art in this valuation, even if multiples are applied as a simplified benchmarking approach. Encountered risk leads either to adjustment in the cash flows or in the applied discount rate, the former being the main approach to treat risk in valuation. The internal rate of return (IRR) approach is the most frequently applied valuation methodology, even if the net present value (NPV) approach is theoretically more consistent and even though many practitioners do not seem to be aware of the former's potential drawbacks. Moreover, the market for such investments has agreed to apply a simplified flow to equity (FTE) valuation approach. It thus ignores the consideration of the right type of discount rate (a dynamic discount rate) for the typically applied autonomous financing structure based on project financing for simplification reasons. Market participants surprisingly still use the weighted average cost of capital (WACC) of the investing company, mostly as a basis for defining hurdle rates, even if finance theory could clearly demonstrate its irrelevance as a cost of capital (CoC) approach in DCF-based valuation. More sophisticated valuation methods are less known and not applied, even if the certainty equivalent (CE) and adjusted present value (APV) methods are promising, complementary methods to support conventional approaches for assessing the investment's value protection ability and performing impairment test respectively.

The discussion of the INF analysis results helps to increase the understanding of this complex topic and provides valuable insights into this usually hidden procedure. The applied MM approach allowed for the exploration of issues and the discussion of possible improvements in valuation practices, which would not be possible within a classic quantitative study. The developed concepts in this thesis provide practitioners, particularly equity investors, with powerful tools to define the relevant equity value drivers, to understand additional influencing factors in valuation and considerations of risk treatments in projects, and to value RE investments along the two dimensions of value creation and value protection.

I declare that the work in this thesis was carried out in accordance with the regulations of the University of Gloucestershire and is original except where indicated by specific reference in the text. No part of the thesis has been submitted as part of any other academic award. The thesis has not been presented to any other education institution in the United Kingdom or overseas.

Any views expressed in the thesis are those of the author and in no way represent those of the University.

Signed   Date 01/10/2018

DEDICATION

This thesis is dedicated to my wife, Andrea; our new-born child, Emma Lou; my parents, Elsbeth and Bernhard; and my brother, Michael.

ACKNOWLEDGMENT

Performing this doctoral research was a long road, which would not have been possible without various key people, organisations, and institutions.

First, I am thankful to my wonderful wife, who gave me the opportunity to embark on such a long journey, as well as to my family and friends who supported my decision to pursue a doctoral degree. Furthermore, I would like to thank my supervisors: Prof. Dr. Dolores S. Bengoa, for her valuable advice, her support in performing this research from the beginning, and her introduction to her wide academic network, and Dr. Jasim Al-Ali, for his valuable professional advisory in the research area and his prompt, constructive, and detailed feedback. My thank goes also to my two examiners Prof. Dr. Rob Ryan and Prof. Dr. Bernd Britzelmaier for their valuable comments and recommendation of improvements. Without all these inputs, this current piece of research would have not been possible.

I would like to thank my employer, Elektrizitätswerke des Kantons Zürich (EKZ), which provided me with the foundation for the whole research, including the research topic, as well as the opportunity and resources to conduct this study.

I am also grateful to the members of my cohort at the university of Gloucestershire and the participants of our action learning circle in Switzerland, to the organisers of the doctoral colloquium at the Kalaidos University of Applied Sciences in Zurich, and to the academic group of energy policy at the ETH Zurich for the opportunity to present and discuss my research. I would like to extend my thanks to several master and doctoral students at the University of St. Gallen (HSG) and the Delft University of Technology for being able to offer advice and input and to discuss certain issues, whilst receiving new food for thought for my research.

Last but not least, this research would not have been possible without all the numerous study participants and people who put me into to contact with other relevant persons and distributed my requests. This was not self-evident due to confidentiality reasons; however, the access to the data was crucial for this research. Therefore, I would express my gratitude to all the involved persons during this process.

Christian Hürlimann

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ABBREVIATIONS

AHP	Analytical hierarchy process
APM	Arbitrage pricing model
APT	Arbitrage pricing theory (=APM)
βj or $\beta asset$	Beta coefficient
CAPM	Capital asset pricing model
CAQDAS	Computer-assistant qualitative data analysis software
CCAPM	Consumption-based CAPM
CF	Net cash inflow
CI	Capital invested
CIO	Chief investment officer
CoC	Cost of capital
DAX	Deutscher Aktienindex
DCF	Discounted cash flow
DD	Due diligence
DNPV	Decoupled net present value
DSCR	Debt service coverage ratio
DV	Dependent variable
eNPV	Expected net present value
EPC	Engineering procurement construction
ERP	Equity risk premium
EVA	Economic value added
EVCaP model	Equity value creation and value protection model
EVDIF model	Equity value driver and influencing factor model
FF	FamaFrench
FiT	Feed-in tariff
FCF	Free cash flow
FCFE	Free cash flow to equity
FCFF	Free cash flow to firm
FTE	Flow to equity
GDB	Gross domestic product
I_0	Initial investment
ICAPM	Intertemporal CAPM
ICF	Initial coding frame
IV	Independent variable
LCOE	Levelised cost of electricity
IPP	Independent power producer
iRADR	Implied risk-adjusted discount rate
IRR	Internal risk of return
LDD	Legal DD

LR	Literature review
M&As	Mergers and acquisitions
MA	Multiple approach (in valuation)
MIRR	Modified IRR
MM	Mixed-methods
MMR	Mixed-methods research
NOPAT	Net operating profit after tax
NPV	Net present value
NTA	Non-traded asset[3] on the public market
OPEX	Operational expenditure
O&M	Operation and maintenance
P	Probability (for example, in the term P value)
PB	Payback period
PCA	Principal component analysis
PD	Project developer
PDF	Probability density function
PI	Profitability index
PPA	Power purchase agreement
PTC	Publicly traded company
PV	Present value
QDA	Quantitative data analysis
qual	Minor qualitative research phase
QUAL	Primary qualitative research phase
QUAN	Primary quantitative research phase
r	Discount rate
RE	Renewable energy
RES	Renewable energy source
RES-E	Power plants producing electricity from renewable energy sources
RAPV	Risk adjusted project valuation
RRM	Risk ranking matrix
ROV	Real option valuation
R&D	Research and development
SMI	Swiss market index
SPA	Share purchase agreement
SPV	Special purpose vehicle
TDD	Technical DD
t	Time and period
VaR	Value at risk
VBM	Value-based management
WACC	Weighted average cost of capital

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1 INTRODUCTION

1.1 Background and Relevance of Research

Starting in 1992 with the Earth Summit in Rio, followed by the Kyoto Protocol in 1997 and the Paris Agreement in 2015, more than 190 countries have joined the international treaty to stabilise climate change by reducing greenhouse gas emissions to keep the average global temperature rise below 2°C (UNFCCC, n.d.). An effective means of reducing such emissions is the decarbonising of the power sector, a central theme promoted in many countries and by many globally acting programmes (Jägemann et al., 2013, Skea, 2015, EEA, 2017, Steffen and Schmidt, 2018). This transformation to a sustainable, low-carbon economy is based on facilitating the breakthrough of power plants producing electricity from renewable energy sources (RES-E)[1] (Reichmuth, 2013, IEA, 2015, Unteutsch and Lindenberger, 2016).

In the current market environment, with historically low overall interest rates and with economic challenges in several countries, many investors are attracted to subsidised[2] RES-E projects with robust returns due to their absence of correlations with stock exchanges and their anticipated, favourable risk-return profiles (Warren, 2014), which make such investments economically more attractive (Monnin, 2015, Thakkar, 2015). However, many investors were forced to accept impairment losses in some of their RES-E investments (Shah, 2011). The question to be answered is now as follows: have all risk components been properly considered in the valuation process?

While asset pricing research has extensively studied the relationship between risk and return on publicly traded companies (PTCs), including many theoretical publications about valuation (e.g. Brigham and Houston, 2012) and several empirical studies about the application of methods (e.g. Graham and Harvey, 2001, Brounen et al., 2004), surprisingly little attention has been paid to the class of non-traded assets (NTAs)[3] to which the majority of RES-E projects belong and to other, mostly qualitative factors that influence valuations and transactions. Even if this private equity[4] market is at least as important, in terms of size, growth, and the volume of acquisitions (Ang and Kohers, 2001, Moskowitz and Vissing-Jørgensen, 2002, Capron and Shen, 2007), relatively little is known about its risk and return characteristics. Furthermore, unsystematic risks, the risk perception of different cultures, and sector specific characteristics are not adequately considered. Collecting data about this topic is challenging, since information is not publicly available for NTAs, and private investment firms are typically highly restrictive in providing corresponding information. Moreover, existing literature provides limited guidance for how to deal with individual and cultural differences in risk perceptions and risk behaviours (Hofstede, 1983, Weber and Hsee, 1998, Weber et al., 2002) within such models.

Knowledge and understanding of factors influencing traditional valuations and transaction dynamics as well as additional complementary and/or alternative valuation concepts may help investors in RES-E to better and more efficiently allocate their investment budgets while improving the quality of investment decisions and eventually decreasing the need to perform extraordinary depreciation of shares or assets.

1.2 Scope and Framework of Research

The aims of this study are to examine and understand the risk and return components and their trade-off in valuation as well as applied capital budgeting processes and cost of capital (CoC) approaches. It explores decision-making mechanisms in RES-E investments to present updated conceptual frameworks, including a revised valuation approach.

The main research questions to be explored are as follows:

- What are the risk components to be considered, and how are they prioritised, processed, and affected within the valuation of RES-E investments? [QUAN]
- What valuation techniques are applied in RES-E investment transactions, and what organisational characteristics influence these application choices? [QUAN]
- Why are certain methods applied in practice, and what deficiencies and influencing factors are encountered in valuation processes within RES-E investment transactions? [QUAL]
- How can the key equity value drivers of RES-E investments within a coherent valuation concept be described? [INF]
- How can the relationship between risk components and investment return be described, and how can the corresponding risk and financial performance be assessed as a basis for developing a revised valuation model for RES-E investments? [INF]

As explained in more detail in section 4.1.1, the abbreviation QUAN stands for quantitative research, QUAL for qualitative research, and INF for inferences while combining the QUAN and QUAL results based on the mixed-methods research (MMR) approach. The stated abbreviations in brackets indicate the main intended research approach for answering the stated research question, without putting the exclusive research focus on one of the research approaches.

Correspondingly, the following research objectives have been formulated to provide the foundation for the research design and guide the research process:

- To assess relevant risk components, to illustrate their prioritisation and consideration, and to analyse potential influences in RES-E investment valuation processes. [QUAN]
- To evaluate the valuation methods that are currently applied in RES-E investment valuations and the organisational characteristics that might affect these processes. [QUAN]
- To understand the valuation process in practice in more detail, and to discuss the corresponding encountered deficiencies and influencing factors (determinants) in the valuation of RES-E investments [QUAL]
- To develop a model that describes the key equity value drivers of RES-E investments [INF]
- To develop a revised valuation model for RES-E investment valuation that combines the risk and financial performance perspective [INF]

While answering these questions and making a contribution to both academia and practitioners, more effective and suitable solutions are offered that are less subjective and arbitrary in nature. An overview of the different research objectives and questions as well as the various contributions of the applied research phases are provided in Table 1. Details of the applied methodology follow in section 4.

The system boundaries in this research are given by the micro-economic perspective of the research questions. The research focuses mainly on the behaviour of and decision making within single economic units, i.e. investment companies, but not on the detailed dynamics within investment decisions and transactions. No particular emphasis is placed on how different political frameworks for promoting RES-E investments influence valuation processes and techniques. The research concentrates on the capital budgeting topics with regard to project valuation methods, risk assessments and corresponding valuation adjustments, risk mitigation measures, hurdle rates, and risk-adjusted return rates. Option pricing is not the focus of this research due the research's main emphasis on RES-E projects in low-risk environments in terms of the operating of the project (section 2.2.4.3) and the financing structure (section 2.4.1.3). However, there is a brief discussion about the characteristics of real option valuations (section 2.4.2.4), since their usage has been evaluated (QUAN phase) in order to research the whole range of possible valuation techniques. Related research fields in valuation, including capital rationing, post audits, capital structuring, and dividends policies, are not the primary focus in this research.

Table 1: Research aim, objective, research objectives, and contribution of literature review and applied methods (main focus: cells with thicker frame).

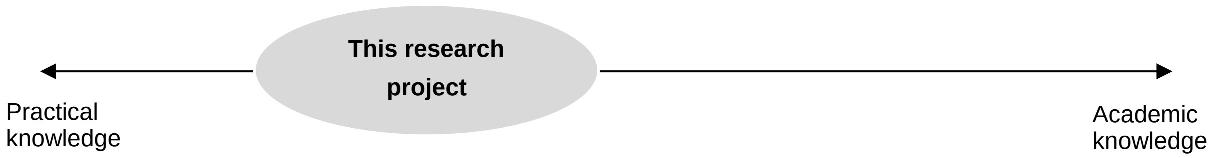
Aim	Research questions	Objectives	Literature review	Contribution of				
				Exploratory quantitative phase	**Quantitative phase with survey**	**Qualitative phase with interviews**	**Inferences from qualitative and quantitative phase**
Examine and understand the risk-return valuations processes/trade-offs, valuation practices, and decision-making mechanisms in RES-E investments	What are the risk components to be considered, and how are they prioritised, processed, and affected within the valuation of RES-E investments?	To assess relevant risk components and to illustrate their prioritisation and consideration, and to analyse potential influences in RES-E investment valuation processes	Identify possible risk components and other determinants from previous empirical research	To gain first insights into the topic and to identify additional determinants from practitioners in addition to the literature review	To collect quantitative results from the focus population	To collect qualitative data while discussing results from quantitative research and deepening understanding	To triangulate the quantitative results with the qualitative results
	What valuation techniques are applied in RES-E investment transactions, and what organisational characteristics influence these application choices?	To evaluate the valuation methods that are currently applied in RES-E investment valuations and the organisational characteristics that might affect these processes	Identify different capital budgeting techniques and CoC from theory and their usage in practice from empirical studies	To gain first insights into the topic and to identify the first reasons certain techniques are applied	To collect quantitative results from the focus population about applied techniques to be statistically analysed	To collect qualitative data while discussing results from quantitative research, deepening understanding, and identifying reasons for applying corresponding techniques	To triangulate the quantitative results with the qualitative results
	Why are certain methods applied in practice, and what deficiencies and influencing factors are encountered in valuation processes within RES-E investment transactions?	To understand the valuation process in practice in more detail, and to discuss the corresponding encountered deficiencies and influencing factors (determinants) in the valuation of RES-E investments	Review and evaluate existing frameworks	-	To collect some influencing factors from a statistical analysis	To collect qualitative data while discussing determinants to refine framework	To complement the quantitative results
	How can the key equity value drivers of RES-E investments within a coherent valuation concept be described?	To develop a model that describes the key equity value drivers of RES-E investments	Identify and evaluate available models to refine and develop an improved model particularly suited to RES-E investments	To gain first insights into potential drivers	To collect some first drivers	To collect qualitative data and discuss equity value drivers and influencing factors	To draw a conclusion from quantitative and qualitative results about equity value drivers
	How can the relationship between risk components and investment return be described, and the corresponding risk and financial performance be assessed as the basis for developing a revised valuation model for RES-E investments?	To develop a revised valuation model for RES-E investment valuation that combines the risk and financial performance perspective	Identify and evaluate available models to refine and develop an improved model particularly suited to RES-E investments	-	-	To discuss the current application of valuation and potentially promising methods with practitioners experienced in valuation	To draw a conclusion from quantitative and qualitative results and literature from presented valuation model

1.3 Contribution to Research

The research is expected to make a valuable contribution to the asset pricing research for NTAs, based on the example of RES-E investments. First, the research demonstrates which theoretical concepts[1] are applied in RES-E investment practice so that practitioners can learn how firms currently operate, assess, and mitigate risk/uncertainties, and apply asset pricing techniques. Second, the research contributes to practice by offering valuable insights into the organisational and cultural differences in the risk perception and risk behaviour of Swiss and German RES-E investors and other relevant factors influencing valuations and investment decision making. Third, it contributes to the field of research and to managerial practice by suggesting improvements as well as complementary and alternative valuation methods for performing valuations in RES-E investments. As a primary contribution of this study, a set of comprehensive, coherent, straightforward, still systematic and more objective frameworks for valuating RES-E investments is developed, while taking into account ‘qualitative and strategic considerations’ (Bierman, 1993:24); the perspectives from the firm’s and investor’s level (Ehrhardt and Brigham, 2016); and the influences of previous investments and experiences in risk materialisation, portfolio effects, and other cognitive aspects. Finally, the MMR approach applied in finance theory, behavioural finance research, and business administration in general contributes to theory and practice, since its relevance is growing in these areas (Miller and Cameron, 2011), achieving a similar relevance to research design type in its frequent application to sociology, health science, education, and some social and behavioural research (Plano Clark and Ivankova, 2016).

Since this research project mainly deals with a significant business problem and needs to conduct an in-depth exploration of the practitioners’ environment, thereby being capable of offering practical advice within the context of a theoretical framework, this PhD thesis seeks to close the gap between theory and practice. After the completion of this study, academia and practitioners alike will benefit from new and adjusted frameworks to do the following: understand the relevant equity value drivers and influencing factors on valuation; optimally consider risk, uncertainty, and the corresponding mitigation possibilities; and value RES-E investments from a value-creation and value-protection perspective. Figure 1 illustrates where this research project is located in the context of a research spectrum, with practical and academic knowledge at opposite ends of the spectrum.

Figure 1: Research spectrum.



1.4 Research Approach

After exploring the theoretical and empirical literature in the field of risk assessment and asset pricing for PTCs and NTAs (section 2) and defining the research gap (section 2.7.2), a first conceptual framework is developed (section 2.7.3), and a preliminary list of relevant themes and subcategories are defined (section 2.7.4), both as a basis for the subsequent empirical research. This initial conceptualisation (framework, themes, and categories) builds the basis for performing the research. However, during the INF phase, it is substituted with a set of more comprehensive and coherent frameworks (section 5.4.5). The applied methodology is based on a particular research phase sequence, starting with a minor, qualitative, exploratory interview phase (qual); a major, quantitative survey phase (QUAL); a major, qualitative interview phase (QUAL); and a final INF phase, which combines and discusses the results and findings of the previous two major phases. This methodological approach is described in literature as a sequential, explanatory MMR approach (section 4.1.1) while following the philosophical stance of critical realism within this research (section 3.1). The research focuses on Swiss and German investors who are investing globally in the million-euro-scale in this RES-E investment sector. The research investigates current frequencies of applied valuation methods within praxis (QUAN phase), and it learns from the practitioners (QUAN and QUAL phase), while taking the opportunity to discuss promising valuation methods (QUAL) before discussing the results of both phases and finalising the revised valuation concepts during the final INF phase. The data analysis is based on the software SPSS for statistical analysis in the QUAN phase and on content analysis using the software nVivo™ in the QUAL and INF phases.

The terms quantitative and qualitative are used in this thesis in two different circumstances. It is either used to distinguish different research methodologies or applied for different valuation approaches. The former is discussed in more detail in section 4.1.1.1. The latter typology concerns the structuring of the investigated topics in quantitative and qualitative methods in valuation techniques. In both cases, the term *quantitative* is about countable, numerical, and sometimes statistically analysable approaches, while the term *qualitative* is about less countable, not statistically analysable, more judgmental, and less generalisable approaches.

1.5 Publications

Several publications were developed during the course of this research, as listed below. Submitted conference abstracts or papers were preceded by full paper versions, which were submitted to research journals. One of these papers has been published, one is in press, and one is currently in review. The publications of Hürlimann and Bengoa (2015) and Hürlimann and Bengoa (2017a) focus on the literature review, while the second pair of publications of Hürlimann and Bengoa (2016) and Hürlimann et al. (in press) are concerned with reporting the QUAN results. Since the results from the QUAL phase cannot be published separately from the previous QUAN results, the next two publications present a final discussion and interpretation of both phases. In doing so, the conference paper of Hürlimann and Bengoa (2017b) presents a comparative review of both phases, being awarded the EuroMed 2017 student award[5]. The subsequent corresponding full-paper version focuses on an in-depth discussion and interpretation of the combined research phases.

Conference abstracts:

- Hürlimann, C. & Bengoa, S. D. (2015) 'A Revised Theory to Estimate Returns in Renewable Energy Investments'. In: Vrontis, D., Weber, Y. & Tsoukatos, E., eds. in 8th Annual Conference of the EuroMed Academy of Business—Innovation, Entrepreneurship and Sustainable Value Chain in a Dynamic Environment, September 16-18, 2015, Verona, Italy. EuroMed Press, pp. 2056f.
- Hürlimann, C. & Bengoa, S. D. (2016) 'Valuation Process in Renewable Energy Investments: a Survey among Investment Professionals'. In: Vrontis, D., Weber, Y. & Tsoukatos, E., eds. in 9th Annual Conference of the EuroMed Academy of Business—Innovation, Entrepreneurship and Digital Ecosystems, September 14-16, 2016, Warsaw, Poland. EuroMed Press, pp. 2008-2013.

Conference paper:

- Hürlimann, C. & Bengoa, S. D. (2017) ‘Valuating Renewable Energy Investment within Transactions: A Comparative Review among Practitioners'. In: Vrontis, D., Weber, Y. & Tsoukatos, E., eds. in 10th Annual Conference of the EuroMed Academy of Business—Global and National Business Theories and Practice: Bridging the Past with the Future, September 13-15, 2017, Rom, Italy. EuroMed Press, pp. 720-739.

Journal publications:

- Hürlimann, C. & Bengoa, S. D. (2017) 'Corporate Finance in Renewable Energy Investments—A Review about Theory and Practice', Global Economics and Business Review, Vol. 19 No. 5, pp. 592-631.
- Hürlimann, C., Bengoa, S. D. & Al-Ali, J. (in press) 'Theory and Practice of Valuation Approaches in Renewable Energy Investments: a Survey among Investment Professionals', World Review of Entrepreneurship, Management and Sustainable Development.
- Hürlimann, C., Bengoa, S. D. & Al-Ali, J. (in press) 'Valuation of Renewable Energy Investments: An Explanatory Study about Applied Methods amongst Practitioners'. Global Economics and Business Review.

1.6 General Outline of the Thesis

The general outline of the thesis is presented in Figure 2, illustrating the main relevant sections and major research milestones.

Figure 2: General outline of thesis with milestones (shown as diamonds).

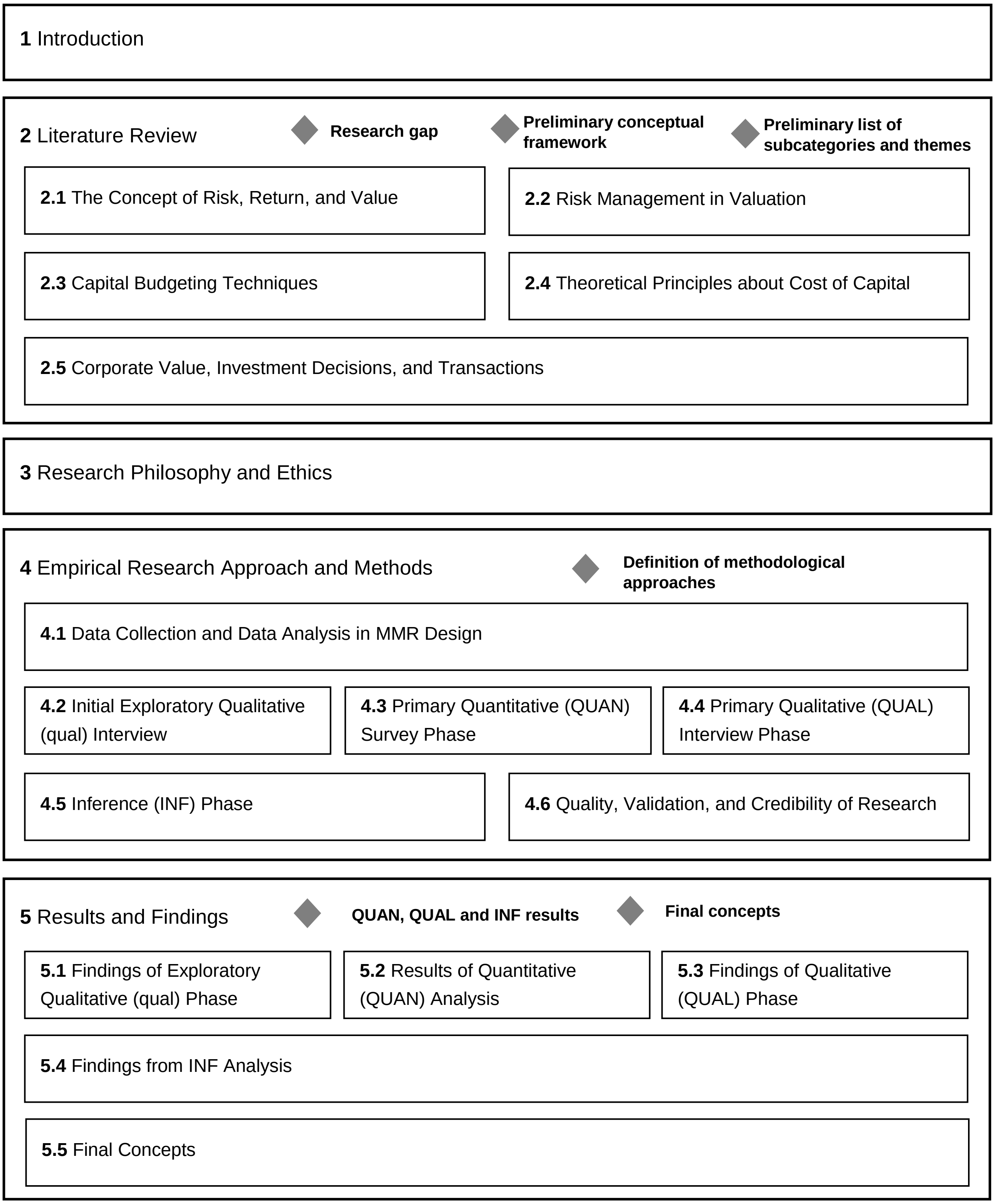


Figure 2: (continued).

6 Conclusion and Outlook

6.1 Discussion

6.2 Contribution to the Body of Knowledge

6.3 Contribution of Practice

6.4 Limitation of Research

6.5 Direction for Further Research

6.6 Personal Reflection about Research Journey

After the introduction (chapter 1), the thesis proceeds to conduct a thorough literature review (chapter 2), defining the research gap, an initial conceptual framework, and an initial list of relevant subcategories and themes to be used in the further research. In chapter 3, the chosen philosophical assumptions for this research are outlined, before defining the applied empirical research approaches and methods in chapter 4. The subsequent chapter 5 presents the results and findings of the different research phases (qual, QUAN, QUAL and INF) and the resulting final concepts before concluding the research in chapter 6 with a discussion of the findings and contributions to theory and practice, the research limitations, and a research outlook and personal reflection on the research journey.

2 LITERATURE REVIEW

This section consists of an extensive overview of the current literature about the general characteristics of RES-E projects and the motives of investors (section 2.1); the basic principles of risk, return, and value (section 2.2); risk management in relation to valuation (section 2.3); the two major parts in valuation[6], namely capital budgeting techniques (section 2.4) and CoC principles (section 2.5); and a final section about corporate value, investment decisions, and transactions (section 2.6).

2.1 Renewable Energy Projects and Investors

2.1.1 Characteristics of RES-E Projects

Power plants producing electricity from renewable energy sources are typically asset-heavy, capital-intensive ventures for most applied types of technologies (particularly those based on wind, sun, hydro, tide, wave, and geothermal heat), and they require low working and operating capital, also due to the natural resources generally being free of charge, resulting in low variable costs (Milligan et al., 2009, DNV GL, 2018). Those two characteristics are both in contrast to conventional and fossil-fuel-based electricity generation (Schmidt, 2014, Noothout et al., 2016). RES-E projects are long-term ventures, both in development (due to elaborate and time-consuming social and environmental assessments) and in operation (due to the longevity of the technology[7]) (Böttcher, 2009, Schmidt, 2014). As the term indicates, those 'projects' have finite livespans, and they are divided into various distinct project stages (section 2.2.4.3). Operating RES-E projects are mostly highly immobile, often remote, and far from centres of demand (Milligan et al., 2009). The generation of most RES-E projects is location-specific, while particularly wind and correspondingly electricity generation from wind are both uncertain to forecast and variable—more than other natural resources, such as sun or geothermal heat. In comparison to other sectors, storage of the produced electricity is still a challenge, since it is associated with high losses and high inefficiencies, and it is still dominated by pumped-hydro storage power plants to store high loads (Dunn et al., 2011, Steffen and Weber, 2013, Penn, 2018, July 24). In operation, RES-E projects generally hold predefined operating contracts with set cost components. Newer RES-E technologies[7] are currently still subsidised in many countries, for instance with feed-in tariffs (FiTs), and this has been an effective system to enable their breakthrough in the generation market (Lipp, 2007, Bürer and Wüstenhagen, 2009, Couture and Gagnon, 2010). Many countries are now moving to either drastically cut down or completely face out subsidies—due to cost reductions in photovoltaic and wind (Warren, 2017)—to reach competitiveness of RES-E (Rogge et al., 2018). As alternatives to FiTs, RES-E projects can also hold long-term power purchase agreements (PPAs) with electricity traders or industrial counterparties to hedge market prices (Böttcher, 2009, Bruck et al., 2016). As such, the business performance of most RES-E projects can be predominantly described as a function of the quality and availability of natural resources as the input variable and—for those years after the end of subsidies or the initially contracted PPA period (the after-FiT/PPA period)—the power market as the output variable. In operation, RES-E projects generally have few options to optimise the business, such as to increase revenue or to reduce costs[8], and hence the management of RES-E projects has limited scope for action[9]. Apart from financing RES-E projects on the investor's balance sheet, as many utilities do, RES-E assets can also be structured in special purpose vehicles (SPVs). In contrast to traditional corporate financing, such SPVs can obtain project financing from credit institutes, particularly in cases of low-risk environments (Böttcher and Blattner, 2010, Steffen, 2018), for instance with predefined sales prices for the generated electricity based on state subsidies or PPAs (see sections 2.4.1.3 and 2.4.2.1 for more details about project financing). Since generated profit is usually not directly re-invested in the asset, but flows to the equity holders and/or group's treasury, and since the business is typically shrinking over the projects lifetime due to high depreciation of the asset, only cash and cash equivalents are left on the balance sheet's active side. At the same time, any debt financing is usually redeemed before the end of the FiT period (Böttcher and Blattner, 2010).

These characteristics of RES-E projects as well as the project stages in focus (sections 1.2 and 2.2.4.3) influence the identification of the relevant risk components and the assessment of their relevance, the valuation adjustment for risk (section 2.3), the choice about the project valuation period (section 2.4.1.2), and the applied valuation techniques (section 2.4.2).

2.1.2 Investors and Investment Motives

The type of investor has an implication on the motives, which are the driving forces of RES-E investors, as argued by Bergek et al. (2013), and on valuation itself, as discussed in more detail in sections 2.3.3.2 and 2.6.2. Recent literature demonstrates that RES-E investments are performed by a heterogenous group (Agterbosch et al., 2004, Bergek et al., 2013, trend:research, 2013), including power utilities (hereafter named *utilities*) with a long tradition in electricity production; project developers; independent power producers (IPPs); financial investors, including insurance companies and pension funds; industrial companies; farmers; associations; cooperatives; and home owners (Wüstenhagen and Menichetti, 2012, Bergek et al., 2013, Holstenkamp and Kahla, 2016). The focus of this thesis lies on corporate investors investing in million-euro-scale RES-E projects (sections 1.4 and 4.1.3).

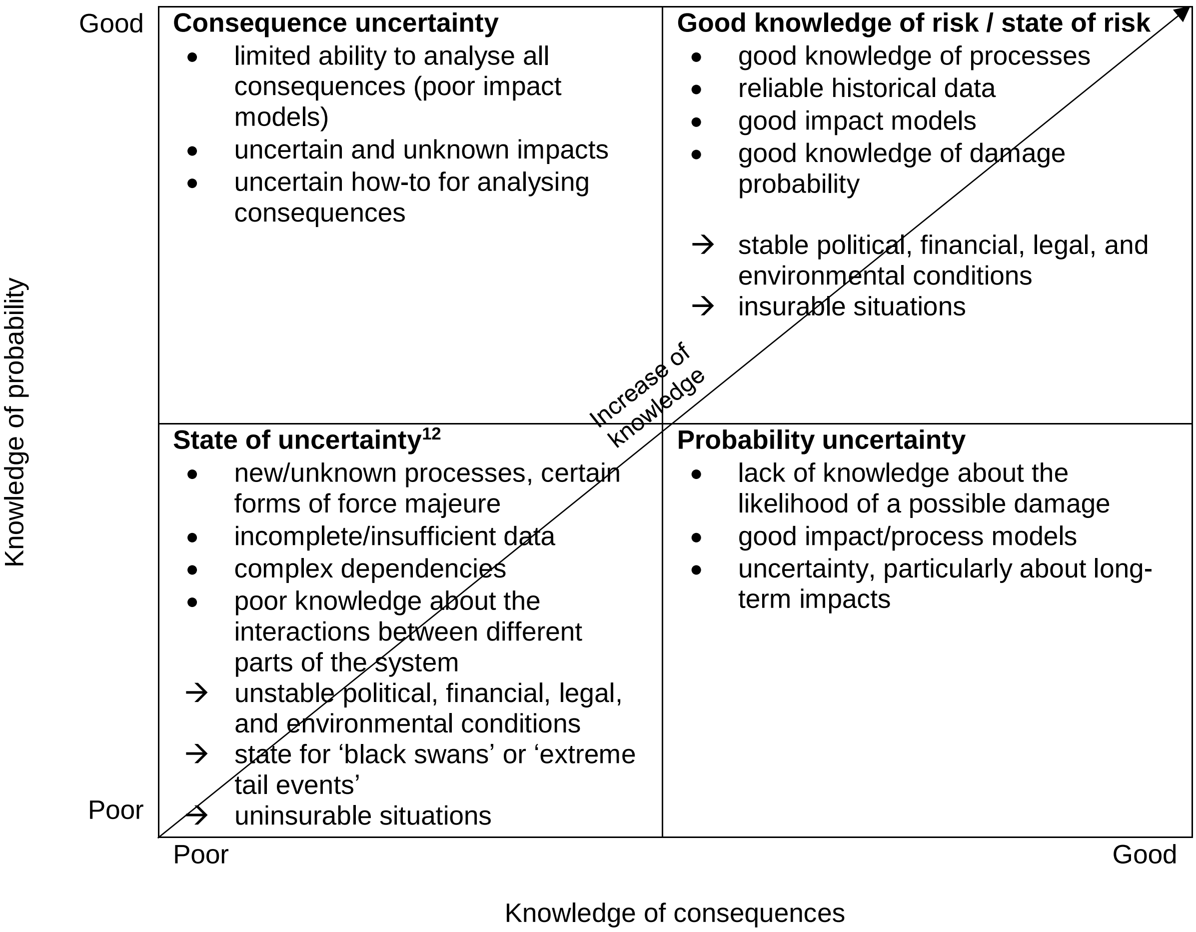
In general, investment motives are probably as numerous as investors and target investments. However, it makes sense to group motives (Mukherjee et al., 2004) in order to investigate their impact on investment and valuation processes. *Profitability* is one of the main investment motives in the RES-E sector (Bergek et al., 2013), particularly when comparing the attractiveness of RES-E with regard to the risk associated with fossil-fuel-based power plants (Awerbuch, 2003, Bhattacharya and Kojima, 2012) and when social costs are also considered (Awerbuch, 2000, Carlson, 2002, Awerbuch, 2003), although regulation risk for RES-E investments can raise the risk level (Finon and Perez, 2007, Söderholm and Pettersson, 2011). In addition, others pursue investments in RES-E projects with an anticipated attractive risk-return profile, and they receive a stable, usually low income (section 2.2.4.2) and hence diversify their existing portfolios in a less general stock-market-related sector. Financial investors in particular pursue this *diversification* of an existing portfolio (Wüstenhagen and Menichetti, 2012), which involves the need to focus on analysing energy portfolios instead of stand-alone projects (Awerbuch, 2003, Bhattacharya and Kojima, 2012) (section 2.3.3). In addition to the common set of motives, there are also *strategic investment motives* for RES-E projects, such as investing in new production technologies, securing attractive production sites, replacing inefficient production capacities (Meyer and Koefoed, 2003), and diversifying production portfolios (Roques et al., 2010). Strategic investments are mainly performed by utilities and IPPs. Other investors pursue the securing of own electricity supply to increase their *independency* from larger utilities (Holstenkamp and Kahla, 2016), which have traditionally dominated the electricity generation infrastructure sector in the past decades (Schleicher-Tappeser, 2012, Richter, 2013). There are other investors who seek to build a portfolio of energy generation units while securing a long-term position in *CO_2 emission-low or emission-free production* to reach their corporate emission reduction goals and to live up to their responsibility to society and the environment, along with an increase in reputation as carbon-low or carbon-free investors, or to consider welfare aspects (Wüstenhagen and Menichetti, 2012, Kalkbrenner and Roosen, 2016). Investment motives related to the protection of the climate are quite unique to the considered type of investments, and they are only found in other climate-related sectors, such as agriculture, heating, and transportation. Investors seldom pursue a sole investment motive. For instance, a combination of different investment motives, such as the risk with regard to the investment profitability, the reduction of its CO_2 emission footprint, and probably also reputation reasons, has led the global insurance company Allianz to invest 3.5 billion euros of equity in RES-E projects (Allianz Capital Partners, 2016) and to withdraw all investments in coal-based electricity generation units (Allianz, 2015).

2.2 The Concept of Risk, Return, and Value

2.2.1 Risk and Uncertainty

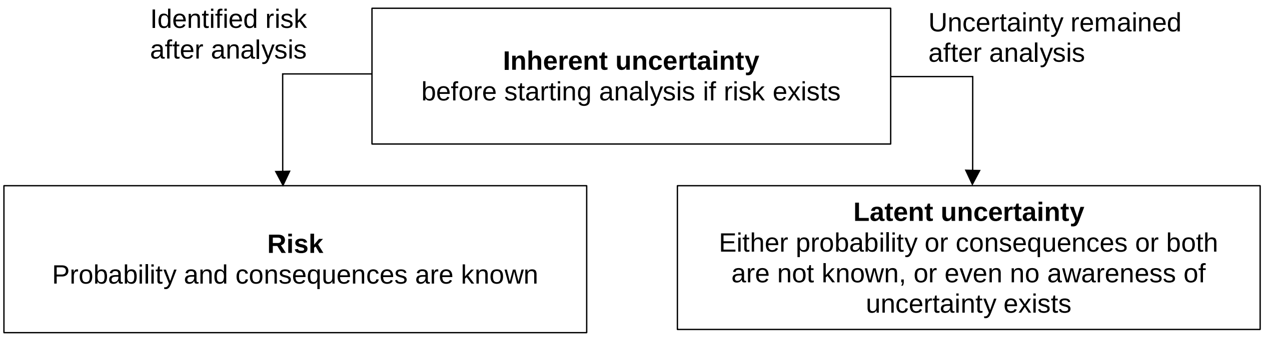
Before considering the risk pricing or discussing the relationship between risk and return on investments, the term *risk* is discussed. However, risk is understood in many ways, and a wide variety of interpretations of risk are available (Hupe, 1995, cited in Böttcher, 2009, Hansson, 2011). Therefore, obtaining a universal definition of the term risk is not an easy task[10]. According to many risk analysts, the only viable definition is that risk is 'the fact that a decision is made under conditions of known probabilities' (Hansson, 2011:1). This is a *decision under risk*, as opposed to a *decision under uncertainty* (Hansson 2011). This risk definition has been shaped by Knight (1921b) in his seminal book *Risk, Uncertainty, and Profit*; he has distinguished the concept of risk from that of uncertainty in terms of probability within decision situations. According to him, *risk*, on the one hand, is present in the case of unknown future events with measurable probability. As such, future events are not known, but the distribution of possible events is known. This implies that possible outcomes of risky situations are insurable (Weston, 1954, Langlois and Cosgel, 1993, Bock and Trück, 2011). On the other hand, *uncertainty* is present in cases of indefinite or incalculable distribution of its likelihood, since outcome probabilities either cannot be derived from data or are logically deducible (Arnold, 2013). Such situations create uninsurable outcomes (Langlois and Cosgel, 1993, Bock and Trück, 2011) (Knight, 1921b). Recent publications have also added whether knowledge is known about the consequences (Bernhardt, 2000, Willows et al., 2003). This means that within uncertainty, the following are both unknown: the nature of future events and what their possible distribution will look like (Rose, 2001, Guerron-Quintana, 2012). Uncertainty and risk can also be understood as a journey of knowledge about the probability and consequences of an event from uncertainty to risk (Bernhardt, 2000, Cleden, 2012, Bitaraf and Shahriari, 2015), as illustrated in Figure 3. Moreover, many scholars (DOA-DOE, 2005, Hillson and Murray-Webster, 2007, Ayyub, 2014, Taylor, 2014b) have placed the focus of the definition on the possible effect that the considered uncertainty has on one or more of the individual's or organisation's objectives, including financial, environmental, health, and safety goals, while being applied at different levels, such as at project, product, process, organisational, and strategic levels.[11]

Figure 3: A 2x2 cross tabulation about the level and quality of knowledge of an event in terms of probability and consequences to define risk and different states of uncertainty (adopted from Bernhardt, 2000, Willows et al., 2003, Bitaraf and Shahriari, 2015).



The process of defining uncertainty (latent uncertainty) and risk is presented in Figure 4, starting with the inherent uncertainties. After having analysed whether risk exists by assigning both probability and consequences to the identified hazardous event, some uncertainties remain without being able to assign any probabilities and/or consequences. Therefore, some risk managers may be misled to consider only risk, and they may fail to appropriately consider the remaining latent uncertainties. These latent uncertainties may emerge as problems later in the project—even without warning (Chapman and Ward, 2003, Cleden, 2012). Moreover, there are latent uncertainties that are not even identified as potentially hazardous, some with dramatic consequences, sometimes known as 'black swans' (Taleb, 2010, Weitmayr, 2017). According to Cleden (2012) and Chapman and Ward (2003), these circumstances demonstrate that not all sources of uncertainty are properly considered within projects and that there is a necessity to move from risk management to *risk and uncertainty management* or just *uncertainty management*, which includes risk management, to fill this gap (Bitaraf and Shahriari, 2015).

Figure 4: Process of defining uncertainty and risk (adopted from Cleden, 2012).



Although the terms uncertainty and risk are often applied as interchangeable terms (e.g. Arnold, 2013, Meder et al., 2013), an important distinction must be made between those expressions, as discussed in an abundance of literature (Bernhardt, 2000, Kaliprasad, 2006, Sackmann, 2007, Samson et al., 2009, Cleden, 2012) and particularly in a strict mathematical sense (Riahi-Belkaoui, 2016). However, the definition of Knight has initiated controversy among scholars, with some of them having denied Knight's approach (Friedman, 1962, LeRoy and Singell Jr, 1987). Despite certain critical points, the essence of Knight's definition is regarded as key for the purpose of this research, and a strict differentiation is regarded as more reasonable to enable a more rigorous analysis of the underlying phenomena, adopting the following definitions for this research:

- *Uncertainty* exists when the probability of the distribution of adverse effects or the associated consequences, or both, are not known or difficult to be assigned, thus creating uninsurable outcomes. In a narrower sense, this uncertainty, which is defined as non-quantifiable uncertainty according to Knight (1921b), exists when there is imprecise knowledge of the considered adverse states or events (often termed *hazards*) (Rodger and Petch, 1999, Willows et al., 2003, Holton, 2004, Kaliprasad, 2006, Sackmann, 2007, Migilinskas and Ustinovičius, 2008, Cleden, 2012, Riahi-Belkaoui, 2016).

- *Risk* exists when both the probability of certain adverse states or events, or the underlying distribution of the outcome, and the magnitude of the associated consequences of those states are known and can be assigned and insured, but the occurrence of a specific consequence is not known for sure (Willows et al., 2003, Sackmann, 2007, Migilinskas and Ustinovičius, 2008). According to Knight (1921b), risk in this view is defined as quantifiable uncertainty.

Both risk and uncertainty must be related to an individual's or organisation's objectives.

Life without having uncertainties is impossible (Taylor, 2014b). They are encountered when humans face situations without being confident and having certain knowledge to make a decision, or when two or more outcomes are possible for each alternative decision (Willows et al., 2003, Holton, 2004). Also, in financial decision making, it is beyond debate that a substantial amount of uncertainty is always involved (Holton, 2004, DOA-DOE, 2005, Neth et al., 2014), i.e., all companies face uncertainty and/or business risk (Hawawini and Viallet, 2011, Taylor, 2014b). Some uncertainties or risks even build a venture's basis to reach its objectives (DOA-DOE, 2005) and to create value (Baker et al., 2010, Cleden, 2012) (sections 2.3.4 and 2.6). Nevertheless, rather than having a dichotomous distinction between uncertainty and risk, as Knight has suggested, additional decision-making scenarios must be considered (Meder et al., 2013), and the reality lies somewhere on a continuum between these two extremes of uncertainty and risk (Neth et al., 2014). However, Meder et al. (2013) have also noted that according to many authors, decision makers do not distinguish between risk and uncertainty when assigning numerical probabilities to conceivable events of both types and acting rationally based on the same. A decisive aspect is that uncertainty or risk is applied in the sense of the probability of occurrences in contrast to determinism (Carmichael and Balatbat, 2008, Carmichael, 2016), or at least as a range of possibilities (section 2.3.3), and whether they can be described in numerical or non-numerical terms (Mohamed and McCowan, 2001).

Since risk takes a central role in economics, modern economics have intensively been studying it while developing several mathematical models of economic activities (Koller et al., 2010, Brealey et al., 2011, Hawawini and Viallet, 2011). Markowitz (1952) has developed, and Tobin (1958) has extended, the modern portfolio analysis and employed a simple statistical measure for the economic analysis of risk. As a risk measurement, the typical variance of possible values from the average value for the expected return of an investment is used. As such, the volatility of the expected return is measured; in other words, the higher the variance or the standard deviation[13] is, the riskier the investment is. Comparing two alternative investment decisions, two numbers can consequently describe each of them, namely their expectation value and their standard deviation or riskiness. Investors typically prefer high expectation values linked with a standard deviation that is as low as possible. While building up an investment portfolio, the relative weights assigned to each of those two components differ between investors (Loderer et al., 2010, Hansson, 2011).

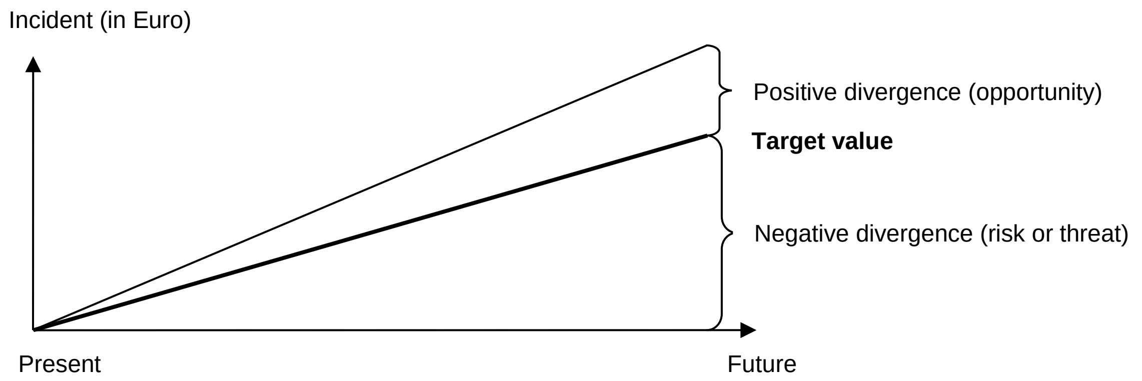
In addition to the discussed definition of risk above, the literature describes different risk perspectives and risk measurements:

- The neutral perspective of risk describes positive and negative possible effects on objectives (Rohrmann, 1998, 2005, Hillson and Murray-Webster, 2007)—also named opportunities and threats respectively (Taylor, 2014b).
- The positive risk perspective can mean ‘thrill’, i.e., danger-induced feelings of excitement (Rohrmann, 1998, 2005). This perspective is encountered, for example, in individual leisure activities.
- The negative perspective looks solely at the possibility of encountering physical, social, or financial harm or loss due to a hazard. Today, this is the dominant understanding of risk in general (Rohrmann, 1998, 2005), and it is widely applied in economic analyses (Drukarczyk and Schüler, 2009, Loderer et al., 2010). Therefore, for most investors, risk is related to the probability of the future assets in a portfolio having less value than expected (Modigliani and Pogue, 1974, Böttcher, 2009).

In this thesis, accordingly, risk is understood as a negative divergence from the target value (Figure 5)[14]—also called *threat* (Taylor, 2014b)—but with the potential to be an opportunity (Taylor, 2014b) to create value (Baker et al., 2010, Cleden, 2012). Risk-taking in life and thriving in business always come with threats and opportunities. For this reason, risks must be appropriately managed by reducing threats and increasing opportunities (Taylor, 2014b).

As such, risk-taking in life and thriving in business require the necessary management of both threats and opportunities (Taylor, 2014b) to simultaneously protect and create value (Baker et al., 2010, Cleden, 2012).

Figure 5: Illustration of opportunity and risk (Böttcher, 2009).



2.2.2 Probability/Likelihood and Consequence

Probability and consequences are applied in relation to risk or in the state of probability or consequence uncertainty. The probability or the likelihood of an event or a consequence is an expression to define the extent of its likelihood of occurring. There are two possibilities for measuring or defining the probability of an event or a consequence:

- In the statistical approach, experts have defined probability as objectively as possible, based on hard data. It is expressed as an event that occurs a certain number of times in a defined time period, i.e., as a relative portion of time, which results in the same situation being repeated an infinite number of times (Bernhardt, 2000, Kristensen et al., 2006, Aven et al., 2007, Sutton, 2014).
- In a more subjective approach, based on the Bayesian perspective (Winkler, 2003), probability has been estimated based on experts' judgement due to their knowledge and experience (Bernhardt, 2000, Kristensen et al., 2006).

Consequence refers to the severity of adverse effects of different situations and events in relation to different aspects of health, safety, and environment, such as loss of life, injuries, and environmental and social aspects (Gough, 1996, Willows et al., 2003, Aven et al., 2007, Sutton, 2014).

Quantitative and qualitative assessments of the probability of occurrences and their consequences define the considered risk component's *risk level* (Bitaraf and Shahriari, 2015), which is often illustrated by means of a risk ranking matrix (RRM) (see section 2.3.1).

2.2.3 Strategic Considerations of Handling and Managing Risk

This section explores the strategic consideration of handling and managing risk, since organisations and individuals perceive and manage risk differently. As with the term 'risk' (section 2.2.1), the literature describes different concepts—some similar and some not—about these phenomena. This research discusses those concepts and their relevance in the context of this research. Therefore, this section does not provide a full overview of this topic.

The *risk universe* includes all the risks, both negative and positive, that could affect an entity (Wikipedia, 2017). The terms risk capacity, risk tolerance, and risk appetite consider only a part of the risk universe and are related concepts. While the terms risk tolerance and risk appetite are sometimes applied interchangeably, they actually belong to two different concepts (Marks, 2011, Taylor, 2014b).

Risk capacity describes the total amount and type of risk to digest and support while reaching the organisation's or individual's objectives. However, risk capacity sets the limit; it 'is a hard fact' (Taylor, 2014b:78). It involves the amount of capital and other assets that an organisation must have available to fend off any threats and sustain itself while taking advantage of opportunities. If threats exceed this limit, the entity runs into serious difficulties (Marks, 2011, Taylor, 2014b).

Risk tolerance (of an organisation) is the acceptable outcome variation in relation to specific key performance measures and the organisation's objectives (Marks, 2011); in other words, it is the maximum amount of risk an entity is willing to accept or is still comfortable taking for each considered risk component in total or for a specific business unit (EY, 2010). In assessing risk tolerance quantitatively, it is measured and communicated in terms of acceptable or unacceptable outcomes or in limits for certain levels of risk in relation to set performance measures with links to the organisation's objectives. In doing so, such an assessment defines an acceptable variation of the outcomes with minimum and maximum levels that are specific to each risk component that the organisation is not willing to surpass so as to avoid jeopardising its strategy, objectives, and even existence in terms of revenues, costs, or impact on its reputation. On an individual level, risk tolerance varies with age, financial objectives, and income (Marks, 2011, RIMS, 2012).

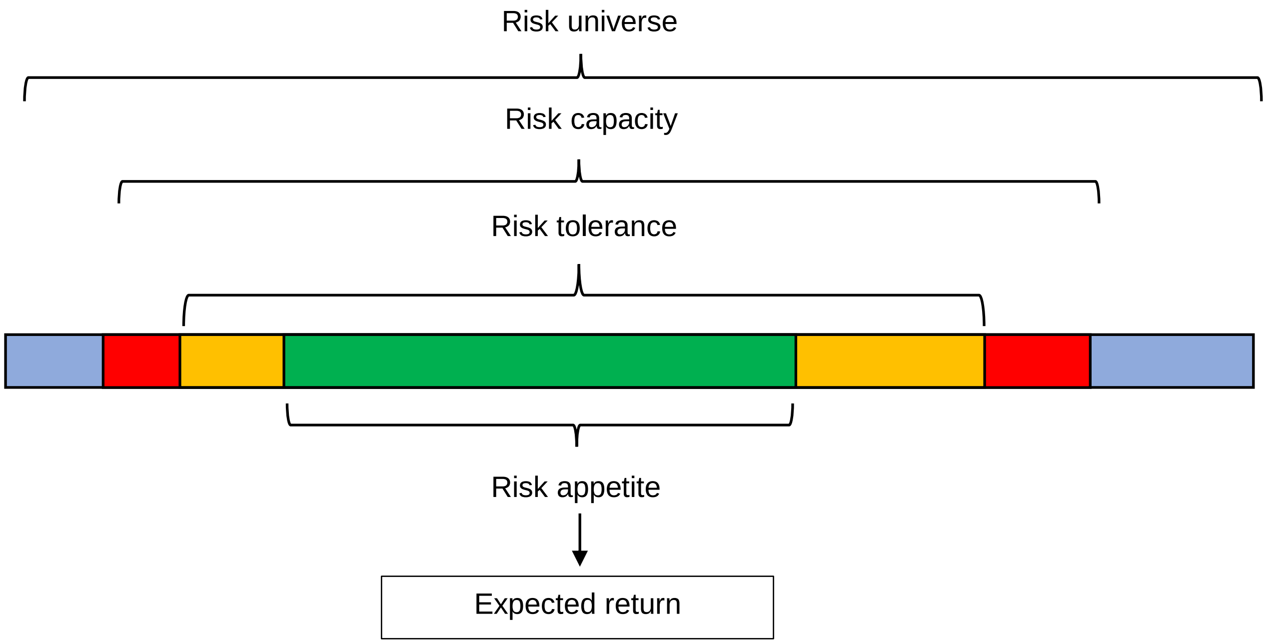
Risk appetite is the total amount and type of risk, i.e., the desired level of risk or range of risk levels that an entity wishes to pursue, retain, or take in the context of risk-return trade-off considerations for a single or multiple targeted and expected outcomes to reach its objectives (International Organization for Standardization (ISO), 2009, RIMS, 2012, Taylor, 2014b, Hassani, 2015, Tattam, 2015). As such, risk appetite must be set within the boundaries of the organisation's risk capacity, and it involves a deliberate discussion about the amount of risk an organisation actively takes, being able to deal with threats and take opportunities while seeking rewards and while considering the organisation's level of risk capacity and risk tolerance. These might vary for different risk components (RIMS, 2012, Taylor, 2014b). This means that risk appetite is directly linked with expected returns, i.e., both change mutually (RIMS, 2012). Expected returns are discussed in detail in section 2.4.3 and 2.5.

Risk appetite and tolerance are generally set by the board and/or executive management, and they are linked with the company's strategy. They capture the board's desired organisational philosophy for managing and taking risks, help to frame and define the organisation's expected risk culture, and guide overall resource allocation (RIMS, 2012).

The *level of risk* is defined by the magnitude of the specific risk component or risk combination. It is expressed as outlined above (section 2.2.2), with the combination of probability/likelihood and consequences.

In line with the explanations of Marks (2011), Figure 6 models the concepts described above. An organisation's risk appetite can be described by the desired range in which the considered risk levels falls (Marks, 2011), and it is the defined optimal range of risk level to pursue the organisation's objectives, set by the board and/or executive management and in alignment with the organisation's strategy (RIMS, 2012). In the words of Taylor (2014b), risk appetite is a combination of risk tolerance and risk capacity. When the level of risk exceeds the range of risk appetite, the organisation's risk tolerance range is reached—still within the organisation's tolerance boundary but suboptimal for the considered venture. As soon as the considered risk levels fall out of this range, a critical status is reached within the risk capacity range, and it is even more severe outside this range in the overall risk universe. In the last two ranges, serious remedies must be applied, and actions must be taken against the corresponding high risk levels (Marks, 2011).

Figure 6: Model representing the ranges of risk universe, risk capacity, risk tolerance, and risk appetite (Marks, 2011).



Risk attitude is another related concept. It is a generic mindset of individuals or a generic orientation of organisations about taking or avoiding a specific risk in the context of decision making within a situation with an uncertain outcome in the context of perceptions (Hillson and Murray-Webster, 2007). Weber et al. (2002) have provided an overview of different risk frameworks: risk attitude within an expected utility (EU) framework; modelling risk attitude based on the decision maker's utility profile (see more below about the utility theory), including the prospect theory (Kahneman and Tversky, 1979); or risk attitude within a risk-return framework (Sarin and Weber, 1993, Weber, 1997, 1998).

Since perceptions of individuals and group of individuals are by essence of a subjective nature, risk attitudes for different individuals or organisations vary within specific situations (Hillson and Murray-Webster, 2007). The following different risk attitudes are typically distinguished to describe distinct and personal risk preferences (Kahneman and Tversky, 1979, Hillson and Murray-Webster, 2007, Loderer et al., 2010, Arnold, 2013, Petrolia et al., 2013):

- *Risk averse* or risk avoiding is a description of an investor, also called a risk averter, who feels uncomfortable with uncertainties, assesses threats as more severe, and consequently prefers a lower risk when comparing two cases with similar return rates. This type of investor is reluctant to gamble for higher returns. In relation to opportunities, such an investor reacts contradictorily, since such an individual or group would not recognise many opportunities and would underrate their significance.
- *Risk tolerance* implies an investor who feels comfortable with many uncertainties while accepting them as normal features within private or business life. It is probably the most dangerous risk attitude, since uncertainties do not have a particular influence on his or her

behaviour, and risk might be not appropriately managed. On the one hand, he or she encounters risk with negative impact, while, on the other hand, they might miss to benefit from risk by utilising available opportunities. These risk-tolerance characteristics of individuals or groups should not be confused with the term risk tolerance of organisations described above.

- *Risk neutral* is a description of an investor who sees taking risks, while applying strategies and tactics, as a possibility to be rewarded with adequate pay-off. Such risk-neutral individuals or groups are quite mature with regard to managing threats and opportunities while being rather long-term focused and taking only action to be able to reach sustainable benefits.
- *Risk seeking* or risk loving is a description of an investor, also called a risk lover. In contrast to the risk-averse investor, a risk-seeking investor welcomes the challenge; prefers a more uncertain option, compared to less risky options with equal results; is not afraid to take action; and would gamble for a higher return while taking an additional risk to receive this goal. Risk seekers thrive on thrills and may in some cases outweigh the potential harm involved. They recognise opportunities readily; however, they may overrate their relevance. Only a rare number of individuals are risk lovers. They should not be confused with individuals with lower risk aversion.

The average investor is risk averse (Drukarczyk and Schüler, 2009, Loderer et al., 2010, Arnold, 2013). Risk-averse investors can also be described by their preference with regard to *diminishing marginal utility*. This approach describes the circumstances in which additional satisfaction, well-being, or utility from consumption diminishes with additional consumption. The *utility theory* inhere considered herein describes a concept in which money itself is not important or not directly important to human beings, but in which well-being, welfare, and satisfaction, which may result from money to buy services and goods, is more important. For example, doubling earnings does not double satisfaction (Arnold, 2013).

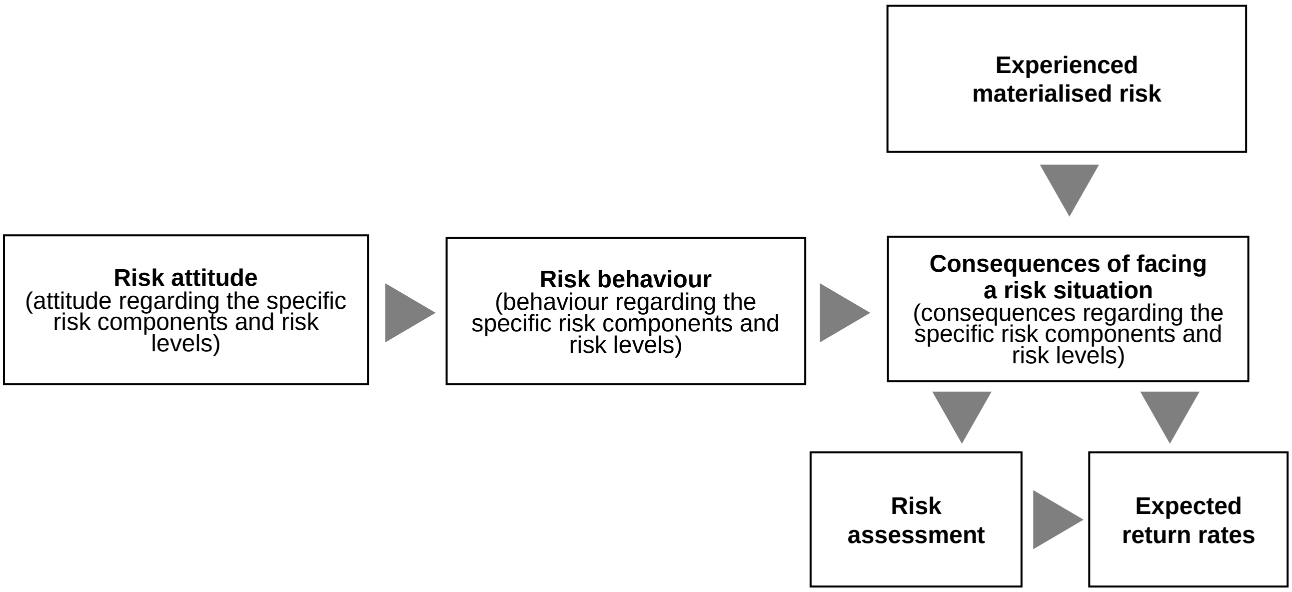
Another way to classify risk attitude is done with the help of the *certainty equivalent (CE) concept* (Drukarczyk and Schüler, 2009) in order to quantify the amount of risk aversion. The CE is regarded as a guaranteed amount that an investor considers to be equally attractive to an amount under uncertainty or risk. With the help of the CE, three types of risk attitudes are distinguished (Drukarczyk and Schüler, 2009).

- In case of risk aversion, the CE is less than the expected outcome under uncertainty or risk.
- In case of risk neutrality, the CE equals the expected outcome under uncertainty or risk.
- In case of risk seeking, the CE is higher than the expected outcome under uncertainty or risk.

This CE concept is again used in handling risk within valuation, but within a different context (see section 2.4.4.3).

Different risk attitudes of individuals and groups to the same situation leads to different risk behaviours (Rohrmann, 1998, 2005) and subsequently different consequences when facing a risk situation (Figure 7) (Hillson and Murray-Webster, 2007). This is also influenced by previously experienced materialised risk, which affects subjective risk perceptions (Baumann and Sims, 1978) and could lead to the implementation of a more intense mitigation for this risk component (Botzen et al., 2009) (section 2.3.4). Nevertheless, assessing risk components and expected return rates are dependent on investors' subjective, personal preferences for taking risks and—since investors are typically regarded as risk avoiding—from this grade of risk aversion (Drukarczyk and Schüler, 2009, Loderer et al., 2010, Arnold, 2013), resulting in different risk assessment results and subsequently different expected return rates in line with the above-mentioned risk-return framework (Sarin and Weber, 1993, Weber, 1997, 1998). Therefore, the investor faces a trade-off between risk and return (Drukarczyk and Schüler, 2009, Loderer et al., 2010, Arnold, 2013).

Figure 7: Risk attitude, behaviour, and consequences (adopted from Hillson and Murray-Webster, 2007, Drukarczyk and Schüler, 2009).



From a strategic point of view, measures must be implemented to avoid suffering from two types of major investment traps: an external and an internal trap, as Baker and Puttonen (2017) have outlined. The first external trap includes actors in the investment business trying to deceive investors. On one end of the spectrum, this could be just a 'moderate' version of deception; for example, sellers who do not disclose all relevant, adverse information about the investment; sellers or consultants who misrepresent 'risky products as safe' (Baker and Puttonen, 2017:227) or consultants who try to pursue their clients regarding an investment due to their specific monetary incentives. On the other end of the spectrum, it could be a major fraud, such as Ponzi and pyramid schemes. The second internal trap is probably even more severe, and it concerns the investors themselves, such as having unrealistic return expectations. Often unknowingly, they are cognitively, emotionally, and socially biased. As such, risk assessment and valuation can be biased because of the subjective attitudes of the investor (for example, a positive attitude for the investment target itself), his or her risk preference, and his or her amount of risk aversion—since investors are mostly risk averse (see above).

2.2.4 The Risk-Return Trade-Off Concept

2.2.4.1 Valuing Risk, Risk Premium, and Expected Return

Due to the fact that cash flow projections are often based on incomplete information, valuations are made in a climate of uncertainty (Riahi-Belkaoui, 2016). Insurance companies provide a prime example of how to value risk, by measuring risk, placing a value on risk, and offering appropriate products in return for premiums. However, this can only be done for insurable risk, i.e., risk that is random in nature and can be quantified. On the other hand, there are uninsurable types of risk; for example, in the case of organisations, reputation losses, the entry of new competitors, new regulations and political turmoil, and threats that are 'certain'. For the latter, a financial institute may provide appropriate hedging products for some of those threats (Taylor, 2014b). Since many risk types are quantifiable and hence measurable, the real interest in valuation lies in valuing and pricing risk (Riahi-Belkaoui, 2016). Particular challenges in valuation are provided in case of the mentioned uninsurable risk types with no additional financial hedging possibilities to put a price tag on them (Taylor, 2014b).

The valuation includes the following two major points:

- *Capital budgeting*, which refers to a planning process and techniques applied to review, evaluate, compare, and select the most appropriate investment (Wolffsen, 2012) and to determine whether an organisation's long-term investments or capital expenditures are worth the funding of cash through the firm's capitalisation structure (debt, equity or retained earnings) (O'Sullivan and Sheffrin, 2005, Brealey et al., 2011). It is discussed in detail in section 2.4.
- *Cost of capital*, which describes the cost of a company's long-term source of financing. It is the basis for various concepts applied in valuation and in close connection with capital budgeting techniques (Baker et al., 2010), such as the hurdle rate or risk-adjusted return rates, discussed in section 2.5.

To understand valuing and pricing risk, investors' attitudes, preferences, and choices are examined (section 2.2.3). In saying this, a typical risk-averse investor prefers a safer return to an unsafe one, but an equal expected cash flow or return. For investing in riskier cash flows, he would only invest by paying a lower price to compensate for this risk (Koller et al., 2010, Loderer et al., 2010, Brealey et al., 2011, Damodaran, 2013). How much lower a price he is willing to pay depends on the *risk premium*, a measurement for the 'expected additional return for making a risky investment rather than a safe one' (Brealey et al., 2011:G-13).[15] An increase in the risk aversion of investors also increases the required risk premium, determined by the collective and not the varying individual risk aversion (Damodaran, 2017). As Knight (1921a, 1921b) has already pointed out, a return or profit can only occur when a company faces risk. Such a return on an investment for taking risk is composed of the price adjustment of the investment and its pay-out as a coupon or dividend, compared to its initial purchase price (Loderer et al., 2010). In terms of a probability distribution of different occurrences, the expected return is the weighted average of all possible outcomes, positive and negative, weighted with the possibility of each occurrence (Modigliani and Pogue, 1974).[16]

2.2.4.2 Risk-Return Trade-Off

For a riskier investment to be a good investment, it must promise higher returns than a safer investment (Arnold, 2008). This seems to be quite intuitive, as Damodaran (2013) has pointed out, and it is about financiers facing a trade-off between risk and return. The investment in which he actually invests depends on his personal risk preference (Loderer et al., 2010). The way in which this intuition about risk and return is supported in the research literature is explored next.

The concept of the trade-off between the anticipated risk and the expected return is a central theme in the field of financial economics (McEnally and Upton, 1979, Pastor et al., 2008, Loderer et al., 2010, Brealey et al., 2011, Damodaran, 2013). Research generally assumes a positive relation between risk and return across assets and over time (Pastor et al., 2008). Sharpe (1964) has been convinced that an investor can only receive a higher expected rate of return following rational economic principles, such as risk diversification, and in a state of market equilibrium, if he accepts higher additional risk. Based on this concept, Moskowitz and Vissing-Jørgensen (2002) have found that an overall diversified portfolio of public equity investments provides a far better risk-return trade-off than for the entrepreneur who invests in private equity companies. The higher risk for investing in private equity would lead to a higher equity premium than the one for public companies (Moskowitz and Vissing-Jørgensen, 2002). The next paragraph explores how much higher this private equity risk premium (ERP) needs to be.

A long time, this academic view about the trade-off between risk and return was shaped by the capital asset pricing model (CAPM) of Sharpe (1964), Lintner (1965b), and Black (1972); it is discussed in detail in chapter 2.5.1. However, its linear and positive correlations have been challenged by the findings of McEnally and Upton (1979), who have stated that the relationships are overestimated in size and effects. The positive relation is also called into question by explanations known as the Bowman's risk-return paradox (1980): the risk-return relation could be negative using accounting measures. It has been supported by various authors (Bettis, 1982, Baird and Thomas, 1985, Henkel, 2008) demonstrating that low-risk companies can have high returns. This result was unexpected due to the generally expected positive relationship between risk and return. Still today, there is no general agreement about the reason for this phenomenon (Andersen et al., 2007). The most common present explanations originate from two behavioural theories, stressing a double risk-return relationship and explaining that negative relations are encountered for low outcomes and positive for high outcomes by the prospect theory[17]about individual risk preferences (Kahneman and Tversky, 1979) and behavioural theory of the firm (Cyert and March, 1963, March and Shapiro, 1987). Both explanations have two common points: (1) each enterprise has a single reference level at which (2) it is either risk tolerant and risk seeking when performance is below this level or risk averse if performance is above this level (Miller and Chen, 2004, Andersen et al., 2007). In contrast, other research has demonstrated that there is no such paradox (Rodríguez and Nickel, 2002), clearly supporting the positive risk-return relationship (Arago and Salvador, 2012). Although there are some critics of the positive risk-return trade-off, which is again a topic in chapter 2.5.1, the general positive relationship between risk and return is a central point for the upcoming explained concepts in this present thesis.

Distinct risk-return relationships can accordingly be observed for different types of financial securities, as illustrated in Figure 8. This relationship or trade-off and its specific position between those two axes is key for defining the investment focus of investors (Arnold, 2008). It is influenced by the risk attitude and hence the personal risk preference of the investor (Loderer et al., 2010) (as described in section 2.2.3). For example, in the case of RES-E investments, some investors are interested in RES-E investments in development with similar uncertainties and subsequently required return rates as a start-up, while others focus on RES-E investments in operation with stable feed-in tariffs (FiT), which have similar risk-return profiles as a corporate bond. Modelling a business case more conservatively, as it would be expected in reality, the required return rate would consequently also need to be adjusted to match the more certain business outcome (see more in section 2.4.4.3 about the CE method).

The risk-return trade-off is outlined from another perspective in section 2.4.3.2 by considering the influence of tax benefits and financial distress on enterprise and shareholder value in situations with companies with financial sources in the form of debt and equity and different debt/equity ratios.

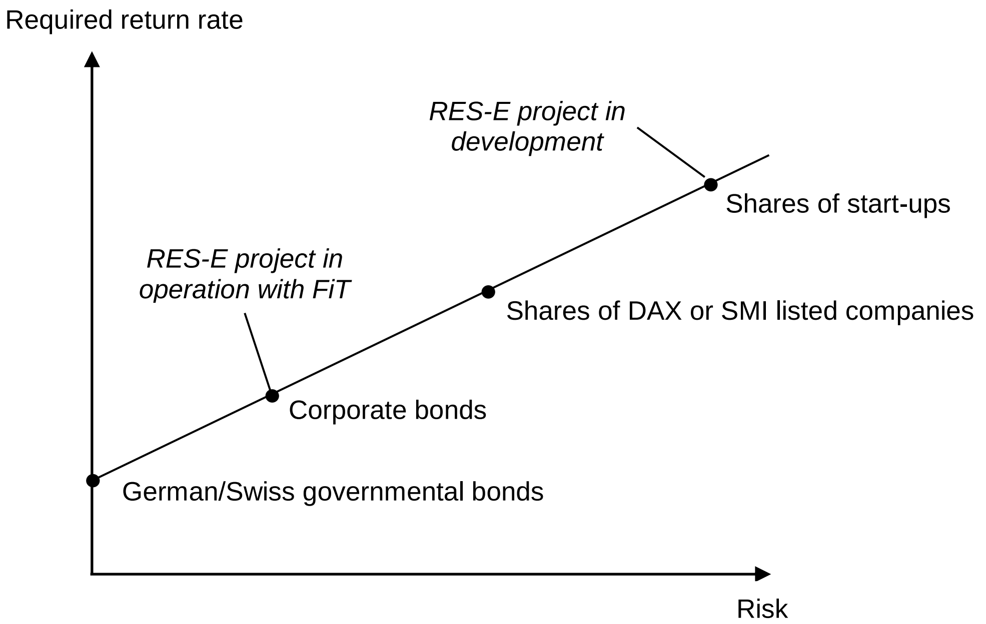
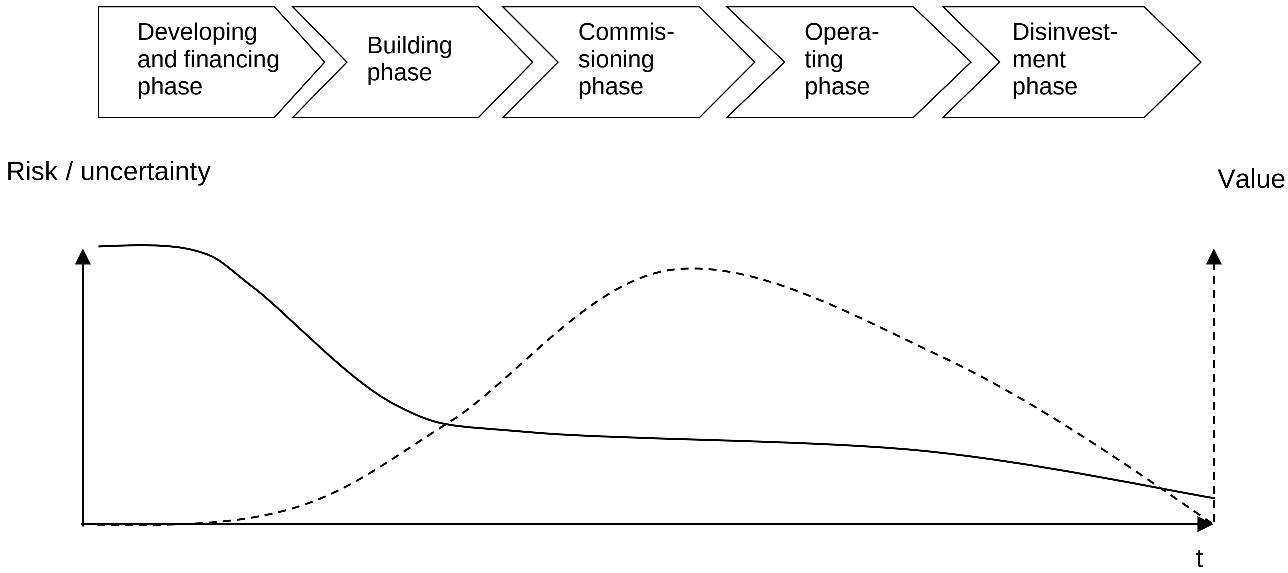


Figure 8: Risk-return relationships of exemplary securities (adopted from Arnold, 2008) (DAX: Deutscher Aktienindex = German share index, listing the 30 largest and revenue-strongest German companies; SMI: Swiss market index, listing the 20 most liquid and largest Swiss companies; FiT: feed-in tariff).

2.2.4.3 Project Life Cycle

The risk-return trade-off discussed above can also be evaluated in relation to the project lifetime (Chapman and Ward, 2003, e.g. Ambler and Kroll, 2007, PMI 2009), for example, for RES-E projects with finite lifespans. Figure 9 presents a typical time-variable risk-value relationship for RES-E projects. The risk of the project decreases constantly after the developing phase, while the value of the project increases to a maximum at the point of the commissioning date (Ambler and Kroll, 2007, Watts, 2011). For example, high risk and therefore higher returns are encountered for RES-E projects in the developing phase in which a complete fail and hence a total write-off of the investment is possible. This research focuses mainly on low-risk environments, and therefore on projects starting with the building phase, also known as ready-to-build projects.

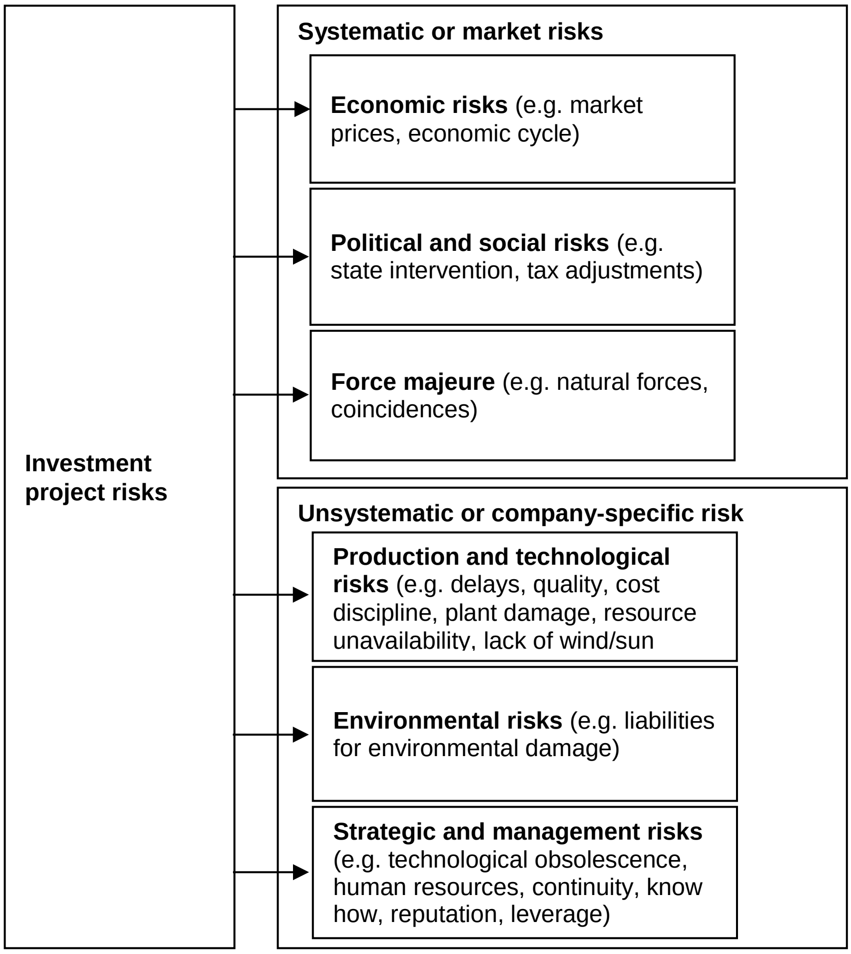
Figure 9: Life cycle phases of RES-E projects, illustrating the time-variable risk-value relationship (adopted from Liebreich, 2005, Ambler and Kroll, 2007, Böttcher, 2009, Project Management Institute (PMI), 2009, Watts, 2011, Deloitte, 2015).



2.2.5 The Concept of Diversification

The neo-classical finance market theories have intensively discussed the pricing of risk (Loderer et al., 2010). In an ideal world of perfect and transparent markets, a complete diversification of specific investment risks in a portfolio can be reached by reducing the variability of the portfolio's components (Böttcher and Blattner, 2010, Brealey et al., 2011). In doing so, the risk derived from a single investment is null, and its price is hence zero, since all *unsystematic risk*[18] emerging from each single investment can be completely diversified. Unsystematic risks can be production, technological, environmental, strategic, and management risk (Modigliani and Pogue, 1974, Böttcher and Blattner, 2010) (Figure 10). In such an ideal world of completely diversified portfolios, only *systematic risks*[19] are left and priced (Figure 11). In that case, only those risk components that are derived from the general market forces, including economic, political, and social risks and force majeure (Böttcher and Blattner, 2010, Hawawini and Viallet, 2011, Watts, 2011), and which cannot be avoided are rewarded by the financial market (Modigliani and Pogue, 1974, Böttcher, 2009, Brealey et al., 2011, Hawawini and Viallet, 2011). This also means that all investors are exposed to the same market risk, independent of the number of securities they hold (Brealey et al., 2011). The advantage of this view is that it allows investor to only to focus on and care about systematic risk (Brealey et al., 2011).

Figure 10: Systematic and unsystematic risks (adopted from Böttcher and Blattner, 2010, Hawawini and Viallet, 2011, Watts, 2011).

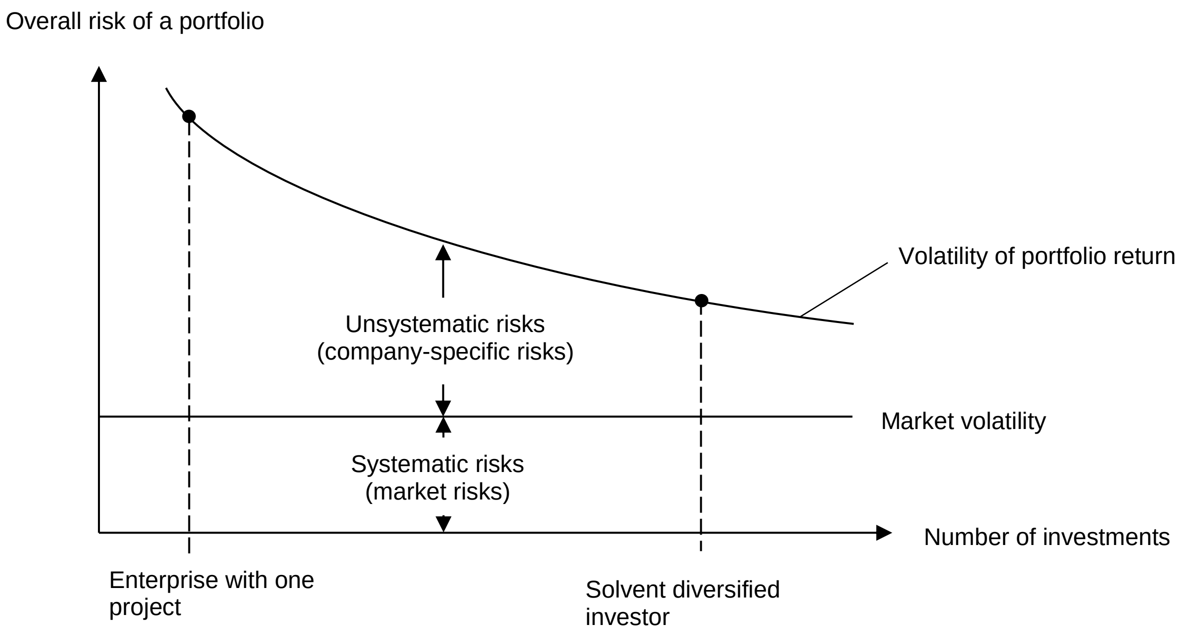


The underlying assumptions of an ideal market in this diversification concept are, however, unrealistic, since markets do not work that smoothly. Therefore, a complete diversification is either hardly reached (Damodaran, 2005a, Brealey et al., 2011, Patchett and Horgan, 2011, Azar, 2016) or can never been reached for a reasonable, economical effort (Böttcher, 2009). Adding further investments to a portfolio for further diversification does not necessarily lead to additional risk reduction, since the benefits from diversification become marginal and tail off with many investments, and an over-diversification could lead to disadvantages due to less management attention for each additional investment (Arnold, 2010). In addition, diversification is limited if investments belong to the same sector (Arnold, 2010) or are dependent on the same environmental conditions (Rugman, 1976). Nevertheless, Brealey et al. (2011) have believed that a reasonable diversification can be reached within a portfolio of 20 or more stocks for only market risks to matter.

In doing so, diversification can reduce 40% to 50% of total security risk (Modigliani and Pogue, 1974). This concept about diversification is also useful, since different capital market investors can reach different diversification grades. For example, a wealthy investor with disposable assets can largely diversify its portfolio to reduce the unsystematic risks to a minimum. By contrast, an enterprise that is dependent on a single or few projects is poorly diversified (Böttcher, 2009), and unsystematic risks are considered to be more relevant (McMahon and Stanger, 1995, Damodaran, 2012). This is also the case for the risk perception of owners and managers of non-traded companies who do not view their firms as part of diversified portfolios and hence consider unsystematic risk in their investment decisions (Cotner and Fletcher, 2000, Petersen et al., 2006, Damodaran, 2012). Similarly, valuation textbooks and scholars (Pratt et al., 2000, Power, 2004, Damodaran, 2012, Bromiley et al., 2015) have suggested taking unsystematic risk into account, and they have provided justifications for considering them if investors are not well diversified, in contrast to the long-lasting argumentation to care only about systematic risks (Sharpe, 1964, Lintner, 1965b). In addition, particularly in real projects, both technical and financial risks[20] must be considered in valuation, since technical risks become at least as dominant than financial risks in many risky projects (Espinoza and Morris, 2013). Therefore, many investors valuating risky investments are well advised to consider the total risk, i.e., both systematic and unsystematic risk, as a starting point in valuation, but with a differentiated approach depending on their effects on the investing firm's and/or investors' level (section 2.3.3.2).

Despite the extent of diversification of the individual investor, Bernstein (1996) has made clear that, in any case, 'diversification is not a guarantee against loss, only against losing everything at once' (6).

Figure 11: Reducing overall portfolio risks through diversification (adopted from Böttcher and Blattner, 2010, Loderer et al., 2010, Brealey et al., 2011, Hawawini and Viallet, 2011, Koller et al., 2015).



Furthermore, enterprises must avoid additional project risks and follow-up costs relating to poor events that put not only the project itself but the whole company at risk. In such a worst-case scenario, the whole company could go bankrupt, and additional liquidation costs could occur. In the case of the solvent investor, who is not the focus of this thesis, he only loses his invested money, and no additional costs arise (Böttcher, 2009).

2.3 Risk Management in Valuation

This section explores how risk and uncertainty are identified (section 2.3.1), measured in terms of project-specific risks (section 2.3.3.1), and considered in the wider context of an existing investment portfolio (section 2.3.3.2). It also examines the mitigation approaches that are applied (section 2.3.4).

2.3.1 Assessment of Uncertainty and Risk

Before considering valuation in more detail below, some basics about the assessment of risk and uncertainty are discussed. Risk assessment typically consists of the following processes: i) risk identification, ii) risk analysis, and iii) risk evaluation (ISO 2009, Ayyub, 2014). The processes are enhanced with the realm of uncertainty, as propagated by Bitaraf and Shahriari (2015), to perform combined uncertainty and risk assessments. Such assessments are usually applied to a project's stand-alone risk; however, they could also be extended to a firm's or an investor's level.

Risk identification consists of either i) determining the root causes of risks, including the potential events that can fail, or ii) determining the relevant process and functions within companies and/or projects that must work well or for which targets must be reached to consider them successful, and then determining all possibilities in which those processes and functions might go wrong (COA-DOE, 2005). This identification is the crucial first step (Ehrhardt and Brigham, 2016) in starting uncertainty and risk assessments (Bitaraf and Shahriari, 2015) and evaluating stand-alone risk (section 2.3.3.1) to eventually be applied as a basis for estimating the project's cost of equity (section 2.5.2). There are various methods for identifying uncertainties and risk. A checklist is a simple method to identify the relevant components; it is optimal for events with low uncertainty und rather simple processes (Sutton, 2014). Brainstorming is another typically applied process (COA-DOE, 2005). A less structured method is the what-if method, which relies on the experience and knowledge of the participants (for instance, analysts and engineers). In doing so, the team must ask direct and the correct what-if question to identify the parameters efficiently (Sutton, 2014, Nolan, 2015).

Following the initial identification of risks and uncertainties, the subsequent risk analysis includes processes to comprehend the nature of the risk factors and to determine the level of risk (ISO 2009, Ayyub, 2014). It also involves a risk-screening process by which the risks that should be investigated in more detail are determined. Risk screening is usually based on ranking or scoring methods (Willows et al., 2003).

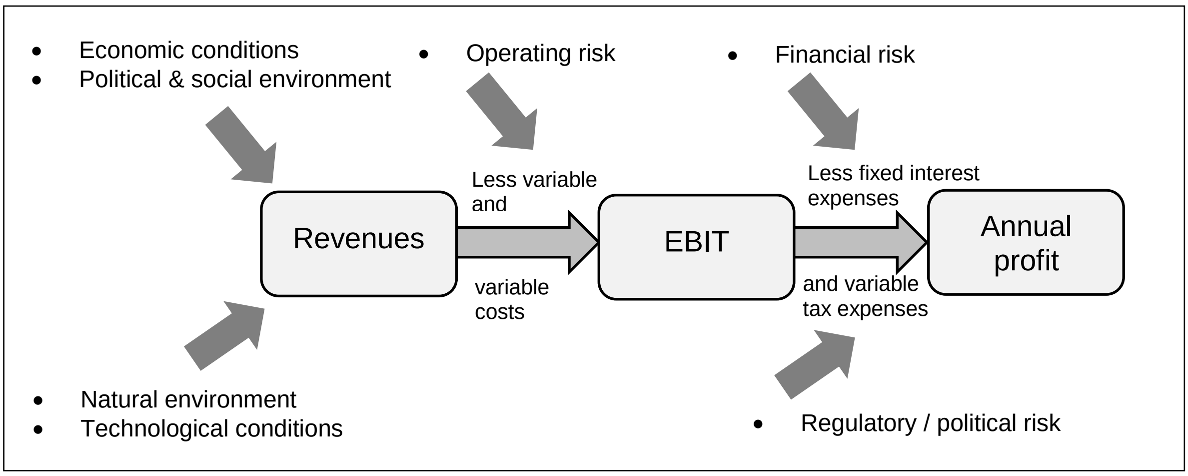
The follow-up risk evaluation involves processes to compare the results from the risk analysis with risk criteria as a basis for determining its level of acceptability and how to handle it (ISO 2009, Ayyub, 2014). In practice, this step is often performed with the comprehensible semi-quantitative risk ranking matrix (RRM), cited in its original form in Roland and Moriarty (1990). It combines the quantitative and qualitative ratings of probability and the consequences of multiple risk components in one model by means of risk levels (Roland and Moriarty, 1990, IEC 2008, Bitaraf and Shahriari, 2015). For example, for the qualitative assessment of consequences, the risk component can be assessed in this model in relation to its grade of possible reputational damage (Power, 2004). In addition, a risk profile can be determined that defines acceptable and not acceptable risks to be monitored.

Risk evaluation processes suited for capital expenditures and investments (Petty et al., 1975) are discussed in the section about capital budgeting techniques (section 2.4).

2.3.2 Risk Components in RES-E Projects

This section discusses the relevance of project risks in valuation in general. It then presents the identified uncertainty and risk components in RES-E projects—as a project's stand-alone parameters—and discusses their relevance in public traded company, non-traded asset, and RES-E-investment valuation processes. An overview of the potential uncertainty and risk components and their level of interaction from an accounting perspective are illustrated in Figure 12.

Figure 12: Sources of uncertainty and risk for an RES-E project, illustrated from an accounting perceptive, based on the income statement (adopted from Hawawini and Viallet, 2011).



Empirical surveys (e.g., Gitman and Maxwell, 1987, Payne et al., 1999) have demonstrated that the majority of today's businesses take different project risks into account when making capital budgeting decisions (Table 2).

Table 2: Businesses that consider different project risks in the capital budgeting process.

Firms considering project risk (%)	Year of survey	Empirical surveys among practitioners
< 25	1966	Robichek and MacDonald (1966)
25 ≤ x < 50	-	-
50 ≤ x < 75	1972 1973 1975 1977 1982 1991	Klammer (1972) Fremgen (1973) Brigham (1975), Petry (1975) Gitman and Forrester Jr (1977) Gitman and Mercurio (1982) Klammer et al. (1991)
≥ 75	1978 1984 1987 1999	Schall et al. (1978) Kim et al. (1984) Gitman and Maxwell (1987) Payne et al. (1999)

Based on an analysis of the academic literature and empirical surveys, supplemented with reports from practitioners, Table 3 and Table 4 list the specific project risk components that are regarded as determinants for estimating risk premiums (section 2.4.1.1), while focusing particularly on RES-E investment risks. Both systematic (S) and unsystematic (U) risks are reported and categorised, as proposed by Böttcher (2009), and they enable the measurement of a project’s stand-alone risk and total risk analysis (section 2.3.3), as well as correspondingly the risk-adjusted discount rate (RADR) estimations (section 2.4.4.1). The table also lays the groundwork for defining appropriate risk mitigation measures (section 2.3.4).

Weather-related volume risk (for instance, sun, wind, and water), as a key risk component of RES-E investments, is more closely elucidated. This risk is highly crucial for RES-E projects due to both its potentially high impact on business performance and its high volatility. It is regarded as a typical unsystematic risk, since most of this risk is unique to the production site and business (Böttcher, 2009) and because its natural volatility from one time period to another (Liebreich, 2005) and the corresponding risk can be reduced within a diversified portfolio (Böttcher, 2009). A minority of this risk cannot be related to the specific production site and business. This is discussed in more detail in section 6.1.

Financial risk is another risk component to be defined in more detail at this point. It primarily includes the risk associated with financing and capital structuring. It is the ‘risk that a firm will be unable to meet its financial obligations’ (Scott, 2003). In other words, it is the ‘possibility that shareholders or other financial stakeholders will lose money when they invest in a company that has debt if the company's cash flow proves inadequate to meet its financial obligations’ (Investopedia, n.d.-a). The amount of leverage influences the amount of risk, since debt financing creditors are paid before shareholders in case of the firm’s insolvency. There are several types of financial risk that are also relevant for this thesis, such as foreign exchange risk and liquidity risk. In Table 3, they are listed separately. Apart from the broader term 'financial risk', the table more specifically discusses interest rate and structure risk.

When performing a valuation, the considered risk components can be encountered in the CoC or the cash flows, or both. As Koller et al. (2015) have explained, 'risk enters into valuation through the company's cost of capital, which is the price for risk, and in the uncertainty surrounding future cash flows' (42) (section 2.4.1). In general, adjustment for risk is most frequently performed in the discount rate, as Block (2005) has also outlined for the energy sector. However, a more detailed discussion about performing risk adjustments in capital budgeting reveals additional differentiated insights. In doing so—with regard to the risk characteristics of investments—much attention in the theoretical literature has been paid to the duration of projects. There is no general rule that long-lived assets account for higher uncertainty than short-lived assets and therefore discount for higher discount rates, as many practitioners would assume (Cornell, 1999). The impact of duration on the discount rate can be evaluated by differentiating between unsystematic and systematic risk components (Myers and Turnbull, 1977). The discount risk is only higher for long-lived assets if their systematic risk is greater than that for short-lived assets. In other words, systematic risk increases with an increasing project duration (Campbell and Mei, 1993, Cornell, 1999). In line with the risk component typology depicted in Figure 10 (section 2.2.5), variations in cash flows with regard to long-term investments are particularly affected by general economic risks, including market risks, as well as tax risks, such as variations in future market prices and tax regulations respectively. Moreover, systematic risk emerges from such variations in future cash flows; it also results from variations in future expected return rates (Campbell and Mei, 1993). The latter includes variations in both the future country-specific risk-free rate (a measure of the general country risk of the considered country influenced by political/regulatory risks and general interest rates [e.g. Graham and Harvey (2001), Damodaran, 2008, 2013, Koller et al., 2010, Loderer et al. 2010]) and risk premium (section 2.5.1)—in relation to news about real interest rates, cash flows, and excess returns (Fama, 1977, Keim and Stambaugh, 1986, Campbell, 1987). This could in particularly be demonstrated for growth companies and high-technology firms, both regarded as long-lived assets, with increases in their discount rates due to higher variations in expected return rates (Campbell and Mei, 1993, Cornell, 1999, Campbell and Vuolteenaho, 2004). However, investors seem to value fluctuations in cash flows more than variations in expected future return rates (Lettau and Wachter, 2007) and therefore overvalue certain long-lived assets in the latter case. The forgone argumentations imply that an increase in project duration, which increases fluctuation of cash flows associated mainly with unsystematic risk, do not lead to higher discount rates due to the diversification potential of unsystematic risk (Cornell, 1999, Lettau and Wachter, 2007). In a case of the valuation of stand-alone projects (section 2.3.3.1), duration might however also become relevant for cash flow variations due to unsystematic risk.

In the context of RES-E projects with FiTs or long-term PPAs, project duration largely does not affect discount rates, since no cash flow variations based on market prices are experienced in the FiT or PPA period, with the exception of future cash flow variations due to changes in tax regulations. However, a duration's effect on valuation becomes particularly relevant for RES-E projects the longer the period is with direct market risk exposures (merchant risks), which corresponds to increasing future systematic risk in the project. In this sense, the characteristics of duration also affect the valuation of projects with a significant post-FiT/PPA period, but with less relevance the further off in the future these systematic risk increases are due the decreased time value of money. Due to its relevance for RES-E projects exposed to merchant risks on a long-term horizon, market risk is listed separately in Table 3.

All RES-E projects encounter increased future fluctuations in unsystematic risk; however, these fluctuations are diversified in portfolios and therefore only relevant in stand-alone project valuation. In addition, RES-E projects can also suffer from increased variations in future expected discount rates due to variations in the possible risk-free rate and changes to the risk premium, particularly with regard to technological advances in the future to more efficient power plants with lower investment sums and a lower levelised cost of electricity (LCOE) as well as systems enabling more demand-driven electricity supply, which could jeopardise current RES-E technologies.

Table 3: Systematic risk determinants for estimating risk premiums and their applicability for publicly traded companies (PTC), non-traded assets (NTA) and suggested for RES-E investments (X: applicable, (X): less applicable, - : not applicable).

Determinants for estimating expected returns	Applicability for			Comments and examples	Sources
	PTC	NTA	RES-E invest-ments		
Economic risks					
Economic risk [1]	X	X	(X)	Less relevant for RES-E projects, particularly those with FiT, due to low correlation with the general market (specific market risk is listed separately below)	Benninga and Protopapadakis (1981), Graham and Harvey (2001), Brandt and Wang (2003), Lettau et al. (2008), Damodaran (2013)
Risk of unexpected inflation	X	X	X	-	Graham and Harvey (2001), Brounen et al. (2004)
Market risk (beta)	X	X	X	Decrease of power or heat prices, incl. merchant risk of power purchase agreements (PPAs), becomes in particular relevant for RES-E projects exposed to merchant risks and corresponding long-term duration (see below)	Graham and Harvey (2001), Liebreich (2005), Böttcher (2009), Michelez et al. (2011), Turner et al. (2013)
Momentum	X	-	-	Recent stock price performance	Carhart (1997), Graham and Harvey (2001)
Political and social risks					
Risk-free rate / interest rate	X	X	X	General country risk, rated by the market	Graham and Harvey (2001), Damodaran (2008), Koller et al. (2010), Loderer et al. (2010), Brealey et al. (2011), Damodaran (2013)
Political/regulatory risk (governmental policy risk and country risk)	X	X	X	Change in public policy affecting profitability, partly considered already in the risk-free rate, incl. tax risk	Bekaert et al. (1997), Liebreich (2005), Böttcher (2009), Pastor and Veronesi (2011), Watts (2011), Damodaran (2013), Turner et al. (2013), Angelopoulos et al. (2016), Wuester et al. (2016)
Force majeur					
Catastrophic risk / Force majeure	X	X	X	Natural forces, coincidences	Modigliani and Pogue (1974), Rietz (1988), Barro (2006), Böttcher (2009), Damodaran (2013)
General risk determinant					
Project life-time (duration) [2]	X	X	X	If systematic risk for longer project is greater then for shorter ones, the discount risk increases	Myers and Turnbull (1977), (Campbell and Mei, 1993), Cornell (1999)

[1] Such as inflation, economic growth (gross domestic product [GDP]) and business cycles. Some of the uncertainty of the inflation in economic risks is captured in the Risk-free rate (Damodaran, 2013).
[2] Project life-time (duration) is shown under systematic and unsystematic risk determinants since latter can be also relevant for stand-alone project risk assessment.

Table 4: Unsystematic risk determinants for estimating risk premiums and their applicability for publicly traded companies (PTC), non-traded assets (NTA) and suggested for RES-E investments (X: applicable, (X): less applicable, - : not applicable).

Determinants for estimating expected returns	Applicability for			Comments and examples	Sources
	PTC	NTA	RES-E invest-ments		
Production and technological risks					
Weather-related volume risk (e.g. lack of water, wind, sun, waves) or other natural resource risk (e.g. lack of geothermal heat or biomass supplies)	-	-	X	One of the key factors for RES-E investments due their high impact on the business performance and possible high volatility	Liebreich (2005), Böttcher (2009), Michelez et al. (2011), Watts (2011), Boland et al. (2012), Agrawal et al. (2013a), Agrawal et al. (2013b), Turner et al. (2013), Wuester et al. (2016)
Commodity price risk	X	X	(X)	Could be relevant for biomass energy projects	Graham and Harvey (2001), Böttcher (2009), Watts (2011), Pereira et al. (2012)
Operational risk	(X)	X	X	Plant damage / component failure, lower technical availability, plant closure to resource unavailability or unclear cost development, illiquidity (cash flows), incl. asset life time risk	Welsh et al. (1982), McMahon and Stanger (1995), Liebreich (2005), Böttcher (2009), Böttcher and Blattner (2010), Brealey et al. (2011), Hawawini and Viallet (2011), Michelez et al. (2011), Watts (2011), Turner et al. (2013), Angelopoulos et al. (2016), Wuester et al. (2016)
Project termination risk	-	(X)	X	Missing operating permit or no acceptance to a bid in tender process	Böttcher (2009)
Environmental risks					
Liabilities for environmental damage					Böttcher (2009)
Strategic and management risks					
Financial risk (capital structure risk, leverage)	(X)	X	X	Debt / equity ratio of RES-E project	Hamada (1972), Bhandari (1988), Dhaliwal et al. (2006), Penman et al. (2007), Dimitrov and Jain (2008), Adamia et al. (2010), Korteweg (2010), Watts (2011), Angelopoulos et al. (2016), Wuester et al. (2016)
Interest rate risk [1]	(X)	X	X	Change of general level of interest rate	Graham and Harvey (2001), Böttcher (2009)
Term structure risk [1]	(X)	X	X	Long-term vs. short-term interest rate	-
Foreign exchange risk (currency changes)	X	X	X	-	Graham and Harvey (2001), Böttcher (2009)

Table 4: (continued).

Determinants for estimating expected returns	Applicability for PTC	NTA	RES-E invest-ments	Comments and examples	Sources
Size	X	X	X	Small firm being riskier	Banz (1981), Levy (1990), Fama and French (1992), Graham and Harvey (2001)
Market-to-book ratio	X	-	-	Ratio of market value of firm to book value of assets	Fama and French (1992), Graham and Harvey (2001)
Illiquidity of investment project	X	X	X	Lack of market for asset type	Amihud and Mendelson (1986), Acharya and Pedersen (2005), Amihud et al. (2005), Damodaran (2005a, 2010), Franzoni et al. (2012), Cheng et al. (2013), Damodaran (2013), Ping et al. (2013), Ehrhardt and Brigham (2016), Mougeot (2018)
Lack of information	(X)	X	X	Information asymmetry increases the risk of not evaluating properly the assets of private targets	Akerlof (1970), Capron and Shen (2007)
Distress of investment target	X	X	X	Probability of bankruptcy (bankruptcy costs)	Graham and Harvey (2001), (Damodaran, n.d.)
Credit standing of involved partners	X	X	X	In case of RES-E projects: project developer, contractor, maintenance and service companies	Liebreich (2005), Böttcher (2009), Turner et al. (2013), Wuester et al. (2016)
Complexity of organisational structure of investment	-	X	X	Many owners, different shareholder interests and inter-correlations between shareholders and suppliers	Author's own experience
Risk of subsidiaries not being under corporate control	X	X	X	In case of minority participations	McMahon and Stanger (1995)
General risk determinant					
Project life-time (duration) [2]	X	X	X	See also Table 3 with regard to unsystematic risk and valuation of stand-alone projects	Myers and Turnbull (1977), (Campbell and Mei, 1993), Cornell (1999)

[1] In order to reflect the situation when the company borrows money, the beta coefficient has to be adjusted (Brealey et al., 2011; Hawawini and Viallet, 2011). Since the interest rate applied for financing an investment is project specific, it is considered as unsystematic risk.
[2] Project life-time (duration) is shown under systematic and unsystematic risk determinants since latter can be also relevant for stand-alone project risk assessment.

2.3.3 The Integrated Risk-Return Concept

Since, in most cases, investors already have a certain amount of realised investments, a decision for a new investment does not have to be considered in complete isolation, but rather within the context of the existing investment portfolio (Drukarczyk and Schüler, 2009). The concept of Ehrhardt and Brigham (2016) about different types of risk in terms of three specific levels (investor, firm, or project level) provides a useful, integrated approach to evaluate and consider the risk of potential investments from different angels as well as its contribution to next higher levels (Figure 13). The following three different risk types and corresponding levels, used to estimate the cost of equity of individual projects, are distinguished:

a) *Market or beta risk* is the risk as viewed by investors holding a well-diversified portfolio and that ignores all unsystematic risk (sections 2.2.5). It is measured by risk effects on the considered firm's beta coefficient (section 2.5.1).

b) *Within-firm or corporate risk* is the project's risk to the firm itself as opposed to its investor, i.e., this risk type considers the firm's risk diversification, but not the shareholder's diversification. It is measured by the project's impact on uncertainty about the firm's future cash flows.

c) *Stand-alone risk* is a project's risk assuming that either an investor or firm has only one asset or the risk is only evaluated for the project itself. It is measured by assessing its components (section 2.3.2), both unsystematic and systematic risks, and then its overall correlation with the other two risk types.

The risk of new investment projects should not be evaluated in isolation, but rather in terms of the contribution of the new project to the existing total risk of the investor or firm. It can stabilise the investor's or firm's cash flows and earnings by the risk decreasing effects of the new project in case of a negative correlation of the outcomes' distribution between the project and the firm or investor (Drukarczyk and Schüler, 2009, Ehrhardt and Brigham, 2016). These thoughts form the basis for building portfolios of investments (Drukarczyk and Schüler, 2009). In case of a positive correlation of the new project's outcome with the existing portfolio, Ehrhardt and Brigham (2016) have suggested taking the project's stand-alone risk, which provides a good proxy for adopting the project's risk in relation to the existing portfolio after having realised the investment.

Figure 13: Types of risks in terms of different levels (investor, firm, and project) for new investment projects and the correlation, either negative (–) or positive (+), of their risk to firms' and investors' risk (adopted from Drukarczyk and Schüler, 2009, Brigham and Houston, 2012, Ehrhardt and Brigham, 2016).

Level	**Types of risk**	**Correlation from project to other levels**	**Risk diversification (relevant risk)**	**Measurement**	**Assessment method**
Investor	Market/beta risk	– Stabilize firm's earnings and lower firm's WACC + Stand-alone risk is a good proxy for within-firm and market risk	Only systematic risk (for well-diversified investors)	Project's beta coefficient	Judgemental assessment [1]
Firm	Within-firm/ corporate risk		Systematic plus undiversifiable unsystematic risk	Project's effect on uncertainty about firm's expected cash flow	Judgemental assessment [1]
Project	Stand-alone risk		Total risk (unsystematic and systematic risk)	Variability of asset's expected returns	e.g. sensitivity and scenario analysis, and simulations [2]

[1] qualitative assessment by experienced managers, [2] quantitative assessment.

That said, quantitative methods in capital budgeting, as outlined below in section 2.4, to estimate stand-alone risk provide valuable information about the individual project risk. However, the within-firm and the market risk (section 2.3.3.2) can be more crucial to the firm and its investors, since it measures the impact of individual project risk on the overall firm's and investor's risk (Brigham and Houston, 2012). Likewise, Bierman has suggested making investment decisions based on the appropriate choice of computational valuation methods, complemented with 'qualitative and strategic considerations' (1993:24). In doing so, key questions remain regarding how well diversified the different firms and types of investors are in terms of risk and what strategic considerations are taken into account in investment decisions.

The effects of individual investments on the firm and investor level are again discussed with the value-based management (VBM) concept in section 2.6.1.

2.3.3.1 Project's Stand-Alone Risk in Valuation

A project's stand-alone risk considers no diversification effects (Ehrhardt and Brigham, 2016) and can be treated as equivalent to the total risk, which is the sum of all unsystematic and systematic risks (Farlex Financial Dictionary, 2009, Financial Glossary, 2011). Having presented the relevant risk components of RES-E projects, this section discusses how to measure and consider a project's stand-alone risk components within capital budgeting processes.

Conventional valuation methods tend to be performed deterministically, considering relevant risk and uncertainty parameters in the form of single, expected values, but in which potential fluctuations with regard to risk or uncertainty factors are more or less ignored, despite awareness of its presence.

Such a deterministic valuation can be supplemented with additional methods to conduct a probabilistic analysis (Carmichael, 2014) and/or probability analysis (Mohamed and McCowan, 2001), which considers risk and uncertainty. This variability in future returns in a project can be analysed by measuring its risk based on the probability and/or possibility distributions of its input variables. In addition to real option valuation (ROV) (section 2.4.2.4), payback period (PB) methods (section 2.4.2.3), and a formal risk analysis (section 2.5.2.3), the financial theory has suggested several additional risk analysis methods, commonly applied in practice, that are used to evaluate a project’s stand-alone risk (e.g., Ross et al., 2008, Brealey et al., 2011, Ehrhardt and Brigham, 2016).

A *sensitivity analysis* involves changing key variables one at a time to determine how sensitive a project's return (for example, the net present value [NPV]) is to deviations from the expected values of the input variables (Graham and Harvey, 2001, Brounen et al., 2004). In its essence, it is a ‘what-if analysis’ (Arnold, 2013:181) that asks what happens to the NPV (or internal rate of return [IRR]) if certain parameters, such as the production amount or interest rates in the debt financing, are changed by a certain percentage in both negative and positive directions. Projects with more sensitive NPVs are considered to be more risky (Baker et al., 2010). The sensitivity analysis belongs to one of the most accepted methods used in uncertainty and risk measurements (Bhandari, 1981). This analysis provides the advantage that the decision makers are aware of the project’s sensitivity in relation to the various input parameters while knowing the range for judgemental failures and being prepared to take risks (Arnold, 2013). In addition, the analysis results indicate where to the focus should be placed, enabling a more efficient approach to collect additional data and information about identified crucial components (Arnold, 2013). Moreover, this analysis provides information on key factors for which specific risk mitigation measurements or particular contingency plans have to be applied or introduced (Arnold, 2013). The main disadvantage of this method is the absence of assigning probabilities to the performed input data variations (Arnold, 2013), i.e., the method does not provide an approach to evaluate whether the investment is more vulnerable with regard to an NPV change due to, for example, a 10% lower production amount or a 10% increase in the interest rate within the debt financing. Another point of criticism is that each parameter is changed in isolation, which is an unrealistic scenario in reality (Arnold, 2013). The scenario analysis below can help to solve this last problem.

A *scenario analysis* involves identifying key variables that are likely to affect the return on a project or the NPV. However, instead of changing each variable one at a time, the variables are changed simultaneously to develop different scenarios: for example, base, worst-, or best-case scenario. This approach can reflect reality much more closely, in contrast to the sensitivity analysis in which only one input parameter is changed each time. To reach a complete picture, Davies et al. (2012) and Arnold (2013) have suggested an approach that estimates multiple cash flow scenarios with corresponding probabilities (known as a *probability analysis*) to calculate the expected NPV or expected return respectively. In addition, Brealey et al. (2011) have proposed that the analyst can assign probabilities based on the past frequency of occurrence of key input variables, subjective judgement, or an a priori reasoning approach so that the sum of the probabilities of the three defined scenarios (base, worst-, or best-case scenario) equals 100%.

Simulations involve creating probability distributions that describe the possible values of key variables, for example, with probability density functions (PDFs) (Espinoza, 2014:1060), used as input data in the algorithm to calculate a project's return. In Monte Carlo simulations, those values are selected randomly and entered into the algorithm—repeated thousands of times—to determine a distribution of outcomes (expected NPV, see chapter 2.4.2.1, and standard deviation) (Trigeorgis, 1996, Villiger and Bogdan, 2005, Brealey et al., 2011). This technique, based again on the probability theory, takes the randomness of the input factors for granted (Behrens and Choobineh, 1992). In many cases, a normal distribution of the NPV is appropriate (Hillier, 1963, Wagle, 1967, Hillier, 1969); however, specific input values and their probability distribution, such as the Weibull distribution for wind (Yeh and Wang, 2008), can lead to another NPV distribution. The use of probability distribution in investment appraisal is well documented (Gregory, 1988), and today, it is occasionally to frequently applied (Baker et al., 2010).

A *possibility analysis* can be appropriately applied for uncertainties that are not based on randomness, but rather on inherent fuzziness (Behrens and Choobineh, 1992), and within investment appraisals based on a mixture of quantitative and qualitative data—a typical case in reality (Gaweł et al., 2017). In contrast to simulations based on the probability theory, this type of analysis is derived from a probability analysis and possibility distribution (Mohamed and McCowan, 2001). Frequently encountered non-monetary factors in projects also limit the applications of simulations (Mohamed and McCowan, 2001). The use of a possibility analysis has been applied in and propagated for several engineering fields (e.g. Wong and So, 1995, Lorterapong and Moselhi, 1996) and investment decisions (e.g. Mohamed and McCowan, 2001, Appadoo et al., 2008).

In addition, probability and possibility analyses can be complemented with the *analytical hierarchy process* (AHP), which is a hierarchical, scaling method developed by Saaty (1980) that weights the relevance of each risk factor to assess the complete risk of the considered object (section 2.5.2.3).

Another approach to consider uncertainty in investments provides so-called *Markov chains* (e.g. Norris, 1998), which model specific combinations of states, such as certain wind strengths, life spans, and interest rates, and the transition between states to calculate its probability of being in each state. Based on each state, which represents a specific NPV result, the investment feasibility and the expected NPV can be computed (Carmichael, 2011). This approach can complement existing sensitivity analyses and simulations, such as Monte Carlo simulations (Hastings, 1970).

A sophisticated method that can be combined with Monte Carlo simulations is the statistical technique called *Value at Risk* (VaR), which i used to measure and quantify the level of financial risk (amount and probability of potential loss) within a firm or investment portfolio over a specific time frame (Brealey et al., 2011). Due to its complexity, it is not often used in practice (Graham and Harvey, 2001, Brounen et al., 2004).

Bhandari (1981) has discussed additional, relevant methods that are generally accepted approaches to account for uncertainties, including the CE method (sections 2.2.3 and 2.4.4.3) and the expected value method (section 2.4.2.1).

Table 5: Overview and summary of all above described risk analysis approaches, including their advantages and disadvantages (author's own illustration).

Risk analysis methods	Advantages	Disadvantages
Sensitivity analysis	▪ Increases knowledge about the project's sensitivity in relation the various input parameters while knowing the range for judgemental failures and being prepared to take risk ▪ Increases sensitivity where to put the focus on, enabling a more efficient approach to collect additional data and information about identified crucial components ▪ Provides information for which key factors specific risk mitigation measurements or particular contingency plans	▪ Absence of assigning probabilities to the performed input data variations ▪ Each parameter is only changed in isolation which is an unrealistic scenario in reality
Scenario analysis	▪ Reflects the reality much closer in contrast to the sensitivity analysis since a realistic set of input data are changed for each scenario ▪ Possibility to compute probabilities to the considered scenarios or for each defined scenarios which sums up to 100%	▪ Difficulty to assess relevancy of different scenarios if information about probability of each scenario is not given
Simulations (e.g. Monte Carlo)	▪ Detailed results, for instance with a distribution profile for the calculated value	▪ Only numerical or monetary factor can be assessed ▪ Not well excepted method by decision makers
Possibility analysis	▪ Numerical or monetary factors as well as non-numerical and non-monetary factor can be assessed	▪ -
Payback period (PB)	▪ Simple, easy understandable method ▪ Widely applied	▪ Time value of money is not considered ▪ Only focusing on risk within the period until reaching the payback date
Discounted payback period (DPB)	▪ Time value of money is considered	▪ Only focusing on risk with the period until reaching the payback date
Formal risk analysis	▪ Comprehensive method	▪ Can be a complex and cumbersome task ▪ Can follow a spurious accuracy
Markov-Chains	▪ Promising method to access feasibility and the expected NPV	▪ not well known by decision-makers

Table 6: Available approaches to assess and/or consider project risks in capital budgeting processes as suggested by financial theory (T) and according to empirical surveys (S) among practitioners, and their supposed applicability for RES-E investments (X: applicable, (X): more or less applicable / only in combination with other methods, - not applicable).

Methods evaluating project risks	**Evidence in theory/surveys**	**Applicability**		**Empirical surveys (S) among practitioners**
		in practice	**for RES-E investments**	
Formal risk analysis	T/S	- [1]	X	Gitman and Mercurio (1982), Akintoye and MacLeod (1997), Baker et al. (1999), Uher and Toakley (1999), Raz and Michael (2001)
Real option	T/S	(X)	X [2]	Graham and Harvey (2001), Brounen et al. (2004)
Payback period	T/S	X	(X)	Petty et al. (1975), Graham and Harvey (2001), Brounen et al. (2004)
Discounted payback period	T/S	X	(X)	Graham and Harvey (2001), Brounen et al. (2004), Baker et al. (2009)
Sensitivity analysis	T/S	X	X	Gitman and Mercurio (1982), Graham and Harvey (2001), Brounen et al. (2004), Baker et al. (2009)
Scenario analysis (for example, base case, worst case, and best case)	T/S	X	X	Baker et al. (2009)
Simulations (for example, Monte Carlo simulations)	T/S	X	X	Gitman and Mercurio (1982), Graham and Harvey (2001), Brounen et al. (2004), Baker et al. (2009)
Possibility analysis	T	X	X	-
Value at Risk	T/S	(X)	(X)	Graham and Harvey (2001), Brounen et al. (2004)
Certainty equivalent method	T/S	X	X	Petty et al. (1975), Gitman and Mercurio (1982), Gitman and Vandenberg (2000), Graham and Harvey (2001), Brounen et al. (2004)

[1] Although a formal risk analysis is applied in risk assessments in the engineering field (e.g., Akintoye and MacLeod, 1997, Baker et al., 1999, Uher and Toakley, 1999, Raz and Michael, 2001) and theoretical concepts have suggested applying it in estimating return rates (e.g., Cotner and Fletcher, 2000, Palliam, 2005b, a), no evidence could be found in the empirical research about its application by practitioners.
[2] Ideal method for valuating investments in high-risk environments, such developing and refurbishing/repowering projects and high leveraged firms with corporate loans (section 2.4.2.4).
T: Theory, e.g., Bhandari (1981), Brealey et al. (2011), Hawawini and Viallet (2011).

Adjustments to risk can also be performed within the applied discount rate in DCF-based valuation methods. This approach is discussed in more detail in section 2.4.4.1.

The firm's beta, which is relevant for the investor's risk level, is not always necessarily affected by a project with a high stand-alone or high within-firm risk. However, if such a project is positively correlated with the earnings of another firm's assets and/or investor returns, all three risk types can be relevant (Figure 13). Since it is difficult, if not impossible, to quantitatively measure the within-firm and market risk, the focus on the stand-alone risk provides, in such a case, a viable approach. On the other hand, having the same project with a negative correlation to within-firm and/or market risk, a stabilisation of a firm's earning can be reached and/or the beta might be reduced, allowing the project to be evaluated with a lower WACC. Experienced managers consider quantitative valuation and stand-alone risk assessment and complement them with judgemental decisions in case of effects on the other risk types/levels (Brigham and Houston, 2012, Ehrhardt and Brigham, 2016).

2.3.3.2 Market or Within-Firm Risk in Valuation

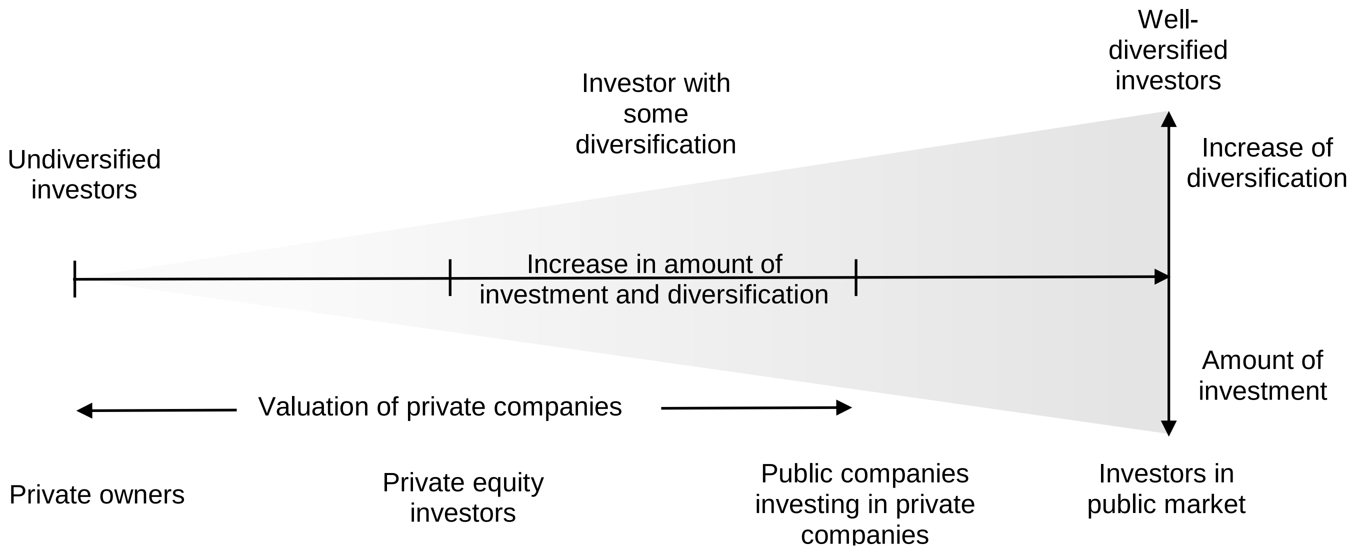
As outlined in section 2.2.5, financial theory suggests that in case of PTCs, the valuation focus should be only on the project's systematic risks, measured with the beta (market risk), since its shareholders can efficiently diversify their portfolios (Brealey et al., 2011). As has been argued, this does not necessarily apply to all investing firms or investors with less well-diversified portfolios, particularly when investing in the NTA market with lower liquidity than PTCs.

Finance theory also proposes that the total investment risk, which is the sum of unsystematic and systematic risk, is not the ideal measurement to be considered when setting the required return rates of the investment. Since firms can be viewed as a portfolio of projects, the individual contribution of the new investment to the investing firm's risk (within-firm risk) is the more appropriate risk measure (Block, 2005). However, due to the fact that estimating the total investment risk is easier than defining its systematic risk, many firms still apply total project risk when making investment decisions (Baker et al., 2010).

In addition to the work of Ehrhardt and Brigham (2016), illustrated in Figure 13 (section 2.3.3), which examines the investment level (project, firm, and investor), other authors have looked at the grade of diversification from the perspective of the various investor types. Damodaran (2012) has provided a spectrum of the two extremes of undiversified and well-diversified investors, illustrated in Figure 14. He has added that a PTC typically values the investments higher than another NTA, since the discount rate of a non-diversified investor is higher. In the energy sector, Block (2005) has demonstrated that a majority of public utilities include such *portfolio effects* in their decision making.

Based on the explanations of Damodaran (2012), it can be said that for investors in private companies, it is impossible to reach the highest grade of diversification, even by diversifying all unsystematic risk. In recent years, many scholars have considered unsystematic risk to be relevant in valuation, and they have provided justification for the management of unsystematic risks (Power, 2004, Damodaran, 2012, Bromiley et al., 2015), in contrast to the long-lasting argumentation to care only about systematic risks (Sharpe, 1964, Lintner, 1965b).

Figure 14: Spectrum of undiversified versus diversified investors (author's own illustration, based on work of Damodaran, 2012).

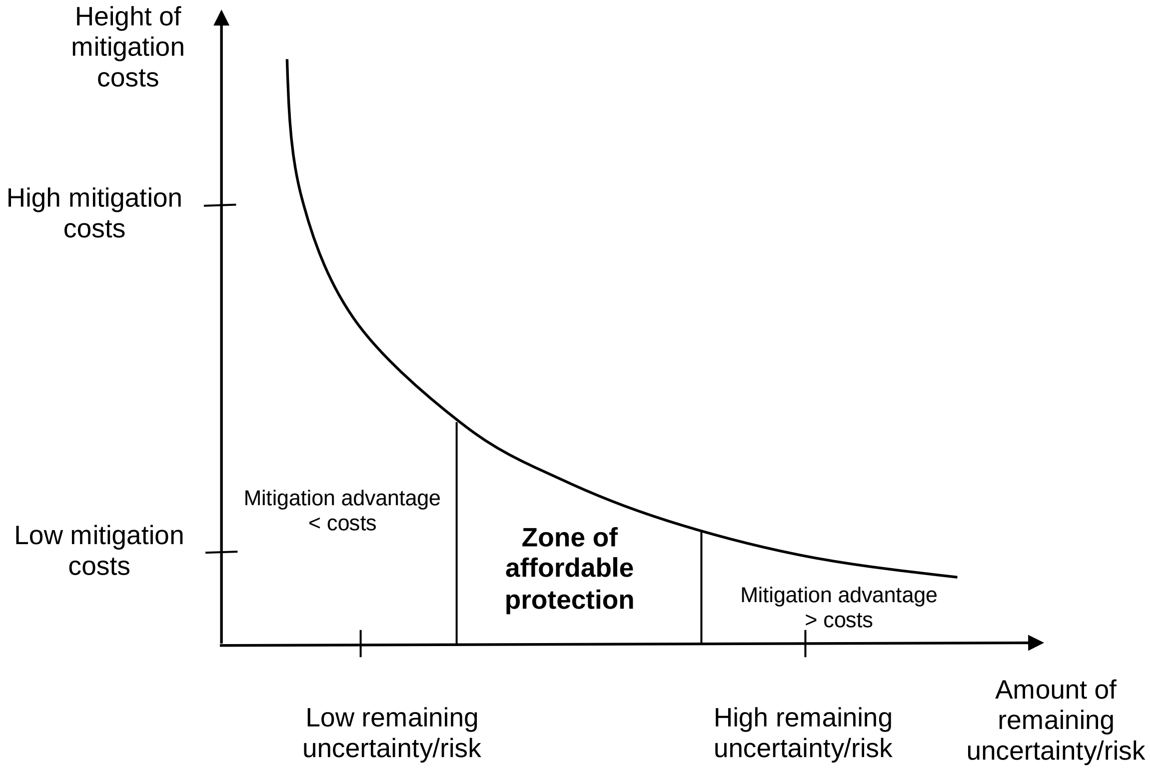


Coenenberg and Schultz have stated that 'the major principle in the valuation of companies is subjectivity. Value is always dependent upon the circumstances and perspective of the party the valuation is performed for' (2002:597). Having said that, the motive for the transaction and valuation matters (sections 2.1.2 and 2.6.2), since it can have an effect on the choice of the valuation techniques (Fernandez, 2016) and hence the value. The valuation also depends on the considered type of company, and the valuation of a private company depends on whether it is sold or bought; whether the buyer is an individual, a private equity company, or a PTC; or whether it is bought to be held for a certain period before being sold again, such as in the case of the strategic existence of certain funds. In addition, apart from each investor's diversification grade, the presented types of investors in Figure 14 apply different discount premiums for liquidity, for the consideration of diversifiable risk within the targeted project, or for the control possibilities within the considered investment (Damodaran, 2012).

2.3.4 Risk Mitigation

After having identified and evaluated uncertainties and risk, uncertainty and risk mitigation is the next natural step (COA-DOE, 2005). Risk mitigation[21] is a type of risk treatment, understood as a countermeasure to reduce or eliminate risk, to transfer risk, to avoid risk, or to absorb and pool risk (Ayyub, 2014). Mitigating risk and uncertainty is a common business practice in all types of ventures (COA-DOE, 2005), and it must thus also be considered in transactions (Perry and Herd, 2004). It involves a systematic reduction in the extent of exposure to a risk and/or the likelihood of its occurrence (COA-DOELangniss et al., 1999, 2005, Mitchell et al., 2006). Risk mitigation measures can reduce the level of compensation (Langniss et al., 1999, Mitchell et al., 2006) and hence the required return rates within valuation. In doing so, businesses apply natural hedges by balancing their assets and liabilities and by investing in a diversified portfolio. Corresponding to that, Arnold (2010:476) has suggested that 'diversification is a cheap and practical way of reducing your risk. You are highly recommended to do it'. If natural hedges cannot be applied or are not sufficient, derivatives can be acquired (Baker et al., 2010). However, risk mitigation does not come for free; it always implies a trade-off between taking risk or hedging and correspondingly having the chance to create value or not respectively (Baker et al., 2010, Cleden, 2012). Understanding the 'zone of affordable protection' (Cleden, 2012:22) leads to the appropriate mitigation strategy (Figure 15). Mitigation is typically performed in cases of low mitigation costs in relation to many advantages, of no knowledge about possibilities and consequences (state of uncertainty), or of drastic consequences with low probabilities for low mitigation costs (Cleden, 2012).

Figure 15: Trade-off between risk mitigation measures and their costs (adopted from Cleden, 2012).



As practitioners outline, many risk components are minor and do not need any further attention, whereas others can be mitigated appropriately in due time if the many known risk components are identified, assessed, and handled adequately (COA-DOE, 2005, Deloitte, 2014). However, particularly high-impact, low-portability risks are more difficult to mitigate (COA-DOE, 2005), and additional mitigation strategies must be considered. It is common practice to transfer risk, for instance, via contracting, to the party that is able to best manage the risk; this is particularly appropriate if both parties completely comprehend the risk taken in relation to the reward. However, such risk allocation can be challenging in cases of difficulties to quantify the risk (DOA-DOE, 2005). Risk avoidance strategies are less intensively used. Avoiding risk considers changing the parameters of a project in such a way as to eliminate the risk completely or to reduce it to an acceptable value. Care must be taken not to create other risks or uncertainties with even greater impacts (DOA-DOE, 2005) which can be avoided by ‘a proper characterisation of uncertainty […] through data collection and knowledge construction’ (Ayyub, 2014:441).

Table 7: A selection of risk mitigation measures in addition to natural hedges as suggested by financial theory (T) and according to empirical surveys (S) among practitioners and their supposed applicability for RES-E investments (X: applicable, (X): more or less applicable / only in combination with other methods, - not applicable).

Risk mitigation measures	**Evidence in theory / surveys**	**Applicability**		**Empirical surveys (S) among practitioners**
		in practice	**for RES-E investments**	
Internal Due Diligence of investment project	T / S	X	X	Angwin (2001), Howson (2003), Perry and Herd (2004)
External Due Diligence of investment project with external consultants	T / S	X	X	Angwin (2001), Howson (2003), Perry and Herd (2004)
The company’s risk management function (e.g. risk management process / policy, identification of exposures, loss control)	S	X	X	Watts (2011)
Standardisation of procedures (e.g. processes, contracts)	S	X	X	Watts (2011)
Check type of suppliers (credit rating) and/or contractual clauses within contracts with suppliers	S	X	X	Bodnar et al. (1998)
Reduce market risks with FiT and/or long-term PPA	S	X	X	Jin and Jorion (2006), Watts (2011)
Reduce operational risks (e.g. full maintenance contracts with availability guarantee, preventive maintenance procedures, periodical inspections)	S	X	X	Cohen and Huchzermeier (1999), Stremersch et al. (2001), Cholasuke et al. (2004)
Making co-investments with partners	T	X	X	Zink (1973), Lankes and Venables (1997)
Reduce revenue risks due to lower conditions in natural resource with so-called Earn-Out clauses in share purchase agreements	T / S	X	X	Kohers and Ang (2000), Datar et al. (2001), Cain et al. (2011)
Arrange for insurance (e.g. machine failure, downtime, liability, directors and officers insurance)	T / S	X	X	Watts (2011)
Arrange for weather protection insurance (e.g. natural resource hedging instruments)	T / S	X	X	Watts (2011)
Implement emergency services	S	X	X	Watts (2011)
Arrange for financial products (e.g. financial hedging of currency and/or interest rate changes)	T / S	X	X	Bodnar et al. (1998), Smithson and Simkins (2005), Watts (2011)

T: Theory, e.g., Langniss et al. (1999).

Risk control is another risk mitigation approach to manage the occurrence probability or its consequences, for instance, by installing a data-gathering with an early alert system to better assess the likelihood, the impact and the time of the risk (DOA-DOE, 2005, Ayyub, 2014).

Apart from these presented generic risk mitigation approaches, a review of the literature has revealed the application of some specific measures, which are then examined in relation to their applicability to RES-E project transactions (Table 7). Within an appropriate due diligence (DD) in transaction processes, uncertainty and risk can be assessed, and acquisition risk can be reduced (Angwin, 2001, Howson, 2003, Perry and Herd, 2004, Deloitte, 2014).

2.4 Capital Budgeting Techniques

This section about capital budgeting begins with some basic finance-mathematical concepts (section 2.4.1) before discussing the fundamental valuation techniques (section 2.4.2), thereby providing an introduction to the related CoC approaches (section 2.4.3) and discussing how to handle risk within valuation (section 2.4.4).

2.4.1 Finance-Mathematical Concepts

2.4.1.1 Time Value of Money

The price for providing capital is known as interest, and it is typically a percentage of the provided capital (Copeland et al., 2005). It is a compensation for sacrificing immediate consumption for lending money. It can also be regarded as an incentive to save and invest while having the possibility to gain a higher return (Arnold, 2013). There are at least three reasons for which to be compensated with regard to the time value of money:

- Being impatient to consume—it is the price for time, since people prefer consumption now compared to consumption later,
- Inflation—if there is inflation, the price for time has to be added to the inflation for the loss of purchasing power over time, and
- Risk—this involves the probability of not receiving a pay-out at all or one that is less than expected (Arnold, 2013).

Capital is consequently only provided if the investor is compensated for impatience to consume, inflation, and the risk involved in the investment. Otherwise, no investor is willing to provide capital (Arnold, 2013).

Under normal conditions, interest rates to be received for providing capital are positive so that the current, nominal amount of the capital is not the same as the future nominal. Having invested an amount CF_0 with an interest rate r, the future amount CF_1 is calculated as follows (Copeland et al., 2005):

$$CF_1 = CF_0 + r \cdot CF_0 = CF_0 \cdot (1 + r) \tag{1}$$

The other way around, the future amount CF_0 can be reformulated based on equation 2 as follows:

$$CF_0 = \frac{CF_1}{(1 + r)} \tag{2}$$

CF_0 is known as the present value (PV) or capital value. This is a basic concept of financial mathematics, which considers the different time value of money. In addition to this single-period perspective, multiple future periods with various money streams can be considered. Assuming the single, periodic interest rate r remains constant for all future periods t, CF_0 equals the sum of the discounted future money streams based on equation 3. This approach provides the theoretical basis of the DCF method described in section 2.4.2.1:

$$CF_0 = \sum_{t=1}^{T} \frac{CF_t}{(1 + r)^t} \tag{3}$$

In a simplified environment in which uncertainties about future money streams do not exist, the discounting can be performed based on the risk-free interest rate r_f (Copeland et al., 2005). However, if there are uncertainties about the height of future money streams—as encountered in reality—then the risk-free interest rate is not appropriate for discounting. Instead, an appropriate risk premium must be added to the risk-free interest for discounting purposes (section 2.5). This concept illustrated herein is known as a *risk premium approach* (Brigham et al., 1985, Arnold, 2008, 2013, Damodaran, 2017)[22].

2.4.1.2 Cash Flow Streams and Valuation Phases

Before discussing the various valuation methods, the cash flow streams and the considered valuation phases are examined in more detail in the context of the above-mentioned concept of the time value of money (section 2.4.1.1) and the below illustrated DCF method (section 2.4.2.1). Identifying the relevant cash flow streams is a crucial and sometimes difficult step within corporate budgeting, with many pitfalls (Ehrhardt and Brigham, 2016). With regard to the cash flow streams for one defined period (for example, a month or year), a differentiation is made between a direct and an indirect estimation of the streams of cash flow. For valuation purposes, cash flow streams are relevant if they run to the provider of capital, while the concept of *double counting prohibition* must be considered, saying that only actual or potential distributions are relevant, and not financial revenues based on the balance sheet (annual net profit) (Brennan, 1971, Moxter, 1983, Damodaran, 2001, Coenenberg and Schultze, 2002). A difference is to be made between cash flow streams exclusively to equity investors (shareholders)—known as free cash flow, levered cash flow, or FCF^{Equity}—and cash flow distribution to providers of both equity and debt—known as free cash flow to entity, gross cash flow, or FCF^{Entity} (Spremann and Ernst, 2011). The FCF^{Entity} corresponds to the earnings before interest, depreciation, and amortisation (EBIDA), but after tax expenses (Kuhner and Maltry, 2006). In case of an all-equity financing, the FCF^{Equity} equals the FCF^{Entity}, naming

FCF^*Entity* also as unlevered cash flow or cash flow under an all-equity assumption (Drukarczyk and Schüler, 2009, Loßagk, 2014).

The *direct estimation of the free cash flow streams* is possible for internal valuations or detailed valuations during a DD process, including the netting of all in- and out-coming streams (Beringer, 2010, Hommel and Dehmel, 2010). As an example, Figure 16 schematically illustrates possible cash flow components to compute FCF^{Equity}.

Figure 16: Scheme for computing the levered and unlevered cash flow according to the direct estimation method (adopted from Beringer, 2010).

Focus on equity cash streams	**Focus on both equity and debt cash streams**
+ revenues	+ revenues
- operating expenses	- operating expenses
+ financial revenues	
- financial expenses	
- taxes on revenues and gains	- taxes on revenues and gains
= Levered cash flow (FCF^{Equity})	= Unlevered cash flow (FCF^{Entity})

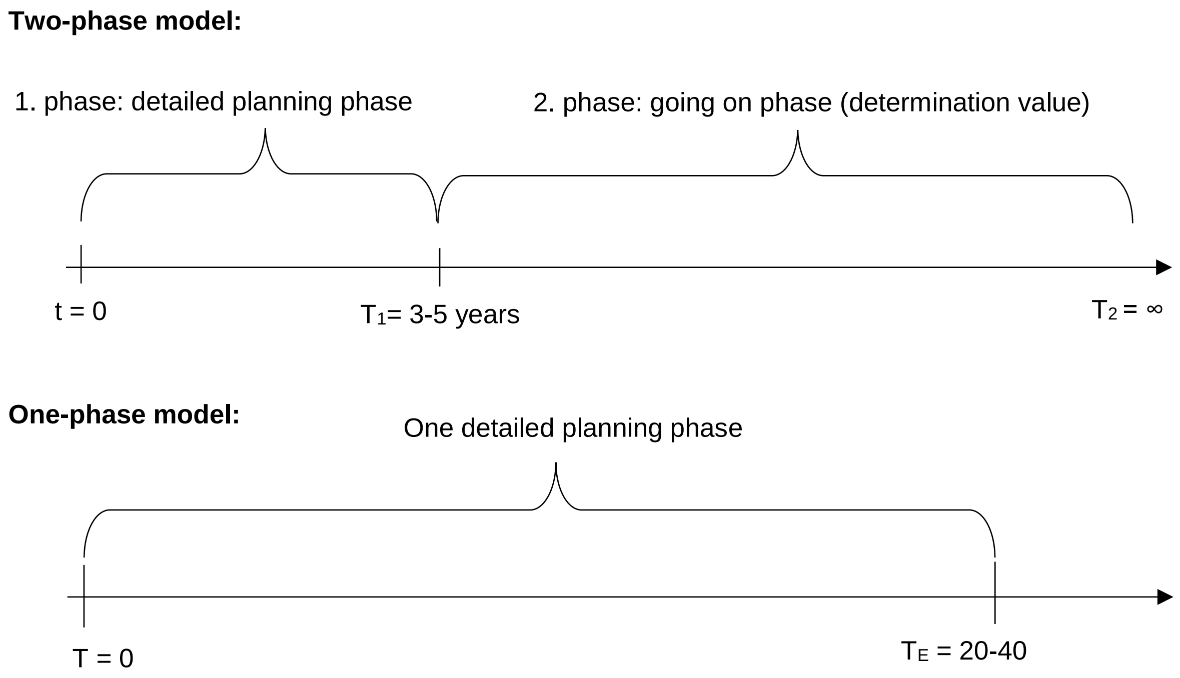
In RES-E investments, the direct estimation method is frequently applied, since the cash flow components are known or provided, either within internal valuation processes, for example, for impairment tests, or during acquisition processes, which are usually based on a DD in which the seller of the project provides all relevant data and documents (for example, reports and contracts).

Since the direct estimation of free cash flow is not always possible for external valuers, an alternative approach is provided with the *indirect estimation method*. It is based on published annual accounts, including the balance sheet and the profit and loss account, to derive the relevant profit gains and to be used as a forecasting instrument (Hommel and Dehmel, 2010). There are a variety of indirect estimation schemes in the literature, as outlined by Günther (1997). Since, as stated above, the indirect estimation process is not frequently applied for the valuation of RES-E investments, a more profound investigation into the indirect estimation method is not conducted in this work.

Under close scrutiny, the cash flow streams must be regarded as estimates and should hence be defined as $E[\widetilde{FCF^{Equity}}]$ or $E[\widetilde{FCF^{Entity}}]$. For simplification reasons, those variables are still written as FCF^{Equity} equals FCF^{Entity}.

Since a projection of the cash flow is the basis for many of the valuation methods described below (section 2.4.2), for example, for the DCF method, the characteristic of the period relevant to the valuation is examined in more detail. For the valuation of the potentially infinite life of an enterprise, the 'going concern principle'[23] (Hawawini and Viallet, 2011, Arnold, 2013) is applied. In doing so, a two-phase model is typically used, dividing the cash flow projection into a detailed, initial forecasting phase and a second phase to determine a terminal value. This concept has been described by various literature (e.g. Kruschwitz and Löffler, 2006). This simplification is usually not encountered in RES-E investments with a typically finite life span due to the ability to project cash flow streams for all relevant periods, i.e., from the commissioning date of the power plant or the point of perspective until the end of the project's lifetime (decommissioning date) (Figure 17).

Figure 17: One-phase model and two-phase model of valuation.



In addition, on the equity level, there are two different types of free cash flows: the generated periodic cash flows within the company, independent of its possibility to distribute the cash flows to the equity investors, and the solely distributable cash flows to the equity investors. Accordingly, either of the cash flow types can be discounted for determining a corresponding PV (section 2.4.2.2).

2.4.1.3 Financing Policies

To understand valuations, it is key to discuss the different types of implemented financing policies and the different rules applied in making decisions about debt financing. Burrowing debt capital typically benefits the company due to a lower corporate tax burden based on the tax deductability of the interest on burrowed capital. This concept is called tax shield of interests (Myers, 1974) (section 2.4.3.2). In relation to valuations, there are two ideal types of financing policies: the autonomous financing policy and the value-oriented financing policy (Richter, 1998, Drukarczyk and Schüler, 2009, Meitner and Streitferdt, 2012). Both of them are based on simplified assumptions about real, existing financing policies.

In the case of the *autonomous financing policy*, which is also known as the determined financing policy (Drukarczyk and Schüler, 2009), the future amount of burrowed capital is given. Such a situation is encountered in credit agreements in which the complete redemption schedule is terminated until the complete repayment; this is frequently applied in project financing[24] credit agreements for RES-E investments which is a financing structure in low-risk environments (Böttcher and Blattner, 2010, Steffen, 2018). As such, the debt-equity ratio—the leverage—is variable. The resulting tax benefits are precisely predictable, and the tax shield can thus be regarded as safe, apart from the insolvency risk (Pawelzik, 2012).

In contrast, the *value-oriented financing policy,* which is also known as the breezing financing policy (Drukarczyk and Schüler, 2009), defines a certain debt financing level or debt ratio as the target value. This could be constant over the observed period or periodically and specifically determined (Dierkes et al., 2009). The amount of debt capital—both the corresponding amount of interest and tax shield—consequently varies in relation to the equity value. As a result, the tax shield cannot be regarded as safe in this circumstance; instead, it is subject to the same risk of future payment surpluses or free cash flow to equity (FCFE) (Kruschwitz and Lorenz, 2011).

Since the financing policy is applied as an instrument to maximise the enterprise, and because equity value and a financing policy that are independent of the company value are unrealistic, there are also mixed forms of those two ideal types of financing policies in reality (Perridon et al., 2014).

2.4.2 Reviewing Existing Valuation Methodologies

Before discussing the models for estimating the CoC, the main available valuation methodologies are discussed. Table 8 provides an overview of different valuation methods. According to Mauboussin (2002b:1), 'valuation is the mechanism by which investors trade cash today for future claims on cash flows'. The academic literature has divided it into two broad groups of methods: discounted cash flow (DCF) and non-DCF methods. In addition, ROV is shortly presented.

The financial literature as well as the practice have demonstrated that the most popular and essential valuation methods are the DCF-based entity approach and equity approach and the discounted economic value added (EVA) (Mielcarz and Mlinarič, 2014). More specifically, the WACC approach, which is an entity approach (discussed in more detail in section 2.4.2.1), is the most popular method in international valuation practices (Drukarczyk and Schüler, 2009). The EVA approach (Appendix 1) is not further investigated in this thesis, since it is seldom applied to valuating RES-E investment projects.[25] Furthermore, practitioners do not concentrate on one technique. Surveys have demonstrated that multiple techniques are applied in valuation processes (e.g. Ryan and Ryan, 2002).

Table 8: Classification of different existing valuation methods (adapted from Drukarczyk and Schüler, 2009, Fernandez, 2016), with main valuation methods according to Mielcarz and Mlinarič (2014) in italics.

Classification of Valuation Methods					
Balance Sheet-based Methods	**Income Statement-based Methods**	**Mixed/Goodwill-based Methods**	**Discounted Cash Flow-based Methods**	**Value Creation**	**Options**
Book value Adjusted book value Liquidation value Substantial value	Multiples per sales, EBITDA Other Multiples (e.g. sales per production output)	Classic method Abbreviated income method	*Entity approach (Free cash flow / free cash flow to entity)* *Equity approach (Equity cash flow / cash FTE)* Residual income valuation Equivalent approaches (CE, decoupled NPV)	*Economic value added (EVA)* Economic profit Cash flow added CFROI	Real option valuation Black and Scholes Investment options Expand the project Delay the investment Alternative uses

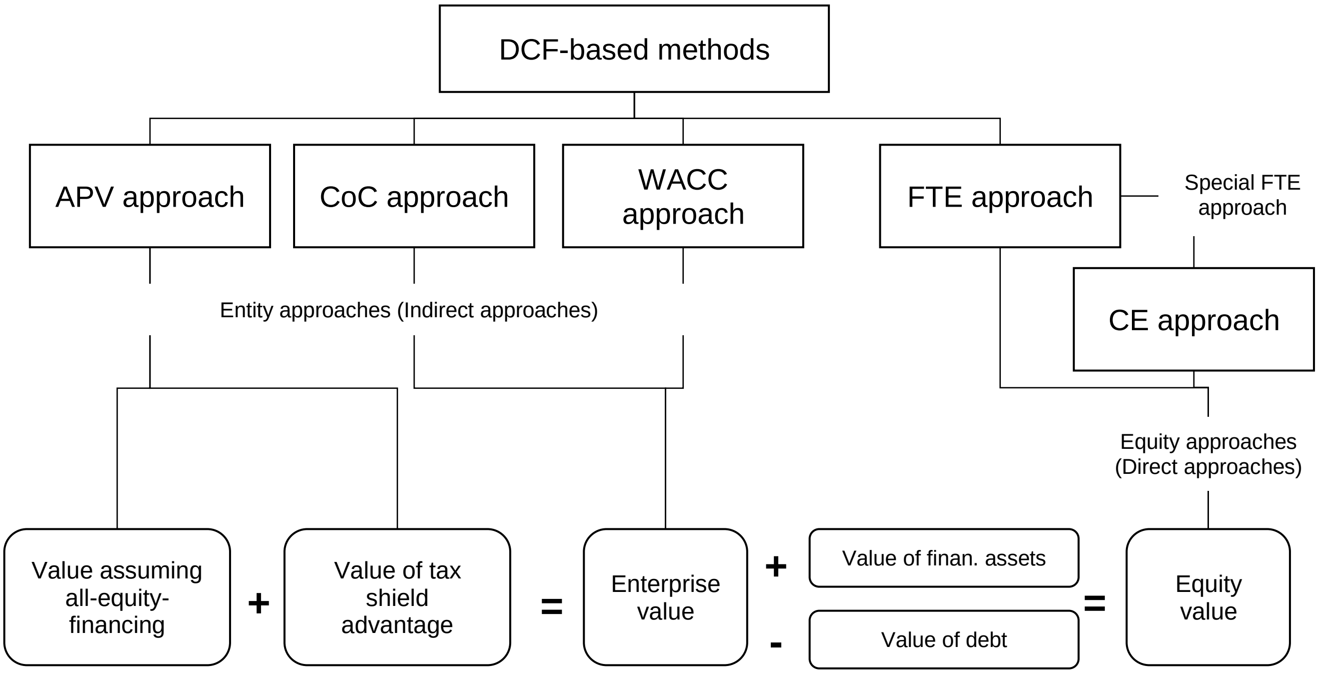
2.4.2.1 Discounted Cash Flow-based Methods

The DCF-based approaches are all based on the research of Williams (1938). His theory of DCF analysis was created after the stock crises in 1929 to better value stocks and Gordon and Shapiro (1956) have 'rediscovered' the work. Today, the DCF method (Fisher, 1930, Williams, 1938, Gordon and Shapiro, 1956) is the benchmark valuation model, and it is used in the majority of financial valuations (e.g., Gitman and Vandenberg, 2000, Viebig et al., 2008). The model measures the intrinsic value, i.e., the expected cash flows, and it does not focus on measuring the book value. The DCF model is typically based on discrete time interval (days, weeks, months, or years—predominately in years) rather than on continuous time (Carmichael, 2014).

The DCF is regarded as superior, compared to non-DCF methods, since it considers the time value of money (section 2.4.1.1): investments with faster realised positive cash flows are more desirable (Baker et al., 2010). It is based on cash flow projections computed in spreadsheets. All of those approaches are static, as are many other approaches, i.e., future financial decisions in response to new available information are not considered in the models (Myers, 1974).

There are various DCF based approaches. The literature has listed at least nine approaches that are based on free cash flow and discount rate calculations; they differ in the cash flows selected as valuation starting points and argue for the optimal technique to consider the tax shield (Küting and Eidel, 1999, Fernandez, 2007b, a, 2015, 2016). Regarding which cash flows to consider, the methods are generally divided into two groups, namely the equity or direct approach and the entity or indirect approach, while four of them are considered to be the most relevant based on the literature review (Kuhner and Maltry, 2006, Hagenloch, 2007, Hawawini and Viallet, 2011) and relevance for this research. The first group of approaches estimates the equity value, while the latter group determines the enterprise value (Perridon et al., 2014). To receive the equity value as well, the market value of the cost of debt must be subtracted (Hawawini and Viallet, 2011). The approach that is chosen depends on the available information, the applied financing policy (section 2.4.1.3), and the type of results required (Figure 18).

Figure 18: Overview of the different DCF-based methods (adopted from Steiner and Wallmeier, 1999, Schultze, 2003, Britzelmaier, 2013).



A first equity approach is the flow to equity (FTE) method, also called free cash flow[26] to equity (FCFE), which uses the free cash flows FCF_t^{equity} available for the equity holders to be discounted with the cost of equity r_{equity} for the leveraged company to directly estimate the equity or shareholder value (Coenenberg and Schultze, 2006, Kuhner and Maltry, 2006, Berk and DeMarzo, 2011, Hawawini and Viallet, 2011, Mielcarz and Mlinarič, 2014). In international valuation practices, this approach could not gain acceptance, compared to other approaches, probably because it does not allow one to differentiate between different capital structures, and it solely focuses on the cash flow stream to equity holders (Kuhner and Maltry, 2006, Britzelmaier, 2013). The FTE approach can be applied for both a value-oriented and an autonomous financing policy (Ross et al., 2008). Applying a value-oriented financing policy with a corresponding constant leverage ratio, the future cost of equity r_{equity} remains constant (Loßagk, 2014). This results in the *PV*, according to the FTE method:

$$PV = \sum_{t=1}^{\infty} \frac{FCF_t^{equity}}{(1 + r_{equity,v})^t} \qquad (4)$$

In the autonomous financing policy, the FCF_t^{equity} must be discounted with dynamic, periodic, specific discount rates $r_{equity,\ v}$ (Loßagk, 2014); practitioners have also called this the *dynamic FTE approach* (Deloitte, 2014). In both financing policies, the FTE approach encounters circulation issues[27] with regard to the appropriate discount rate in relation to the debt/equity ratio and the corresponding WACC (Casey, 2004, Loßagk, 2014).

In any of the financing policies, the equity approach has problems with interdependencies in relation to determining discount rates and/or free cash flows, which leads to inconsistencies (Drukarczyk and Schüler, 2009).

For simplification purposes, the FTE approach is often also applied with a constant discount rate, even if an autonomous financing policy is implemented. This *simplified FTE approach* is the most frequently used valuation method in pricing RES-E projects. It has the advantage of being easy to implement, understand, and communicate. However, it comes with the drawback of being overly simplified and inaccurate due to its negligence of the changing risks and capital structure over time (Deloitte, 2014).

According to Mielcarz and Mlinarič (2014), the FTE approach provides incentives to improve the capital structure (debt/equity ratio) by increasing the project's leverage to receive higher equity return rates, while causing higher risks of over-financing the project and financial distress for the superior entity. This risk is reduced when the principles are ensuring by minimising the WACC and simultaneously maximising the company value (section 2.4.3.2). The WACC approach described below has less jeopardy in this sense. However, project financing, which is a widely applied financing approach for special purpose vehicles (SPVs), provides a specific case for FTE valuation. The financial risk of the project, the SPV, must be separated from the superior entity, i.e., an increase in debt in the SPV does not directly increase the financial risk of the entity. In such a case, an increase in the financial distress risk does not decrease the value of the entity. At the same time, the investing entity must be considerably diversified and stable to losses of the invested equity in case of the bankruptcy of the SPV (Mielcarz and Mlinarič, 2014).

The *CE* method and the deduced *decoupled NPV* (DNPV) approach, discussed in sections 2.4.4.3 and 2.4.4.4, can both be considered as methods derived from the FTE approach.

The *adjusted PV* (APV) model is an alternative DCF-based approach, as developed and presented by Myers (1974). Its modular approach enables a valuation with less interdependencies between the unlevered asset value and tax shield effects. In addition, the APV does not require any iterative computations (Drukarczyk and Schüler, 2009) in case of the autonomous financing policy, in contrast to the encountered circulation issues in the FTE, WACC, and CoC approaches. It is particularly adequate for valuing a business that changes its capital structure over its lifetime and for providing transparency in applying the CoC (Drukarczyk and Schüler, 2009, Deloitte, 2014, Koller et al., 2015). It is an entity approach, since the APV method calculates the enterprise value. This levered value of the business assets is computed by adding the unlevered asset value, which is the all-equity-finance value, to the PV of the tax savings (Hawawini and Viallet, 2011, Britzelmaier, 2013), whereas the all-equity value results from discounting the free cash FTE, the FCF^{entity} (equation 5). Then, to receive the equity value, the PV of debt is subtracted, and the PV of financial assets is added.

$$APV = \sum_{t=1}^{\infty} \frac{FCF_t^{entity}}{(1 + r_o)^t} \tag{5}$$

In case of the autonomous financing policy, the risk free interest rate r_f is applied for calculating the tax shield, since it is regarded as secure (see 2.4.1.3) if the insolvency risk is not considered (Richter, 1998). For the value-oriented financing policy, the PV of the debt is more complex to be calculated using again iteration processes, and the intermediate results based on the WACC approach described below (Miles and Ezzell, 1985). Therefore, a reasonable and economically efficient application of APV is only given for the valuation of a company with an autonomous financing policy (Locarek-Junge and Loßagk, 2011), although a consistent application of the APV with a value-orientated financing policy leads to results comparable to those of the other DCF methods (Wallmeier, 1999). The valuation of a company with a capital structure that is expected to change over time or an autonomous financing policy is best performed with the APV method (Ross et al., 2008, Hawawini and Viallet, 2011, Britzelmaier, 2013). Consequently, it is also the most optimal method for RES-E investment projects with such a financing structure (Deloitte, 2014). APV is also the preferred method to valuate companies which plan to reduce its (high) leverage (Inselbag and Kaufold, 1997). However, a significant disadvantage is the more cumbersome calculation of the unlevered equity discount rate (Britzelmaier, 2013). There is also a risk that the bankruptcy costs, particularly in cases of high leveraged companies, are not adequately considered in the valuation, which, if ignored, could lead to an overstatement of the firm's value (Damodaran, n.d.). This could create some challenges when applying APV in practice. Damodaran (n.d.) has provided some suggestions for calculating the bankruptcy costs (equation 6) and selecting adequate input data:

*Expected bankruptcy cost = Probability of bankruptcy **
*Cost of bankruptcy * Unlevered firm value* (6)

However, this bankruptcy cost might be less relevant for project-financed companies (Mielcarz and Mlinarič, 2014), since in the case of a non-recourse finance scheme, only the project itself guarantees the project's default (Böttcher and Blattner, 2010, Investopedia, n.d.-e).

As another entity approach, the *WACC approach* (Drukarczyk and Schüler, 2009, Mielcarz and Mlinarič, 2014) is based on discounting the free cash flow to firm/entity, the FCF^{entity}. It takes the perspective of all parties financing the project by assuming a fictive all-equity financing (Drukarczyk and Schüler, 2009), as in the APV. The general characteristics of the WACC are described in section 2.4.3.2. Different to the WACC of an investing company, the applied discount rate in this approach is defined as the project WACC, in line with Mielcarz and Mlinarič (2014), which equates to the WACC of the investment object. The interest rates of debt providers are not taken into account in this approach to not lead to a double counting, since they are already represented in the project WACC r_{WACC}, which is taken as the discounting rate. In other words, to compensate for a potential tax income increase by not accounting for tax deductible capital expenses in the cash flows, a tax shield is introduced within the WACC calculation (Drukarczyk and Schüler, 2009, Britzelmaier, 2013, Mielcarz and Mlinarič, 2014). As with the APV approach, the equity value is reached by subtracting the PV of the debt and by adding the PV of the financial assets (Hawawini and Viallet, 2011).

Applying the WACC approach has the advantage of avoiding uncontrolled debt increase, high gearing, and corresponding financial risks (Mielcarz and Mlinarič, 2014). The approach is also regarded as advantageous due to its simplicity and its suitability in the case of a value-oriented financing policy with a constant discount rate (Ross et al., 2008, Mielcarz and Mlinarič, 2014) while following a predefined, targeted capital structure (Drukarczyk and Schüler, 2009). In line with the perspective of VBM (section 2.6.1), investors' interests are not jeopardised by over-investing with high purchase prices or under-financing with low equity amounts, in contrast to the FTE approach (Mielcarz and Mlinarič, 2014). However, Mielcarz and Mlinarič (2014) have admitted that project-financed projects are an exception to this rule, since over-averaged debt financing amounts do not increase the financial risk of the investing entity due to their non-recourse finance nature (see above). Another advantage is given for all entity approaches alike by not focusing on the optimal capital structure, i.e., by separating investment decisions from activities in finding the optimal financing structure (Mielcarz and Mlinarič, 2014) and for situations with uncertain tax shield advantages. However, special care must be taken in the case of companies with expenses from allocation to provisions and with low levels of earnings and liquidity, which can lead to inconsistencies with this approach (Drukarczyk and Schüler, 2009).

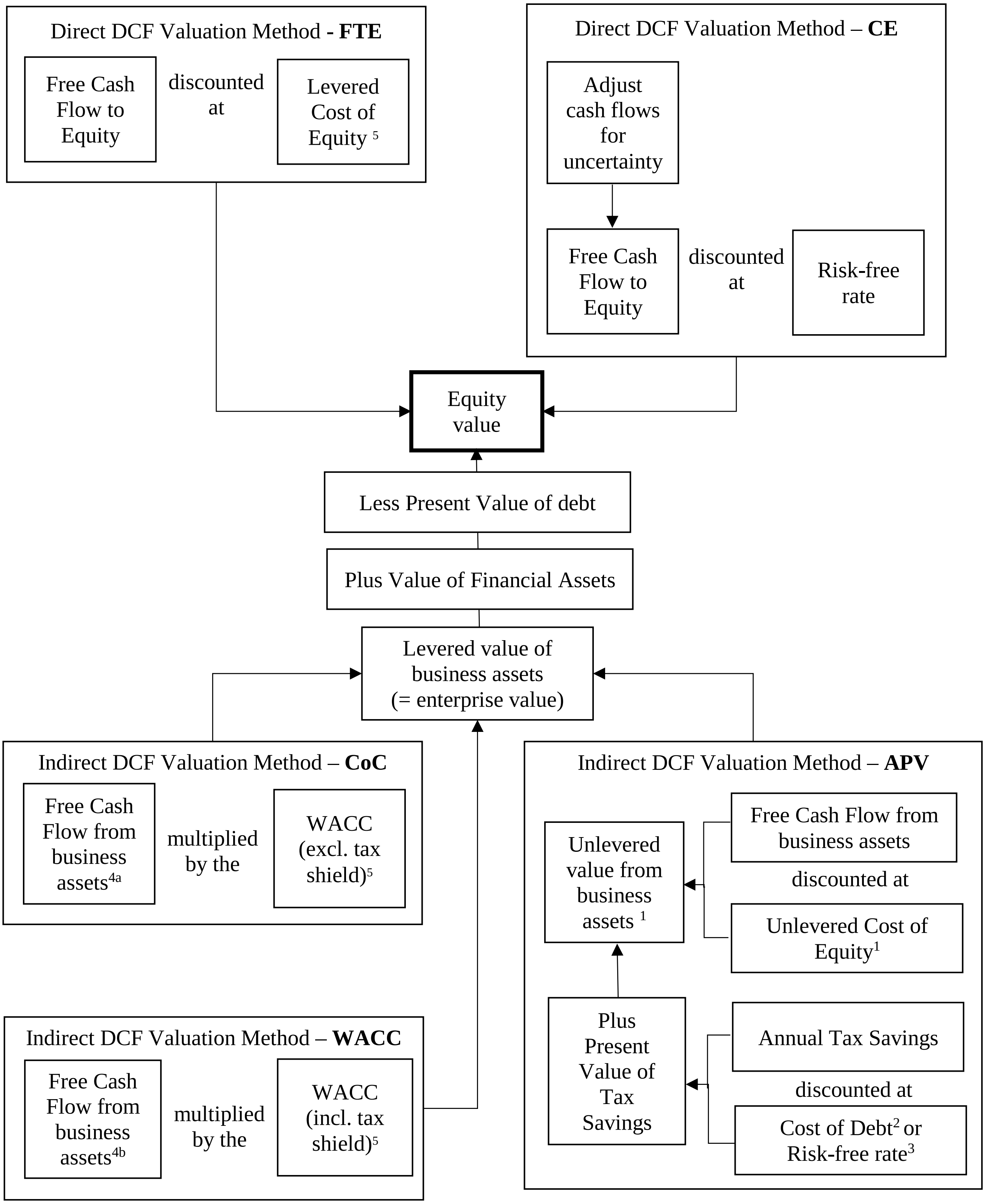
Within the value-oriented financing policy approach, both the debt and equity ratio are determined and fixed, and the r_{WACC} is constant if the cost of equity r_{equity} and the cost of debt r_{debt} are constant in time (Spremann and Ernst, 2011). In case of the autonomous financing approach, the discount rate r_{WACC} is not constant over time, since the equity and debt ratio changes from each considered period to the next. The r_{WACC} must consequently be recalculated from one period to another. Again, the circulation issue must be considered to calculate the PV of the tax shield and the enterprise value for each period in order to able to compute the periodic-specific $r_{WACC,t}$ (Inselbag and Kaufold, 1997). To avoid the application of the cumbersome and impractical iteration processes in practice, the approach falls back on the outcomes of the APV approach (Drukarczyk and Schüler, 2009).

The *CoC approach*, also known as total cash-flow approach, is also an entity approach; it is related to the WACC approach. It has as a similar cash flow perspective, without assuming a fictive all-equity financing, but considering the cash flow streams to both equity and debt providers. In contrast to the WACC approach, it incorporates the tax shield advantages directly within the cash flow projections and applies a WACC without considering the tax shield effects (Drukarczyk and Schüler, 2009, Britzelmaier, 2013). However, Lonergan (2009) has pointed out that pre-tax discount rates on cash flows must be applied with specific caution in order not to make fundamental mistakes. The suitability of this approach is similar to the WACC approach.

Table 9a and Table 9b summarise the above-mentioned findings, while Figure 19 provides an overview of the main previously presented DCF-based valuation models, focusing on determining an equity value. If the presented models are applied consistently, the same outcomes (NPV or IRR) should result (Drukarczyk and Schüler, 2009, Deloitte, 2014, Fernandez, 2015, 2016)—at least theoretically. Therefore, they are called alternatives, differing in the cash flows selected to start the valuation (Fernandez, 2016). However, applying two or more of those methods does not necessarily result in the same outcome (Damodaran, n.d.). Moreover, the inconsistent application of their interchangeable assumptions often leads to the wrong conclusion (Mielcarz and Mlinarič, 2014). Nevertheless, each of those methods must be evaluated in terms of its strengths and weaknesses in valuing a target company or asset. The following concise comparison provides some support in choosing the optimal valuation method:

- There are many who regard the APV approach as the most consistent method for valuing a company with an autonomous financing policy (Kruschwitz and Löffler, 1999, Drukarczyk and Schüler, 2009). To avoid overvaluing assets, it is crucial to also consider the bankruptcy costs, particularly in the case of high leveraged companies. This could create some challenges when applying the APV in practice (Damodaran, n.d.). However, for the valuation of companies with project financing (a typically autonomous financing policy), the APV is the most suitable approach, while bankruptcy costs are less relevant for project-financed companies, which only provide project-specific securities to the debt providers (Mielcarz and Mlinarič, 2014).
- The WACC approach is the optimal choice in the case of a value-oriented financing policy with uncertain tax shield advantages and a predefined target capital structure (Kruschwitz and Löffler, 1999, Drukarczyk and Schüler, 2009).
- The CoC approach for the valuation of companies is also suitable for companies with a value-oriented financing policy, but with more certain tax shield advantages. Bankruptcy cost are directly considered in this approach, and no specific adjustment has to be made, in contrast to the APV approach (Damodaran, n.d.).
- For the application of the equity approach, there are different opinions. Since the APV and the WACC approaches are best suited to both financing policies, the equity approach becomes superfluous, according to Kruschwitz and Löffler (1999). Likewise, Drukarczyk and Schüler (2009) have argued that the equity approach is inappropriate in both autonomous and value-oriented financing policies, since it depends on the APV or WACC approach. Sieben (1995) has still seen some potential in the equity approach in practice when having to make a choice between the WACC and the equity approach for a company valuation with an autonomous financing policy. The exclusive focus on this technique might lead to maximised value with increasing financial risk (uncontrolled debt increase) (Mielcarz and Mlinarič, 2014).

Figure 19: Different valuation models in relation to defining the equity value (adopted from Richter, 1998, Drukarczyk and Schüler, 2009, Hawawini and Viallet, 2011).



[1] The DCF method is applied by assuming that the firm is all-equity-financed; [2] in case of value-oriented financing policy (Miles and Ezzell, 1985); [3] in case of autonomous financing policy (Richter, 1998); [4a] Tax shield is not considered in the *FCF[entity]* of the CoC approach (Drukarczyk and Schüler, 2009); [4b] Tax shield is considered in the *FCF[entity] of the WACC-approach* (Kuhner and Maltry, 2006); [5] Static version or dynamic version with yearly/multi-year adjustment (Deloitte, 2014).

Table 9a: Overview of the various DCF-based methods for the equity/direct approaches to estimate the equity value of an investment (adopted from Hagenloch, 2007, Drukarczyk and Schüler, 2009, Hawawini and Viallet, 2011, Britzelmaier, 2013, Deloitte, 2014, Mielcarz and Mlinarič, 2014).

	Equity / direct approaches	
	FTE	**CE**
Perspective	Exclusively investor's equity capital	Exclusively investor's equity capital
Relevant cash flows	Net free cash flow FCF^{equity}	Certain net free cash flow to equity $cFCF^{equity}$
Discount rates	Cost of equity of a leveraged company as premium for i) investment risk and ii) financial risk	Risk free rate
Consideration of tax shield	Integrated in cash flow analysis	Considered in cash flow analysis, but less relevant due to lower cash flows
Necessary assumptions for constant discount rate	Constant investment risk, constant leverage, no insolvency risk	Constant investment risk, constant leverage, no insolvency risk
Autonomous financing policy	Dynamic, periodic specific equity discount rate $r_{equity,\ v}$ Circulation problems	Apply risk free interest rate r_f
Value-oriented financing policy	Constant equity discount rate $r_{equity,}$ of the whole valuation period Circulation problems	Apply risk free interest rate r_f
Appropriate approach in case of	No particular suitability (although being an adequate valuation approach in case of project finance investment)	Focus on risk and value protection (section 2.4.4.3)
Issues	Exclusive focus on this technique might lead to maximize value with increasing financial risk (uncontrolled debt increase), iterations for both financing policies necessary, bankruptcy costs must be considered particularly for high leveraged companies	Comprehensibility and communicability
Appropriate for RES-E investments	Typical method for pricing in the market, however, by applying a simplistic approach with constant discount rate	Possible, but seldom applied

Table 9b: Overview of the various DCF-based methods for the entity/indirect approaches to estimate the equity value of an investment (adopted from Hagenloch, 2007, Drukarczyk and Schüler, 2009, Hawawini and Viallet, 2011, Britzelmaier, 2013, Deloitte, 2014, Mielcarz and Mlinarič, 2014).

	Entity / indirect approach		
	APV	**WACC**	**CoC / Capital-Cash-Flow**
Perspective	Assuming an all-equity financing (i.e. ignoring debt financing), capital structure is considered separately for tax shield effects	All financing parties perspective, assuming an all-equity financing (i.e. ignoring debt financing),	All financing parties perspective, from both equity and debt provider
Relevant cash flows	Gross free cash flow FCF^{entity}	Gross free cash flow FCF^{entity} without tax deduction	Gross free cash flow FCF^{entity} a (sum of equity, after tax deduction, and debt cash flows)
Discount rates	Cost of equity of unlevered company plus debt financing costs	WACC including tax shield considerations (r_{WACC})	WACC without considering tax effects (r_{CoC})
Consideration of tax shield	Separate analysis by discounting tax saving	Integrated in discount rate	Integrated in cash flow to equity
Necessary assumptions for constant discount rate	Constant investment risk, autonomous financing policy (see below), no insolvency risk	Constant investment risk, constant leverage, no insolvency risk	Constant investment risk, constant leverage, no insolvency risk
Autonomous financing policy	Apply unlevered cost of equity[1] as discount rate and risk free rate r_f for calculating tax shield No restrictions	Dynamic, periodic specific project WACC r_{WACC} Circulation problems	Dynamic, periodic specific CoC r_{CoC} Circulation problems
Value-oriented financing policy	Apply unlevered cost of equity[1] as discount rate and cost of debt r_{debt} for calculating tax shield Circulation problems	Constant project WACC r_{WACC} No restrictions	Constant CoC r_{CoC} No restrictions
Appropriate approach in case of	Autonomous financing policy	Value-oriented financing policy	No particular suitability
Issues	No particular issues (estimating unlevered cost of equity is less common)	Project WACC vs. company WACC in case of big differences in debt/equity structure Risk of inconsistencies in case of companies with expense from allocation to provisions and with low levels of earnings and liquidity	Not commonly known, less accepted by decision makers
Appropriate for RES-E investments	Recommended	Not recommended due to the complexity of applying periodic specific and changing r_{WACC}	Not recommended if calculation of IRR is necessary

[1] The DCF-based method is applied by assuming that the firm is all-equity-financed.

Other types of DCF-based methods that are used to rate and compare investments include the profitability index (PI) and the discounted payback period (DPB). However, these methods are less adequate for estimating the enterprise or equity value; they are often used as key indicators. The PI is the PV of the project's cash inflow per currency unit of its initial investment. It provides a return per currency unit of the investment, which is a relative measure to be able to rank projects. A ratio of 1 is logically the lowest acceptable value, since any measure lower than 1 would indicate that the PV of the project is less than the initial investment. Similar to the IRR, the PI has a limitation for comparing mutually exclusive projects of different sizes; for example, a substantially larger project with a lower PI or lower IRR could add more value to a firm, compared to a smaller project with a higher PI or higher IRR (Baker et al., 2010, Brealey et al., 2011). The DPB measures the time between the initial outlay and the time to recover from the cash inflows using DCF. A project with a shorter recovery period is more attractive due to the lower involved risks (Hawawini and Viallet, 2011). However, the DPB ignores the issue and challenges of valuation with project duration (section 2.3.2). In particular, it erroneously assumes a constant risk also for distant cash flows, even if there is increasing systematic risk due to the duration (Myers and Turnbull, 1977, Cornell, 1999). It also neglects the cash flows after the DPB (Baker et al., 2010, Brealey et al., 2011). If the primary cause of systematic risk is the variation in future expected return rates, then this method is applicable (Cornell, 1999). Since it does not consider the total project profitability, it is not an optimal method for comparing mutually exclusive projects (Baker et al., 2010, Brealey et al., 2011) and for projects with high volatility in cash flows due to systematic risk in case of a long project duration and a correspondingly long DPB (Cornell, 1999).

Apart from the previous discussion on how to consider the different types of risk (unsystematic and systematic, section 2.3.1) in valuation, critics have said that uncertainty in the cash flows cannot explicitly be accounted for (Copeland and Antikarov, 2003). Although possible solutions for considering uncertainty in DCF models exist by incorporating scenario and/or sensitivity analyses or simulations (section 0), or within the proposed CE method (above and section 2.4.4.3), reacting to uncertainty through active decision making cannot be appropriately covered by DCF methods (Leslie and Michaels, 1997, Villiger and Bogdan, 2005). This limitation implies that to use DCF methods, management must take the decision today without being able to make major decisions during the lifetime of the project (Kemna, 1993, Villiger and Bogdan, 2005). However, there are model versions that incorporate uncertainties, such as the expected NPV (eNPV)[28] models (Stewart et al., 2001, Villiger and Bogdan, 2005), which are not elaborated in more depth in this thesis. Moreover, when it is known that different elements of a cash flow are associated with different risks, this circumstance should be reflected by applying different discount rates in the DCF model (Kemna, 1993).

2.4.2.2 The NPV and IRR

The investment appraisal based on DCF is either done by computing the NPV or the IRR, both of which are examined in more detail below.

The calculation of the *NPV* of an investment is based on the time value of money and the risk adjusted future cash flow projections with an appropriate discount rate (Baker et al., 2010, Loderer et al., 2010, Hawawini and Viallet, 2011). It is a quantitative model, ideally to compare different investments (Mauboussin, 2002a). The most straightforward DCF model to calculate the NPV is derived from equation 1 with the following variables: time t, initial investment I_0, net cash inflow[26] CF_t in period *t*, and discount rate *r* (equation 7). The first two variables are known, while the other two must be estimated. For the time being, the discount rate *r* is provided, before discussing it in more detail in sections 2.4.3 and 2.5.

$$NPV = -I_0 + \sum_{t=1}^{\infty} \frac{CF_t}{(1+r)^t} \tag{7}$$

For any given point in time, the cash flow is adjusted with the discount rate *r* for market risk and time value of money. As described above, depending on the financing policy (section 2.4.1.3), *r* can be constant and periodically, specifically adjusted. There is always a pair of inputs: one discount rate and one cash flow for each point per time period (Loderer et al., 2010, Hawawini and Viallet, 2011).

An additional, widely applied DCF method is the *IRR*; it also considers the time value of money (Arnold, 2013). For practical reasons, only one IRR over the whole valuation period is calculated. This method is appropriately applied in the case of the simplified FTE approach, which supposes a constant discount rate, i.e., a constant IRR (Deloitte, 2014). In contrast to the NPV method, the IRR starts the other way around, from the investment amount. The IRR of a project is the rate of return *k* in which the initial investment I_0 equates to the PV of the future net cash inflows CF_t (equation 8). In other words, the IRR is the rate of return at which the NPV is zero (Arnold, 2013) (equation 9).

$$I_0 = \frac{CF_1}{1+k} + \frac{CF_2}{(1+k)^2} + \frac{CF_3}{(1+k)^3} \dots . \frac{CF_t}{(1+k)^t} \tag{8}$$

$$NPV = -I_0 + \frac{CF_1}{1+k} + \frac{CF_2}{(1+k)^2} + \frac{CF_3}{(1+k)^3} \dots . \frac{CF_t}{(1+k)^t} = 0 \tag{9}$$

If the IRR exceeds the required return rate for a project, or a hurdle rate (section 2.4.3), i.e., the opportunity costs of investors' funds, then the project should be accepted (Baker et al., 2010, Arnold, 2013). If the NPV is the main result of the valuation, then an implied IRR can be calculated, provided that the valuation methodology is consistent for the applied investment and the application of a constant return rate can be applied (Espinoza and Morris, 2013, Damodaran, 2017).

The NPV is ideally used to compare different investments (Mauboussin, 2002a, Arnold, 2013), and it is regarded as better suited than the IRR, which has some limitations and drawbacks (Table 10) in some specific circumstances (Baker et al., 2010, Arnold, 2013, Ehrhardt and Brigham, 2016), such as the following:

- an unacceptable situation of receiving multiple solutions while computing the IRR in case of cash flow projections with unconventional cash flows, for example, outflows followed by a series of inflows and vice versa (Arnold, 2013);

- a misleading ranking of mutually exclusive projects with different sizes—for example, a substantially larger project with a lower IRR but higher NPV could add more value to a firm, compared to a smaller project with a higher IRR but lower NPV (Baker et al., 2010, Osborne, 2010, Ehrhardt and Brigham, 2016)—and with different shapes between the relation of NPV versus discount rates and different IRRs. Ranking projects in terms of their IRRs is constant, whereas the ranking of projects by their NPV is not fixed, since they depend on the applied discount rate (Figure 20) (Arnold, 2013);
- the possibility of misinterpretation in cases of financing-type decisions, in contrast to investment-type decisions (Arnold, 2013);
- biases due to intra-periodic cash flows being reinvested at the same rate of IRR rather than the often lower and more realistic opportunity CoC or going concern rate (Arnold, 2013); and
- the drawback of not being able to sum up the IRR of various projects in a portfolio, in contrast to the NPV of each project (Arnold, 2013).

Despite the reported limitations, the IRR approach continues to enjoy great appreciation in capital budgeting processes (e.g. Bröer and Däumler, 1986, Pike, 1996, Arnold and Hatzopoulos, 2000, Graham and Harvey, 2001, Brounen et al., 2004). Modern computers with easily applicable spreadsheet programmes provide additional support for calculating the IRR, which is usually more difficult to compute manually than the NPV (Arnold, 2013). Some of the reasons for the IRR's high popularity are as follows:

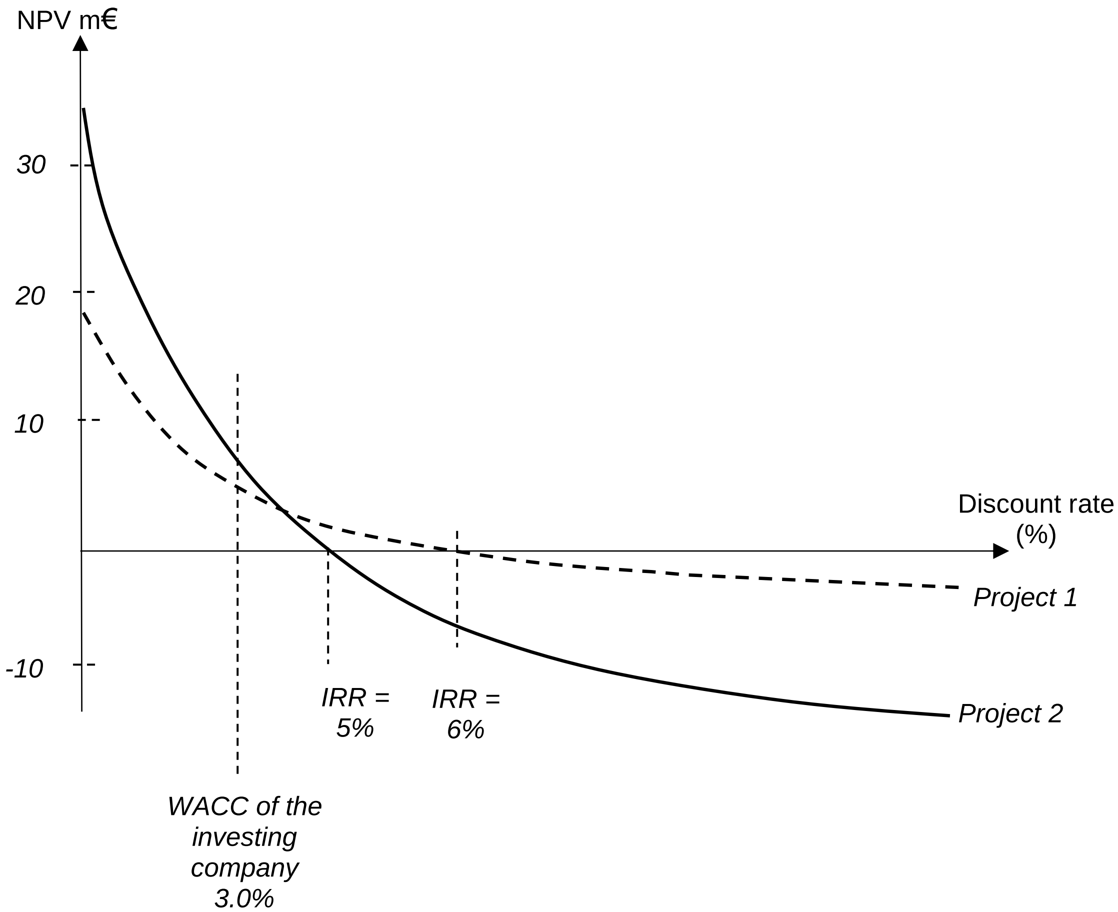
- From a psychological point of view, percentages (for example, an IRR of 9%) can be more easily grasped than an absolute amount of an NPV (for example, 100,000 EUR) (Arnold, 2013).
- For the calculation of the IRR, no predefined required return rate is necessary, in contrast to the NPV approach for which the required return rate is essential. Not knowing the required return rate might be done on purpose. The senior manager might not communicate it before seeing the IRR result to avoid bias in valuation processes. This danger always exists, since humans naturally try to reach their personal goals; for example, by trying to adjust the cash flow projection of the targeted investment to match the required return rate (Arnold, 2013).
- The issue with the ranking of IRR (see above and Table 10) results might not be known by some managers, erroneously believing that ranking the projects based on their IRRs is an accurate and straightforward process (Arnold, 2013).
- Practitioners appreciate the IRR method, since it is a straightforward approach to compare investments in market dynamics and price negotiations (Deloitte, 2014).

These above-mentioned disadvantages and limitations of the IRR method have only been found for the NPV approach with regard to potential biases due the involved assumption of reinvesting the intra-periodic cash flows at the same discount rate applied in the NPV calculation, particularly in case of discount rates lower or higher than the CoC of the investment company (Table 10). Therefore, the NPV approach is the theoretically dominant method as well as the best method with regard to maximising shareholder value while valuating investment projects. However, the application of the NPV method requires profound research, understanding, and thought (Arnold, 2013). Therefore, the communication of a project's viability is often still done in terms of percentages (Arnold, 2013). However, some of the IRR's limitations can also be solved, including the application of an NPV versus discount rate relationship diagram. In doing so, mutually exclusive projects (Figure 20) can be discussed with regard to their influence on the NPVs in relation to the projects' IRRs while maximising investors and company value. As another alternative, the modified IRR (MIRR) approach is a more realistic approach to reinvesting intra-periodic cash flows with the opportunity CoC instead of the higher, unrealistic IRR (Kierulff, 2008, Arnold, 2013). These limitations of the IRR method and the preferred type of communication with percentages is probably the reason larger organisations do not rely solely on one valuation approach for analysis and communication (Arnold, 2013).

Table 10: The NPV vs. the IRR—characteristics, limitations, drawbacks, and theoretical dominance (adopted from Kierulff, 2008, Arnold, 2013).

NPV	**IRR**
▪ Considers the time value of money	▪ Considers the time value of money
▪ In cases of the non-mutual exclusivity of projects (all projects can be accepted), all projects with a positive NPV should be accepted to maximise shareholder value.	▪ In cases of the non-mutual exclusivity of projects (all projects can be accepted), all projects with an IRR higher than the opportunity CoC or a set hurdle rate can be accepted to maximise shareholder value.
▪ Handling of non-conventional cash flows.	▪ Multiple solutions due to unconventional cash flows (i.e. outflows followed by a series of inflows or vice versa)
▪ In the case of mutually exclusive investment projects, the ranking of various projects based on absolute amounts leads to better decisions, since the NPV depends on the applied discount rate, and as an absolute amount, it is more meaningful as a percentage.	▪ In the case of mutually exclusive investment projects, the ranking of various projects with respect to different project sizes or different ages based on percentages can lead to wrong decisions → solution: present graph with NPV vs. discount rate (IRR)
▪ Takes into account the scale of investment (theoretical dominance of NPV approach).	▪ Does not take into account the scale of investment
▪ Additivity of NPV of different projects is possible, e.g. in case of acquiring a portfolio of projects	▪ No additivity of IRR of different projects is possible
▪ Both investing- and financing-type decisions can be performed with NPV	▪ Financing-type decisions can result in wrong interpretations of IRR results
▪ Biases due to intra-periodic cash inflows to be reinvested at the same discount rate applied for the NPV calculation until the end of a project's life (reasonable assumption in case of applied discount rate is similar to the CoC of the investing company, but unrealistic assumption when the applied discount rate is higher or lower than the CoC of the investing company)	▪ Biases due to intra-periodic cash inflows to be reinvested at the same rate of IRR until the end of a project's life (problematic with particularly high IRR, an unacceptable assumption) → solution: apply MIRR approach.

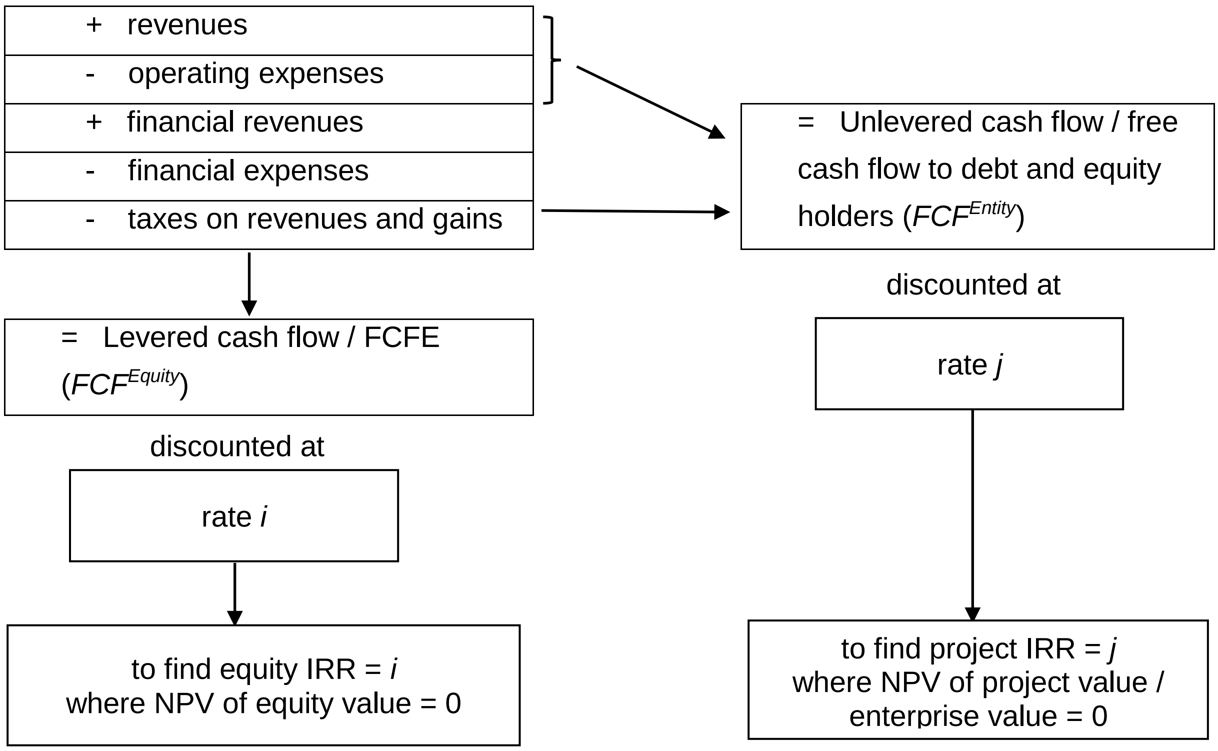
Figure 20: The NPV vs. the discount rate relationship diagram, applied to discuss and rank mutually exclusive projects (adopted from Arnold, 2013).



From another perspective, DCF methods for project valuations distinguish between *equity IRR* or equity return rate, discounting the free cash flow to equity (*FCF*^{Equity}), and *project IRR* or project return rate, discounting the free cash flows to firm or entity (*FCF*^{Entity}), i.e., discounting all cash flow streams to debt and equity holders (Figure 21, see section 2.4.1.2). The project IRR corresponds to the discount rate applied in discounting the EBIDA streams to reach the enterprise value.

As mentioned in section 2.4.1.2, the equity IRR or equity NPV can also be based on the forecasted distributable cash flows to the equity investors (Output IRR or Output NPV), which considers distribution restrictions.

Figure 21: Equity IRR and project IRR calculation (author's own illustration).



2.4.2.3 Non-DCF-based Methods

Non-DCF methods remain popular due their simplicity and their focus on risk (Baker et al., 2010, Brealey et al., 2011), although they are regarded as less sophisticated, and they have receive less positive recommendations for application from the capital budgeting theory (Mielcarz and Mlinarič, 2014).

As with DPB, the *PB* looks at the time to recover its initial investment without discounting cash flows, and it is characterised by its advantage to focus on risk. The shortcomings are similar to DPB in that the deficiencies do not take into consideration the total project return while failing to consider the time value of money (Baker et al., 2010, Brealey et al., 2011).

The *accounting rate of return* (ARR) methods divide the average annual incremental accounting profit by the initial investment—either capital, equity, or assets—to obtain the expected ratio: either the return on capital (ROC), the return on equity (ROE), or the return on assets (ROA). All are based on accounting information and are therefore also known as book rates of return (Solomon, 1963, Brealey et al., 2011). The ARR is a straightforward method; however, again, it fails to consider the time value of money and the cash flows instead of the accounting profit, since firms cannot reinvest accounting profits (Baker et al., 2010). Moreover, some relevant, intangible assets might not be considered in the accounting statements (Brealey et al., 2011).

Another simple non-DCF method is the *multiple approach* (MA) or valuation by comparables (Drukarczyk and Schüler, 2009, Koller et al., 2015). Such market-price-oriented approaches are based on the principles of the law of one price (Berk and DeMarzo, 2011) and of making comparision with other similar investments (Moxter, 1983)[29]. The MA assumes that a ratio comparing value to some firm-specific variable (such as operating margins, cash flow, or production output) is the same across similar firms based on the comparative company approach (Popp, 2012) to compute earnings, book value, EBITDA, or revenue multiples (Lewis et al., 1994, Drukarczyk and Schüler, 2009, Hawawini and Viallet, 2011). For example, in the EBITDA MA, the enterprise value is calculated by multiplying the average EBITDA by the selected or defined EBITDA multiple. The equity value can be similarly computed with one of the equity MAs, such as earnings, cash flows, and book value. On the other hand, for RES-E projects, the ratio between the investment value divided by the annual energy production is a widely accepted MA. As a starting point, to apply any of the available MAs, the affiliation to a peer group must be defined. According to Ballwieser and Hachmeister (2013), companies must be similar or equal to each other at least in terms of the following:

- Sector or markets
- Lifecycle of company
- Ownership structure
- Size
- General conditions regarding research and development, production, and sale
- Financial structure
- Regulatory obligations

This trivial approach is often a first step in the valuation process to compare different investments (Brealey et al., 2011). Advocates of this method believe that this approach is performed faster than the DCF method. However, MAs may be only apparently true (Ballwieser and Hachmeister, 2013), since the choice of the right peer companies can lead to insurmountable difficulties; for example, how to consider outliers or how to deal with the lower fungibility in the case of an NTA when having to compare it to a group of PTCs with accessible data (Loßagk, 2014). In addition, MAs have serious disadvantages in performing sensitivity analyses to determine the relevant value drivers. This ability is a powerful technique of all DCF-based methods (Hawawini and Viallet, 2011) (section 2.4.2.1).

2.4.2.4 Real Option Valuation

Although the focus of this research is not on RES-E projects with high uncertainties, such as projects in the development phase or highly leveraged firms with corporate loans[30], this topic is still discussed at this stage to provide a full picture of possible valuation approaches for RES-E projects. Regardless of adjustment possibilities in the DCF models (section 2.3.3.1), for modelling higher uncertainties, the ROV models are better suited (Amram and Kulatilaka, 1999, Villiger and Bogdan, 2005), as introduced by Myers (1977). Real option[31] valuation depicts active decision making better than DCF models (Villiger and Bogdan, 2005, Regan et al., 2015), since models based on DCFs do not assign a value to flexibility (Leslie and Michaels, 1997). Since it is almost impossible to define the correct discount rate for projects with high uncertainties and with option-like characteristics, ROVs are based on option pricing considerations (Gilbert, 2004, Loderer et al., 2010) on the basis of the model of

Black and Scholes (1973). The Black-Scholes model is regarded as one of the most effective approaches to assess the value of a bet or an insurance policy based on stock exchange data (McNulty et al., 2002). From a practitioner's point of view, some authors (Copeland and Weiner, 1990, Dixit and Pindyck, 1995) have also been convinced that the use of the options methodology offers managers a better handle on uncertainty.[32] This rather complex method necessitates corresponding knowledge and experience to be able to make appropriate decisions. Incorrect application of ROV modelling could have severe effects on investment decisions (Collan et al., 2016).

Real option valuation seems to be particularly suitable for earlier phases of RES-E projects in which management still has a greater scope of action (Loderer et al., 2010), in contrast to the limited scope of action in the operating phase (section 1.2), and incomplete major milestones in the development phase can be fatal for the whole project. Conventional valuation models typically do not capture the flexibility provided by an option (Brennan and Trigeorgis, 2000); for example, whether to receive a building and operating permit. As there are different ROV approaches, divided into six types (Hommel and Pritsch, 1998, Vintila, 2007), the so-called abandonment option (Myers and Majd, 1990, Williams, 1991, Trigeorgis, 1993, Berger et al., 1996, Trigeorgis, 1996) seems to be an appropriate valuation approach for RES-E projects with higher uncertainties, giving the option holders the right to withdraw from the project if it becomes unprofitable. However, since many RES-E projects in operation are structured in line with project financing requirements (Steffen, 2018), they are only debt financed if incentives to abandon the project are made impossible or limited and if a corresponding bet on the future value of RES-E projects with the favourable probability to win more than to lose is not facilitated (Böttcher and Blattner, 2010). As a consequence the downside risk in operating project-financed projects for equity holders is typically higher than the opportunities to be gained. Having outlined these points, ROV is less beneficial and hence DCF-based methods are preferred for operating RES-E projects with lower uncertainties.

The usability of ROV is also limited due to a lack of confidence in the underlying assumption of many managers as well as the increased complexity of its calculation (Miller and Park, 2002, Damodaran, 2005b, Hartmann and Hassan, 2006, Shockley, 2007, Csapi, 2013). Furthermore, there is no standard ROV model—there are many different models criticising each other (Damodaran, 2005b). Although simpler methods (Mathews et al., 2007, Collan et al., 2009) have recently been suggested, ROV is still not a widely accepted framework in practical business life (Hartmann and Hassan, 2006). Moreover, rather than a competing methodology, in most cases, ROV is a complementary technique to the DCF methodology, since DCF values the underlying asset (Kemna, 1993, Brealey et al., 2011).

In addition, an interesting option-based model is presented in section 2.5.1 in order to determine the CoC based on future volatility expectations.

Table 11 summarises the academic literature on capital budgeting methods. It evaluates them in relation to handling uncertainties, active decision making, and the corresponding survey research that demonstrates its usage amongst practitioners. Furthermore, an indication of its relevance for RES-E investments in practice is provided.

Table 11: Available approaches in capital budgeting processes as suggested by financial theory (T) and according to empirical surveys (S) among practitioners, certain key features and their supposed applicability for RES-E investments (X: applicable, (X): more or less applicable / only in combination with other methods, - not applicable.

Methods	Characterisation: Incorporation of uncertainty	Characterisation: Active decision making	Applicability for RES-E investments	Empirical surveys (S) among practitioners
Theoretical foundation available				
NPV	(X)	-	X	Robichek and MacDonald (1966), Klammer (1972), Petty et al. (1975), Gitman and Forrester Jr (1977), Oblak and Helm Jr (1980), Pike (1983), Kim et al. (1984), Stanley and Block (1984), Bröer and Däumler (1986), Gitman and Maxwell (1987), Reichert et al. (1988), Brunwasser and McGowan (1989), Bierman (1993), Sangster (1993), Gilbert and Reichert (1995), Pike (1996), Shao and Shao (1996), Burns and Walker (1997), Kester et al. (1999), Arnold and Hatzopoulos (2000), Graham and Harvey (2001), Ryan and Ryan (2002), Brounen et al. (2004, 2006), Truong et al. (2008), Baker et al. (2009)
IRR	-	-	X	Christy (1966), Robichek and MacDonald (1966), Klammer (1972), Fremgen (1973), Petty et al. (1975), Gitman and Forrester Jr (1977), Schall et al. (1978), Oblak and Helm Jr (1980), Moore and Reichert (1983), Pike (1983), Kim et al. (1984), Stanley and Block (1984), Gitman and Maxwell (1987), Brunwasser and McGowan (1989), Bierman (1993), Sangster (1993), Gilbert and Reichert (1995), Pike (1996), Shao and Shao (1996), Burns and Walker (1997), Kester et al. (1999), Arnold and Hatzopoulos (2000), Ryan and Ryan (2002), Truong et al. (2008), Baker et al. (2009)
PI	-	-	-	Istvan (1961), Klammer (1972), Burns and Walker (1997), Ryan and Ryan (2002), Brounen et al. (2004), Baker et al. (2009) Truong et al. (2008)
DPB	-	-	(X)	Ryan and Ryan (2002), Brounen et al. (2004), Baker et al. (2009)
APV	-	X	(X)[1]	Truong et al. (2008)
ARR	-	-	-	Istvan (1961), Christy (1966), Robichek and MacDonald (1966), Klammer (1972), Fremgen (1973), Petty et al. (1975), Gitman and Forrester Jr (1977), Schall et al. (1978), Oblak and Helm Jr (1980), Moore and Reichert (1983), Pike (1983), Stanley and Block (1984), Gitman and Maxwell (1987), Reichert et al. (1988), Brunwasser and McGowan (1989), Bierman (1993), Sangster (1993), Gilbert and Reichert (1995), Pike (1996), Shao and Shao (1996), Burns and Walker (1997), (Kester et al., 1999), Arnold and Hatzopoulos (2000), Ryan and Ryan (2002), Truong et al. (2008), Baker et al. (2009)
ROV	X	X	X[2]	Graham and Harvey (2001), Ryan and Ryan (2002), Block (2003), Brounen et al. (2004, 2006), Truong et al. (2008), Baker et al. (2009)

Table 11: (continued).

Methods	**Characterisation**		**Applicability for RES-E investments**	**Empirical surveys (S) among practitioners**
	Incorporation of uncertainty	**Active decision making**		
Rule of thumb or no (profound) theoretical foundation available				
PB	-	-	(X)	Istvan (1961), Christy (1966), Robichek and MacDonald (1966), Klammer (1972), Fremgen (1973), Petty et al. (1975), Gitman and Forrester Jr (1977), Schall et al. (1978), Oblak and Helm Jr (1980), Moore and Reichert (1983), Pike (1983), Kim et al. (1984), Stanley and Block (1984), Reichert et al. (1988), Brunwasser and McGowan (1989), Bierman (1993), Sangster (1993), Gilbert and Reichert (1995), Pike (1996), Shao and Shao (1996), Burns and Walker (1997), Kester et al. (1999), Arnold and Hatzopoulos (2000), Ryan and Ryan (2002), Truong et al. (2008), Baker et al. (2009)
MA	-	-	(X)	Graham and Harvey (2001), Brounen et al. (2004, 2006)

[1] Suitable for RES-E projects which change the capital structure over the project life time.

[2] Optimal method for valuation of projects within high-risk environments, such as the development and refurbishing/repowering phase or for highly leveraged firm with corporate loans, however less optimal for evaluating projects in low-risk environments, e.g. the building and operating phase and/or project financing structures, since is is too complex.

T: Theory, e.g., Brealey et al. (2011), Hawawini and Viallet (2011).

2.4.3 Basics of CoC Approaches

Cost of capital (CoC) has been introduced several times in the previous sections in the form of interest rates or discount rates. In this section, its basics are presented before discussing CoC determination techniques in section 2.5.

2.4.3.1 Opportunity Costs and Equivalent Principle

The discount rate corresponds to finance mathematical terms in the context of a PV calculation as the interest (price) of an alternative investment with the same risk profile (Locarek-Junge, 1997, Arnold, 2013). Alternatively, the CoC is understood as the 'expected return rate' (Kruschwitz and Löffler, 2006:5), which a project, business division, or company must offer investors to provide them with incentives to invest or buy and hold a financial security and, at the same time, to dissuade them from investing in an alternative investment with a similar risk (Arnold, 2013) to the return of an investment that provides future cash flows in the same expected height and corresponding risk (Spremann and Ernst, 2011). Having said that, the CoC is also expressed as the opportunity cost in terms of a lost alternative investment and missed return (Laitenberger, 2006) with the same risk (Koller et al., 2015). According to Pratt and Niculita (2008:181),

> 'A present value discount rate is an 'opportunity cost', that is, the expected rate of return (or yield) that an investor would have to give up by investing in the subject investment instead of investing in available alternative investments that are comparable'.

The concept of opportunity costs of capital is only applicable if the principle of equivalence and correspondingly five criteria are considered, in which the investment object must be comparable with the alternative investment (Moxter, 1983, Kuhner and Maltry, 2006, Arnold, 2013), including:

- Term (life span of investment project)
- Work input in case the investor must become active in the acquired investment
- Fungibility (risk of reselling share or transferability of shares)
- Purchase power (homogeneity of purchase power in relation to size and market power)
- Risk

The risk equivalence of the alternative investment is probably the most crucial issue, also because of the wide disagreement regarding the applied methods of risk measurement (Kuhner and Maltry, 2006) (section 2.3.3.1). In addition, equivalence in taxing, distribution, and currency must be considered. The return rate of an alternative investment that complies with the stated criteria of principles of equivalence is theoretically the correct one if the found return rate is regarded as a deterministic and constant input variable for the valuation of the complete project's lifetime in order to avoid random valuation results (Laitenberger, 2006). In practice, finding such a comparable alternative investment is challenging, if not impossible in certain cases.

2.4.3.2 Weighted Average Cost of Capital

As outlined above, firms need to provide returns to their investors. First, assuming an all-equity financed firm with this sole financial source as its optimal capital structure, the required rate of return applied in valuing investments would be the expected rate of return demanded by its shareholders (Tijdhof, 2007a). However, this is only if the valued investment has the same level of risk as the existing portfolio of projects and businesses (Arnold, 2013). In reality, the situation is usually more complicated, considering the different possible sources of financing of companies. Since firms use a wide range of long-term financing sources, including equity, preferred stocks, bonds, and bank credits, they view the CoC as a weighted average of each source (Brigham and Ehrhardt, 2008, Arnold, 2013). The solution is the WACC, which defines the minimum return rate to perform investments in order to generate enough returns to meet the requirements of the lenders, while leaving enough to satisfy the return expectations of shareholders (Arnold, 2013). Examining the equation of the WACC, an apparently simple solution to increase value would be to lower the WACC by increasing the debt portion, i.e., increasing the financial gearing (used in the UK) or leverage (used in the US). As such, the returns to the shareholders would be increased. This raises the following question: why do managers not apply this method systematically? An answer has been given by the early work of Modigliani and Miller (1958): in the case of a perfect capital market, increasing the debt to increase shareholder value, the return of equity would exactly offset the effect of the higher debt portion, leaving the WACC at a constant rate. From this perspective, there would be no optimal capital structure that maximises shareholder value (Arnold, 2013). As we know today, this approach does not completely consider all relevant aspects, since Modigliani and Milller have downplayed at least two essential parameters: the effect of tax benefits and financial distress (Drukarczyk and Schüler, 2009, Arnold, 2013).

- Tax benefits must be considered in the case of a profitable company that pays taxes and operates in countries that allow interest expenses to be deducted from taxes, as outlined in equation 10 below. This is known as the *tax shield* (sections 2.4.1.3 and 2.4.2.1), which reduces the WACC and correspondingly leads to an increase of available cash flows for the shareholders, since the debt holders still receive the agreed flows for the contractual debt service.
- Tax benefits increase the incentive of introducing high gearing and reaching a higher value. However, this increases the risk, particularly for the equity providers, because of financial distress, which eventually ends in a liquidation. This increases the probability of the equity providers receiving less or no return. As a consequence, the equity providers demand higher return rates to compensate for this higher risk. (Figure 22).

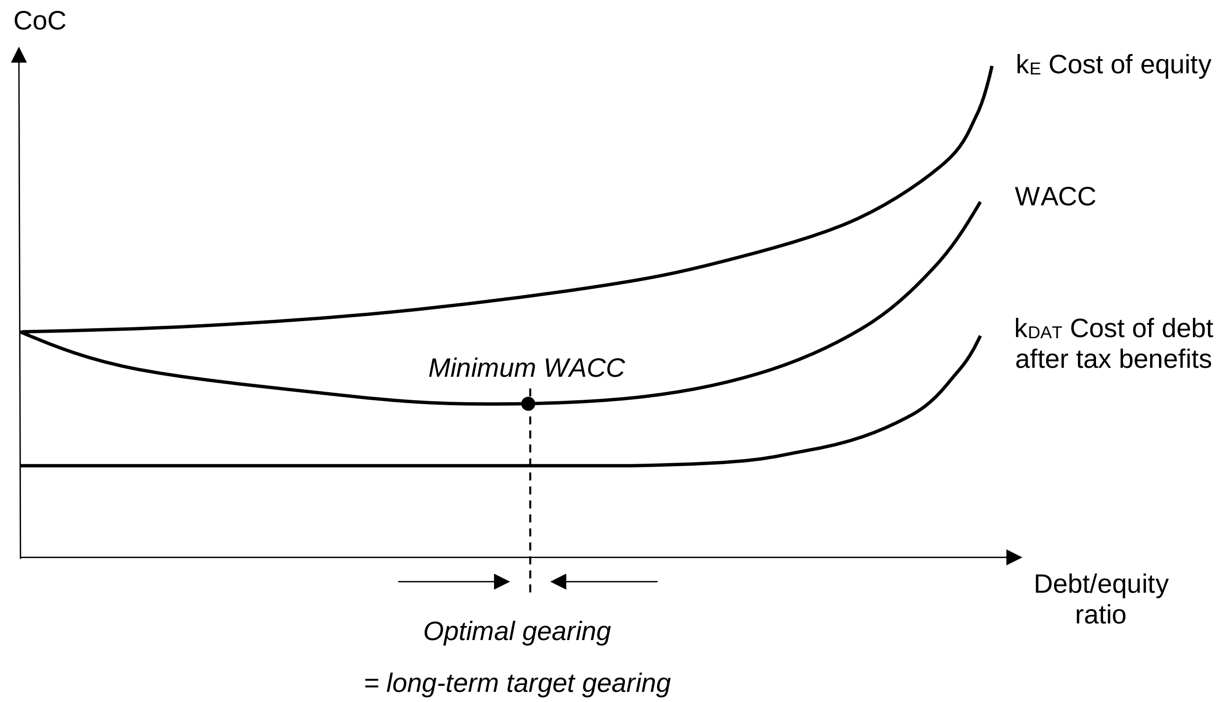
Based on the seminal works of Modigliani and Miller (1958, 1963), the WACC is described with following equation 10, with the corporation tax rate *T*, amount of debt *D*, amount of equity *E*, cost of debt r_D, cost of equity r_E, and the sum of debt and equity *V* (Arnold, 2013), i.e., the WACC directly considers the tax shield (Mielcarz and Mlinarič, 2014):

$$WACC = (1 - T)\left(\frac{D}{V} r_D\right) + \left(\frac{E}{V} r_E\right) \quad (10)$$

Financial theory propagates that a firm's target capital structure should be reflected in the WACC, considering a capital structure both minimising its WACC (Figure 22) and maximising firm value (Brigham and Ehrhardt, 2008, Arnold, 2013, Mielcarz and Mlinarič, 2014), and in the long-term debt/equity ratio, instead of the gearing of the time of calculation (Arnold, 2013). Having said that, the WACC is periodically adjusted and not constant over time (Tijdhof, 2007b). Within firms, the WACC[33] is used for many reasons. In most cases, it is used for defining the hurdle rate (section 2.4.3.3) in capital budgeting processes and, while doing so, as the discount rate in DCF-based valuation methods, which simultaneously consider the time value of money (Robichek and Myers, 1966). It is also used as a benchmark for compensation plans or for determining the firm's target capital structure (Baker et al., 2010). This *post-tax WACC* is applied to cash flows after deducting the taxes (Tijdhof, 2007c, Lonergan, 2009, Arnold, 2013). The alternative *pre-tax WACC* is derived from the post-WACC by dividing it by one minus the corporation tax rate (Tijdhof, 2007c, Arnold, 2013). This pre-tax WACC can be applied for discounting cash flows before making a tax deduction (Tijdhof, 2007c, Lonergan, 2009) or for the CoC approach (section 2.4.2.1).[34]

Various international empirical studies (e.g. Arnold and Hatzopoulos, 2000, Ryan and Ryan, 2002, McLaney et al., 2004, Block, 2005, Hermes et al., 2007, Truong et al., 2008) have demonstrated that the majority of surveyed companies apply the WACC as the relevant CoC approach.

Figure 22: The CoC in relation to different capital structures, considering tax shield and financial distress (adopted from Brigham and Ehrhardt, 2008, Arnold, 2013, Mielcarz and Mlinarič, 2014).



2.4.3.3 Hurdle Rate Approach

In the case of investment projects with different risk profiles than the firm or the corresponding division, the firm's or division's WACC[35] is not the appropriate key figure for this project. Instead, a specific hurdle, cut-off, or benchmark rate for this project should be applied. This rate is either the minimum rate of return that a firm or division expects to earn when investing in a project or the opportunity cost that is forgone by not investing in the capital market (Brigham, 1975, Hawawini and Viallet, 2011). This also means that the actual costs of financing the project are not a suitable benchmark (Brigham and Ehrhardt, 2008; Baker et al. 2010). Multiple hurdle rates must be specifically defined for different business fields and types of investments, and then periodically adjusted (Krueger et al., 2015). Theory has stated that only when an investment project has the same equity and debt structure as the investing company itself and is of average risk for the investing company, should the hurdle rate for this project equal the firm's WACC to add value to the company (Harris and Pringle, 1985, Brigham and Ehrhardt, 2008). Moreover, applying hurdle rates also excludes possible arbitrariness in a capital budget analysis due to different proportions of equity and debt in investments or cheaper debt for specific projects (Baker et al. 2010). In light of the above considerations, it can be concluded that projects with higher overall risks need to deliver a higher return and must therefore comply with a higher hurdle rate to compensate for adopting riskier projects (Baker et al., 2010, Brealey et al., 2011, Hawawini and Viallet, 2011). An appropriate risk-adjusted allocation of capital for investments within firms consequently demands either multiple hurdle rates—one for each division in case of different risk levels (Ehrhardt, 2001)—or separate hurdle rates for each individual project (Weston, 1973, Harris and Pringle, 1985). For nonfinancial executives, not discounting with own CoC is not easily explained and understood, while internal organisational processes also support the use of multiple hurdle discount rates (Krueger et al., 2015). In practice, various approaches to determine and apply hurdle rates are employed[36], as presented in Table 12, which provides an indication of their relevance for RES-E investments.

Table 12: Available approaches to determine or apply hurdle rates as suggested by financial theory (T) and according to empirical surveys (S) among practitioners and their supposed applicability for RES-E investments (X: applicable, (X): more or less applicable / only in combination with other methods, - not applicable).

Definition and application of hurdle rates or discount rates	**Evidence in theory/ surveys**	**Applicability**		**Empirical surveys (S) among practitioners**
		in practice	**for RES-E investments**	
The discount rate for the entire company / WACC	T/S	X	(X)	Petty et al. (1975), Gitman and Mercurio (1982), Bierman (1993), Bruner et al. (1998), Payne et al. (1999), Gitman and Vandenberg (2000), Graham and Harvey (2001), Brounen et al. (2004), da Silva Bastos and Martins (2007)
A specific discount rate for the considered country (country discount rate)	S	X	X	Graham and Harvey (2001), Brounen et al. (2004)
A specific discount rate for the applied technology / concerned industry	S	X	X	Graham and Harvey (2001), Brounen et al. (2004)
A specific discount rate for the concerned project stage (e.g. planning/designing, financing, building, operating)	- [1]	-	X	-
A divisional discount rate	S	X	X	Graham and Harvey (2001), Block (2003), Brounen et al. (2004)
A RADR for this particular project	T/S	X	X	Petty et al. (1975), Gitman and Mercurio (1982), Graham and Harvey (2001), Brounen et al. (2004)
A discount rate based on the cost of financing the project	S	X	-	Gitman and Mercurio (1982), Payne et al. (1999), Gitman and Vandenberg (2000)
A discount rate based on the firm's past experience	S	X	X	Payne et al. (1999)
A different discount rate for each component cash flow that has a different risk characteristic (e.g. depreciation vs. operating cash flow vs debt service reserve account)	T/S	X	X	Graham and Harvey (2001), Brounen et al. (2004)
Discount rates are at least as high as defined hurdle rates	T/S	X	X	Graham and Harvey (2001), Brounen et al. (2004, 2006), Baker et al. (2010), Brealey et al. (2011)
CE method: discount rate at least as high as the Risk-free rate	T/S	X	X	Petty et al. (1975), Gitman and Mercurio (1982), Gitman and Vandenberg (2000), Graham and Harvey (2001), Brounen et al. (2004)

[1] No evidence found in literature (based on author's own experience).
T: Theory, e.g., Kemna (1993), Brealey et al. (2011), Hawawini and Viallet (2011).

2.4.3.4 Discount Rate, Risk, and Time Value of Money

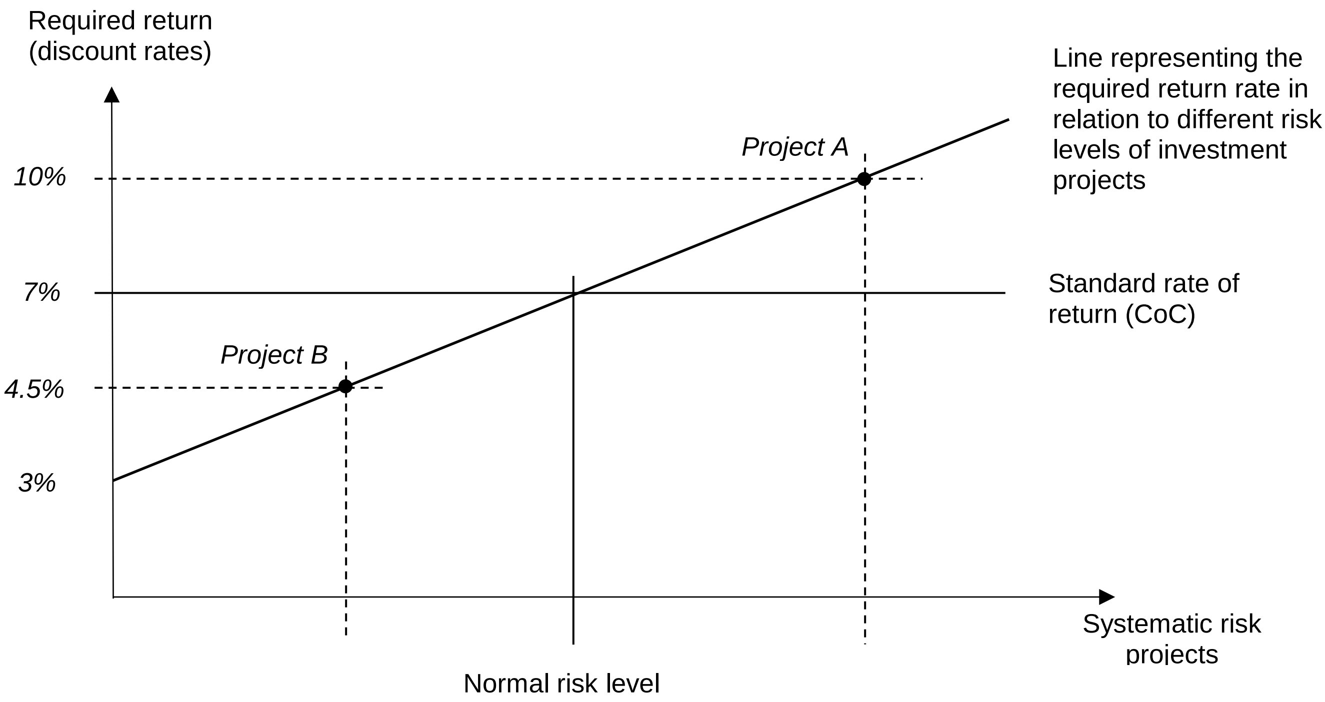
The applied discount rate in DCF-based valuations as a single variable for the time value of money as well as risk does not properly consider the nature of both variables, as outlined by Robichek and Myers (1966, 1968). Risk (section 2.2.3) and the time value of money (section 2.4.1.1) are clearly, inevitably interrelated; however, as confronted, they should be separately considered as much as possible within valuation analyses (Robichek and Myers, 1966, Zeckhauser and Viscusi, 2008, Espinoza and Morris, 2013). A possible solution to this issue is provided by the CE method (section 2.4.3.3), the DNPV approach (section 2.4.4.4), and the discussed financial-risk performance concept (section 2.4.4.2).

2.4.4 Risk Treatment within Valuations

2.4.4.1 Risk-Adjusted Discount Rates

Investing in riskier projects will eventually increase the WACC of the investing firm and reduce its value, since its investors will also demand higher returns for taking higher risks. As a consequence and to avoid the misallocation of capital within firms by using single hurdle rates, finance theory proposes using project-specific risk-adjusted discount rates (RADRs), while considering project-specific risk components (section 2.3.2) for investments that can change a firm's WACC, and enabling an optimal comparison of mutually exclusive projects (Weston, 1973, Fuller and Kerr, 1981, Butler and Schachter, 1989, Titman and Martin, 2008, Loderer et al., 2010, Ehrhardt and Brigham, 2016).

Figure 23: Illustration of RADR concept in case of an all-equity financed company[37] (adopted from Arnold, 2013).



The RADR concept is illustrated in Figure 23, demonstrating a project A with higher risk than the normal level that should only be accepted with a higher return rate, while project B, with a lower risk-level, can be discounted at lower discount rates that would otherwise be rejected at normal risk and return levels (Arnold, 2013). The RADR concept enjoys higher popularity due to its acceptance by financial decision makers and its simplicity in application (Ryan and Gallagher, 2006, Ehrhardt and Brigham, 2016).

Although the RADR has been promoted by significant academic researchers (Ariel, 1998, Froot and Stein, 1998, Santiago and Vakili, 2005), several drawbacks have been encountered in the RADR method, such as the following:

- The RADR reflects only an aggregated level of risk, which is a weighted average of the risk of all cash flows in the investment project (Sick, 1986), and it is regarded as an oversimplified approach (Everett and Schwab, 1979). A simple risk adjustment factor within the RADR concept does not properly consider the project's appropriate risk level (Ryan and Gallagher, 2006).
- The applied assessment of a project's riskiness also involves a substantial amount of subjectivity (Riahi-Belkaoui, 2016) and susceptibility due to the individual bias influencing risk perception and judgement (section 2.2.3). The selection of the appropriate discount rate consequently seems to be, to some extent, an arbitrary process. In practice, the allocation of appropriate discount rates to corresponding projects is difficult due to the encountered susceptibility of personal sensitiveness and casual observations (Arnold, 2013).
- In addition, concerns are expressed about combining the effect of uncertainty and the time value of money in a single parameter, namely the discount rate (section 2.4.4.3). This allows for the automatic assigning of more risk to future cash flows (Ehrhardt and Brigham, 2016) and consistency is only found for the RADR for exponentially replicated cash flows, not for mean-reverting cash flows (Bhattacharya, 1978, Halliwell, 2011). This also means that in the case of investments with increasing risk over time, the RADR is a valid procedure (Robichek and Myers, 1966, Chen, 1967, Robichek and Myers, 1968). However, this also implies that when applying the RADR to various investments possibilities, projects with short-term payoffs seem to be more attractive than projects with longer payoffs, since the RADR imposes a higher burden on the latter projects (Ehrhardt and Brigham, 2016). These circumstances must be carefully considered if the cash flow generation within different projects is not equally spread over time. For example, in one project, the generated cash flow is almost equally spread over time, making the RADR-valuated projects more attractive than another project with higher leverage. In this latter case, the generated cash flows increase over time due to the decrease of debt financing, thereby increasing the future cash flows and lowering the financial risk, which is adversely considered in the valuation with the RADR. However, in many investments, the increase of risk is valid; therefore, the RADR is a reasonable approach (Ehrhardt and Brigham, 2016). In the case of RES-E investments, a detailed risk assessment must be performed to determine what the risk over time will look

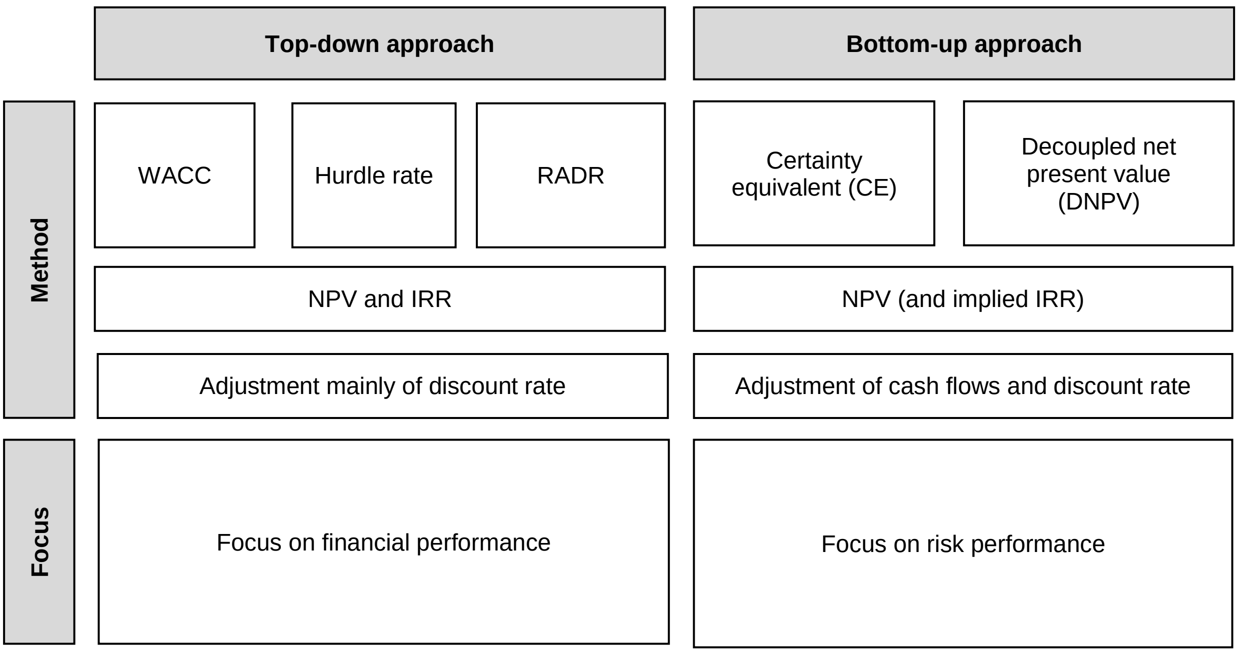
like, since the projects' structures and risks vary considerably between different alternative investment opportunities.

Instead of, or also in addition to, risk-adjusting with a single discount rate, different project risk levels can also be reflected in valuation by adjusting the cash flows for uncertainty—in its maximum grade of implementation known as the CE method, discussed in more detail in sections 2.2.3, 2.4.4.2, and 2.4.4.3.

2.4.4.2 Financial and Risk Performance Measures

The conventional valuation methods are *top-down approaches*, since they are based on capital sourcing processes for equity and debt portions, which subsequently lead to computing and defining a WACC, a corresponding hurdle rate, or an RADR to compensate for a project risk profile, which is the typical approach to adjust for risk (Damodaran, 2005c). In contrast, alternative valuation methods, such as the certainty equivalent (CE) or the decoupled net present value (DNPV) method, are considered as *bottom-up approaches*. This is because they first start to identify projects risks and then assign costs to each risk before integrating them as cost components into the valuations processes and adjust discount rates (Beedles, 1978). As outlined in more detail in the subsequent section, the top-down approaches with a focus on the CoC of the investing company can be applied as financial performance measures, while the bottom-up approach with a focus on the project risk (Ryan and Gallagher, 2006) can be applied as a risk performance measure (Espinoza and Rojo, 2015) (Figure 24).

Figure 24: Comparing top-down and bottom-up approaches (author's own illustration).



2.4.4.3 Certainty Equivalent Method

The proposed certainty equivalent (*CE) method* is an alternative valuation approach that has been introduced as a concept with regard to different risk attitudes in section 2.2.3. In contrast to adjusting the discount rate with additional risk premiums, the CE method, which is based on the utility theory (section 2.2.3), involves adjusting the different cash flows to reflect the corresponding uncertainties to provide risk-averse investors with a guaranteed return (Sick, 1986, Pinches and Vashist, 1996, Brealey et al., 2011, Espinoza, 2014) and hence focusing on downside risk consideration and value protection (Espinoza, 2014, 2015). This method was first proposed by Robichek and Myers (1966, 1968) as an alternative to traditional RADR approaches, and it is regarded as theoretically superior to them because of the applied separation between the time value of money and risk (Hamada, 1977, Sick, 1986, Gitman, 1995, Megginson, 1997, Halliwell, 2001, Ryan and Gallagher, 2006, Zeckhauser and Viscusi, 2008, Cheremushkin, 2009, Espinoza and Morris, 2013), i.e., a single discount rate as a risk measure is not an adequate approach (Espinoza, 2014). Although the CE method has some of the same drawbacks as the other traditional methods, since it is based on the same philosophy as the CAPM (Wolffsen, 2012) (section 2.5.1), it is the preferred method for addressing risky cash flows (Zeckhauser and Viscusi, 2008).

The CE method consists of an adjustment of the numerator within the PV equation (equation 2), with a deduction for risk to assured CE cash flows, while the applied hurdle rate in this case should equal the risk-free rate (Baker et al., 2010) to calculate the project's PV.[38] In theoretically consistent application of the CE approach, the results are the same as with the valuation method based on the RADR (Bamberg et al., 2006). The estimation of CE cash flows is based on an individual and hence subjective utilisation function (Bamberg et al., 2006), based on the Bernoulli principle, which reflects the risk attitude of the decision maker (Laux et al., 2014).

Even though this method is conceptually powerful, since it accommodates different risk levels among the various cash flows, and it is more flexible and robust, compared to the conventional NPV and valuation with the above-mentioned RADR (Hamada, 1977), the difficulties to estimate the appropriate CEs is a practical drawback (Ehrhardt and Brigham, 2016). This is due to the fact that various valuators might use a different utilisation function to arrive at a different PV (Drukarczyk and Schüler, 2009) and due to the lack of risk-neutral valuers (instead of the predominant risk aversion in reality) (Bamberg et al., 2006). Furthermore, no observable data are directly available for CEs (Ehrhardt and Brigham, 2016). An additional issue arises, since multi-period utilisation functions are not available in reality, making multi-period CE valuations only possible within theoretical research setups with strong assumptions (Bamberg et al., 2006). Moreover, the CEs should not be set by the company's management only, since they should reflect the shareholders' risk preferences. In this case, having shareholders set the investment requirements with appropriate discount rates seems to more practical. In addition, setting the RADR is also easier to apply in practice, since it can be based on available market data for the firm's corporate costs (Ehrhardt and Brigham, 2016). Although the CE method is theoretically robust and powerful, it has seldom been applied in practice (Bamberg et al., 2006, Ryan and Gallagher, 2006, Espinoza, 2014, Loßagk, 2014). Nevertheless, the CE valuation method might appear to be an optimal complementary valuation method for RES-E investments (Espinoza and Rojo, 2015) with detailed earnings and cost projections over the whole lifetime of the project, while many CEs are known, such as for sun and wind resources and for O&M costs, and while focusing on measuring the risk performance (Espinoza, 2014, 2015).

2.4.4.4 Decoupled NPV

Viewed as an extension of the CE method, the *DNPV* method provides additional detailed guidelines for setting the cash flows to be riskless (Espinoza and Morris, 2013, Espinoza, 2014, Piel et al., 2018). The DNPV uses insurance and contingency claim valuation concepts to estimate synthetic insurance premiums, which are then subtracted from the stochastic cash flows to render a synthetically riskless cash flow (Espinoza, 2014, 2015, Piel et al., 2018). A powerful metric based on DNPV is demonstrated with the implied RADR (iRADR), which is the average discount rate for a specified project's lifetime of cash flows, resulting in an NPV that is set equal to the DNPV (Espinoza, 2014). The iRADR, along with the above-mentioned synthetic insurance premiums, is a useful risk-based metric to assess the risk performance and provide inputs for investment decisions (section 2.6.3).

There are three different approaches in quantifying the price for the different risk components within the DNPV approach: (i) a heuristic approach based on an investor's experience with similar investment projects; ii) a probability-based approach that applies more sophisticated mathematical methods, such as Monte Carlo simulations, and specifies the PDFs for key input variables; and (iii) a stochastic approach with option pricing in line with insurance pricing, which is an enhance probability approach, including the random variation of revenue or expenditures (Espinoza and Morris, 2013, Piel et al., 2018).

2.4.4.5 Integrated Risk Return Management process

With the CE method and the expended DNPV method, valuation is aligned with 'risk management, financial objective, operational alternatives, and strategic options' (Espinoza, 2015:45). With regard to appropriately integrating risk into valuations, the integrated risk return management (IRMM) process, originally proposed by Buehler et al. (2008) and then adapted for infrastructure projects, as outlined by Espinoza and Rojo (2015), proposes the following five steps: (i) identification and understanding of the major project risks, (ii) assessment of natural risk ownership, (iii) determination of own risk capacity and risk appetite (section 2.2.3), (iv) embedding of risk process (including risk mitigation processes) in all decisions, and (v) implementation of risk monitoring and management processes in alignment of governance and organisation around risk.

2.5 Theoretical Principles about CoC

Determining the expected return rate is still a key issue in corporate finance today (Dimson et al., 2002a). It is based on the concept of the time value of money, as elaborated in section 2.4.1.1. One of the simplest methods to determine the expected return has been developed by Badger (1925). This multiplier method categorises investments into four risk classes and assigns each class a risk and an appropriate multiplier to calculate the expected return.

In the 1950s, more sophisticated models were developed. In general, all those available models that estimate expected returns in finance agree that investors require higher returns to take more risks, which are predominantly based on market risk and cannot be eliminated by diversification (Brealey et al., 2011). There are additional common assumptions about the relationship between risk and return that are shared within the different models. First, the risk is related to the variance of the actual return on the expected return. Therefore, if the actual return is always equal to the expected return, then the investment is considered riskless (Dimson et al., 2002b, Loderer et al., 2010, Damodaran, 2013). Second, only the additional risk of a marginal investor on a diversified portfolio is measured and compensated for (Damodaran, 2013). As explained in chapter 2.2.5, compensation by the market only occurs for non-diversifiable investment risks concerning the market forces.

The following sections (sections 2.5.1 to 2.5.2) introduce many quantitative approaches to estimate expected return rates in order to provide a coherent overview of this topic, even though only a few of the below described concepts can be applied for NTAs (section 2.5.2). However, this focus on numerical approaches should not offer the impression that determining discount rates is simply a matter of scientific preciseness, as outlined in section 2.6.4.

2.5.1 Capital Asset Pricing Model and Alternative Approaches

In the last 50 years, the CAPM, which was developed by Treynor (1961, 1962), Sharpe (1964), Lintner (1965a, 1965b) and Mossin (1966), independently, has been one of the most widely used methods to estimate the expected return. This model describes the risk-return relationship of an investment target, using the risk-free rate R_F, the market risk premium known as equity risk premium (ERP), and the beta β_j (or $\beta_{asset)}$ as variables (equation 11). The ERP is the excess return over the risk-free rate, representing the expected risk premium of a diversified market portfolio. The beta coefficient is a measurement of the risk contribution of the investment *j* to the total risk of the market portfolio, while the investment *j* also belongs to the market portfolio by definition. As such, the beta of a company represents the expected procentual change of return rate of its share compared to the change of the return rate of the market portfolio by 1% (Berk and DeMarzo, 2011). The beta expresses the additional risk to a diversified portfolio (Pratt and Grabowski, 2002). As such, the beta measures only systematic risks due the diversification effects of portfolios of shares, which eliminates unsystematic risks (Espinoza, 2014, Damodaran, 2017).

$$Expected\ Return\ =\ Riskfree\ Rate\ +\ \beta_{asset}(Equity\ Risk\ Premium) \tag{11}$$

The critics of the CAPM have claim that it is based on oversimplified assumptions. According to this model, all investors have good diversified portfolios, which combine risk-free investments with the market portfolio of risky investments (Böttcher and Blattner, 2010, Loderer et al., 2010); are similarly risk averse; have the same information, assessments about the market, portfolio opportunities, and decision horizon; and have homogenous expectations (Fama, 1968, Brealey et al., 2011). Furthermore, the CAPM breaks down the risk into diversifiable and non-diversifiable risk, while only the latter is relevant for the beta coefficient (Damodaran, 2013). It measures the marginal contribution of a single investment's market portfolio risk, thereby not allowing one to model a single investment in isolation (Brealey et al., 2011). However, following Böttcher (2009) and Böttcher and Blattner (2010), as explained above, since the diversifiable risks can never be completely diversified, the CAPM falls short, particularly for application by investors who do not have completely diversified portfolios.

Furthermore, evidence has demonstrated that the beta used in the CAPM does not sufficiently describe the expected return. There are variables that seem to explain the expected return better, including the market capitalisation, the book-to-market-equity ratio, the earning-price ratio, and the leverage (Hamada, 1972, Banz, 1981, Basu, 1983, Rosenberg et al., 1985, Bhandari, 1988, Chan et al., 1991, Fama and French, 1992). Due to the mentioned known shortcomings of the CAPM, academics and practitioners have both been looking for alternatives to the CAPM. As viable alternatives to the simple one-factor CAPM, some authors (Merton, 1973, Ross, 1976, Breeden, 1979, Reinganum, 1981, Chen et al., 1986, Fama and French, 1996) have suggested multiple factor models (multi-beta models, CAPM adjusted with additional determinants, and proxy models).

Option-based models, such as the well-noticed, market-derived capital pricing model (MCPM), presented by McNulty et al. (2002), are other alternative and more recently developed methods to determine CoC. In contrast to the CAPM and other approaches, the MCPM is appealing because it is forward-looking by inferring the cost of capital from analysts' forecasts and hence does not rely on historical data to determine the future (McNulty et al., 2002, Câmara et al., 2009, Chang et al., 2011). It considers the total volatility of an individual traded security (McNulty et al., 2002) and thus both systematic and unsystematic risks (instead of only systematic risk in the case of CAPM and other methods). Therefore, it is not limited to investors with diversified portfolios. However, the MCPM does not have the theoretical backing (Câmara et al., 2009), compared to the CAPM. Due to the MCPM's recent publication, empirical evidence about its usefulness in practice is missing. In addition, little work has been performed to further develop the model, and there is no literature about its application for NTAs. In any case, the application of the MCPM for NTAs seems to be challenging due to the absence of actively traded options and the lack of issued corporate bonds.

Since these alternative approaches have been developed particularly for PTCs (Zimmermann et al., 2005, Damodaran, 2013), and given that detailed discussion is beyond the scope of this thesis, they are outlined in more detail in Appendix 2, including an overview table of the main available CoC approaches for PTCs. However, in particular, MCPM and its basic features have still been considered in the final discussion in this research (sections 6.1.2 and 6.5).

Although having been weathered over the years, the CAPM is still widely applied, particularly by practitioners[39] (Bruner et al., 1998, Gitman and Vandenberg, 2000, Welch, 2000, Graham and Harvey, 2001, Chen et al., 2011, Damodaran, 2013). Similarly, most textbooks for financial executives still propose the CAPM as the main model to estimate the cost of equity (Fama, 1996, Loderer et al., 2010, Brealey et al., 2011, Hawawini and Viallet, 2011). It is also a favourable method taught in MBA courses (Jagannathan and Meier, 2002). Furthermore, Lo and MacKinley (1990) and Brealey et al. (2011) have argued that the long-discussed CAPM anomalies may be the result of data-snooping or selection bias.

Despite the CAPM being built on strong assumptions, its advantage is its simplicity and its ease of use (Womack et al., 2003, Zou, 2006), based on a linear relationship between return on investment and the beta, the risk-free rate, and the market risk (Fama and French, 1992). Although the realism of the CAPM is being questioned and the CAPM is less convincing than scholars once thought (Brealey et al., 2011), it still produces remarkably good results for describing prices in the capital market (Elton et al., 2010, Brealey et al., 2011), no practical alternative model has been presented so far for business valuation (Koller et al., 2015), and still more firms are moving to apply the CAPM (Cornell et al., 1997, Gitman and Vandenberg, 2000, Graham and Harvey, 2001).

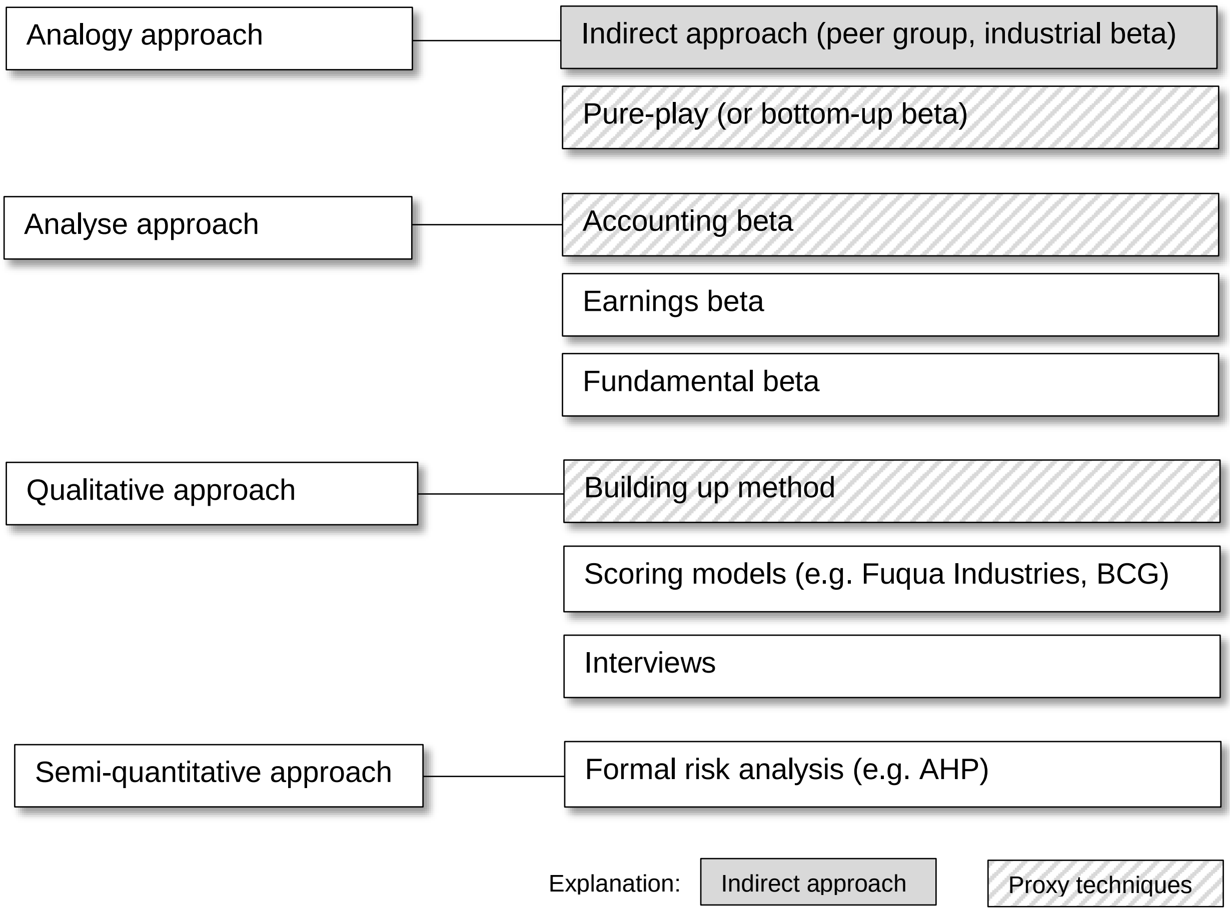
Although the CAPM has been developed for PTCs, its basic structure can also be applied to NTAs while being aware of its assumptions on the one hand and taking into account the possibility to adjust it with additional determinants on the other. Therefore, the core understanding of the CAPM and its variables establishes a starting point of this research, used to describe the relevant determinants or equity drivers (sections 1.2, 2.6.1, 2.7.3, and 5.5.1).

2.5.2 Estimating Expected Returns of NTAs

In the case of NTAs, their limited liquidity makes the application of conventional return models meaningless (Zimmermann et al., 2005, Petersen et al., 2006). In the case of private equity companies, data cannot be accessed within the market easily (Günther, 1997)—only cash flows generated by the enterprise itself can be observed (Cochrane, 2000, Nielsen, 2011, Driessen et al., 2012) if data access is available. The situation for investment projects is similarly challenging, since the cost of assets can normally not directly be monitored. Nevertheless, the literature has described possible bypass methods to determine risk premiums for NTAs (Table 13). These methods are based on the principle theoretical concepts derived from PTCs. All those methods can be applied to estimate the RADR (section 2.4.4).

The frequently used CAPM cannot be directly applied for the valuation of NTAs without adjustments (Velez-Pareja, 2005), since the beta factor cannot directly be estimated. However, there are alternative approaches that can be applied for NTAs to estimate beta factors. Moreover, there are additional proxy techniques that are not based on the CAPM (section 2.5.2.2). Figure 25 summarises the different approaches to estimated expected returns of NTAs into four basic groups.

Figure 25: Classification of different approaches to estimate beta factor for CAPM and/or risk premium for NTAs (adopted from Pfister, 2003, Peemöller, 2005, Britzelmaier et al., 2012).



2.5.2.1 *Indirect Approach*

A first technique is the *indirect approach* by assessing the return characteristics of securities investing in private equity companies. After evaluating the historical performance data with the discussed models above, conclusions can be drawn for the average private equity investments of these funds (Nielsen, 2011). Most of the reviewed literature (Ljungqvist and Richardson, 2003, Cochrane, 2005, Kaplan and Schoar, 2005, Zimmermann et al., 2005, Driessen et al., 2012) has used, in one or another, the CAPM as the model for estimating expected returns. In doing so, the most difficult part is the estimation of the beta (Pratt and Grabowski, 2002) due to the lack and/or the low resemblance grade of necessary publicly traded peer companies to estimate an appropriate company beta (Brealey et al., 2011). As a result, the suggestion is often to use industry betas[40] for a single, distinctive asset class instead (Koller et al., 2010, Pereiro, 2010), as periodically calculated by Professor Damodaran[41].

2.5.2.2 *Proxy Techniques*

A first proxy technique is the so-called *bottom-up beta* or *pure-play technique*, which is based on the CAPM and an adjusted beta. Based on comparable PTCs, called pure-play firms, for example, within the same industry or line of business of about the same size and/or leverage, a proxy from their betas is derived for the beta of the concerned NTAs (Hamada, 1969, Wood et al., 1992, Loderer et al., 2010). This approach is based on the assumption that the operative risk of the investment project has the same risk as the pure-play or investing company, although each project has a different risk profile (Loderer et al., 2010). The necessary information is relatively easily available, and the model is quite simple. However, the challenge is to find adequate companies (Ehrhardt and Bhagwat, 1991, Cotner and Fletcher, 2000, Chua et al., 2006).

A second proxy technique is the *accounting beta method*, based on a regression approach of a company's specific key performance indicators (for example, EBIT/Total Assets) and the rate of returns on the market index (Beaver et al., 1970, Ehrhardt and Brigham, 2016). This technique for estimating the market beta assumes that the chosen key performance indicator is an adequate substitute for the return on investment used in the regression model. Both of those previous proxy techniques do not consider the total risk (section 2.3.1), i.e., including the relevant non-systematic risk components, in estimating the CoC, which is necessary for NTAs (Cotner and Fletcher, 2000).

A third proxy technique that is frequently applied in practice (Britzelmaier et al., 2012) can be summarised as the *build-up approach*. It adds project-specific risk premiums to the risk-free rate (Hostettler, 2002, Pfister, 2003). Another approach adds a risk premium, for instance, for a lack of liquidity for thinly traded assets to the firm's cost of equity (Damodaran, 2017). Both approaches are again subjective methods, since this risk premium cannot exactly be estimated (Ehrhardt and Brigham, 2016). Similarly, a judgmental ERP—normally about three to five percentage points—can be added to the rates of the considered firm's long-term debt (Ehrhardt and Brigham, 2016). This is a highly subjective approach, and it does not work if the non-traded company has no or little recently issued long-term debt (Cotner and Fletcher, 2000).

2.5.2.3 Qualitative Approach

Alternatives to overcome the difficulties of not having sufficient information are based on qualitative approaches to directly estimate risk premiums for NTAs.

The assessment of systematic risk can be performed with *scoring models* to deduce discount rates or risk premiums by evaluating specific organisational criteria, such as the competitors, entry barriers, market, products, and cost structure, among others (Lewis et al., 1994). Such scoring models include one from the Boston Consulting Groups (Lewis et al., 1994) and another from Fuqua Industries Inc. (Gup and Norwood III, 1982, Bufka et al., 1999, Pfister, 2003).

Another pragmatic approach includes the performance of *interviews and surveys* to estimate the risk premium or discount rate. The idea is to ask the investors directly in order to assess systematic risk. This approach should yield generally good results (Damodaran, 2017), since investment managers have the best knowledge of the considered investment market (Copeland et al., 2002).

2.5.2.4 Semi-quantitative Approach

Apart from qualitative approaches, more numerical approaches are proposed, such as a *formal risk analysis* or the *risk component model* (Britzelmaier, 2013). They are systematic reviews of evidence that define or estimate a project's risk and subsequently define the CoC. Cotner and Fletcher

(2000), Palliam (2005b, 2005a), Sundberg and Engzell (2007), and Guerrero-Baena et al. (2013) have suggested applying the AHP to compute CoC. The proposed framework decomposes the decision problem while estimating the ERP into independently analysable sub-problems, including both tangible and intangible risk factors, organised into a hierarchy. It subsequently assesses how these risk factors impact on the risk of the specific firm. Individuals or a group of decision makers judge each risk factor by making comparisons to the other factors in the same hierarchy level and with respect to the hierarchy above them and then assigning priorities for each of the elements. These judgements are converted into numerical numbers to calculate their priorities and relative importance for each decision alternative over the entire hierarchical system (Saaty, 1990, Cotner and Fletcher, 2000). Following the systematics of CAPM, the logical computed risk premium is added to the risk-free rate to determine the return rate for the specific NTAs. Some authors (Cheng et al., 2002, Velez-Pareja, 2005, Sundberg and Engzell, 2007) have suggested avoiding pitfalls while applying the AHP.

An overview of the various CoC approaches for NTAs is provided in Table 13; however, with limited evidence of use in practice based on empirical studies. Some of them might be suitable for RES-E investment valuations.

Table 13: Proposed models for estimating expected returns of non-traded assets as suggested by financial theory and according to empirical surveys among practitioners and their supposed applicability for RES-E investments (X: applicable, (X): more or less applicable / only in combination with other methods, - not applicable, PTC: publicly traded company, NTA: non-traded asset).

Model name	**Model**	**Assumptions/ Limitations**	**Applicability for RES-E investments**	**Pros (+)/Cons (-)**	**Sources of basic research**	**Empirical surveys among practitioners**
Indirect approach	Assessment of return characteristics of securities investing in private equity companies	- based on CAPM, usually	(X)[1]	- not applicable, if no appropriate securities are publicly traded - focus only on systematic risk	Ljungqvist and Richardson (2003), Cochrane (2005), Kaplan and Schoar (2005), Zimmermann et al. (2005), Driessen et al. (2012)	-
Bottom-up beta technique / pure-play technique	Based on CAPM and a proxy from the beta of comparable PTC is derived for the beta of the concerned NTA	- project's operative risk equal to investor's risk	-[2]	- not applicable, if no appropriate companies are publicly traded - total risk not considered	Hamada (1969), Weston (1973), Wood et al. (1992)	-
Accounting beta method	Accounting approach based on a regression approach of specific key performance indicators of the company (e.g. EBIT/Total Assets) and rate of returns on the market index	- chosen key performance indicator is an adequate substitute in modelling	-	- subjective approach - total risk not considered	Beaver et al. (1970)	-
Cost of debt plus a risk premium / premium for equity	Adding an ERP to long-term debt of investment project	- project has issued debt	(X)	- highly simplified method	Cotner and Fletcher (2000), Ehrhardt and Brigham (2016)	Gitman and Mercurio (1982), Petry and Sprow (1994), Kester et al. (1999), Graham and Harvey (2001), Brounen et al. (2004), Baker et al. (2009)
Adjustments for lack of liquidity	Adding a liquidity premium for thinly traded assets to firm's cost of equity	- NTA have lower liquidity than PTC	(X)	- difficulty to estimate liquidity premium	Ehrhardt and Brigham (2016)	-
Scoring model	Deduce discounts rates or risk premiums by scoring specific organisational criteria	- Based on expert knowledge	(X)	- Focus only on systematic risks	Gup and Norwood III (1982), Lewis et al. (1994), Pfister (2003)	-
Interviews and surveys	Asking directly the investment managers about current discount rates or risk premiums	- Based on expert knowledge	(X)	+ pragmatic approach + quite good results - confidentiality issues - Focus only on systematic risks	Copeland et al. (2002), Damodaran (2017)	Poterba and Summers (1995), Bullard et al. (2002)
Formal risk analysis technique	Analytical process to overcome insufficient information, for example AHP	- ERP is divided into independent analysable sub-problems	X	+ assessment of total risk + applicable for projects of investors with undiversified investment portfolios	Cotner and Fletcher (2000), Hastak and Halpin (2000), Hastak and Shaked (2000), Palliam (2005b, 2005a)	-

[1] Not many securities in the field of RES-E investments are publicly traded.
[2] There are no comparable PTCs available for RES-E investments.

2.6 Investment Appraisal—Value, Price, Measures, and Managerial Judgement

The detailed dyanamics of investment decisions and transaction processes[42] are not the main foci of this research and could be the subjects of a separate research project. However, some selected topics in this field are discussed in this literature review to understand the basic principles of managing corporate value from an investment perspective, how non-financial factors and managerial judgment are applied in investment appraisals, and how to differentiate between value and price in investment appraisals.

One of the main objectives of investing is to increase the corporate value and eventually the value for the shareholders (Baker et al., 2010) and shareholder wealth (Arnold, 2013). Therefore, the risk related to the investment and estimated return must be set in relation to its influence on the overall risk, the corporate value of the investing firm, and the wealth of its investors. The three-risk-level framework, introduced in section 2.3.3, provides a comprehensive approach to this. A complementary perspective with a focus on value creation, while considering the CoC from shareholders and the firm, is provided by VBM (Arnold, 2013). As outlined in section 2.2.1, uncertainty and risk are inevitable and linked to any business, and some of them provide the basis for making business decisions. As such, certain key components of risk and uncertainty then become value drivers (Matzen, 2005).

2.6.1 Value-based Management

Value-based management is today's main concept in maximising shareholder value. According to Arnold (2013:G-30), it is defined as follows:

> 'Value-based management is a managerial approach in which the primary purpose is long-run shareholder wealth maximisation. The objective of the firm, its systems, strategy, processes, analytical techniques, performance measurements, and culture have as their guiding objective shareholder wealth maximisation.'

Its metrics are based on DCF, in contrast to the outdated and flawed traditions of accounting-based performance measures that examine profits, return on investments, and earnings per share (Arnold, 2013). The latter can be misleading, for example, due to the potential of manipulating and distorting accounting, a misrepresentation of the performed investments, as well as exclusions of the time value of money and the involved risk (Cornelius and Davies, 1997, Rappaport, 1998).

Apart from focusing on DCF-based concepts (section 2.4.2.1) when valuating new projects and considering the notion of the opportunity CoC (section 2.4.3.1), progressive organisations in favour of VBM evaluate their businesses or part of businesses by asking the following questions (Arnold, 2013):

- How much capital do the investors place in the considered business?
- What actual rate of return is generated for those investors?

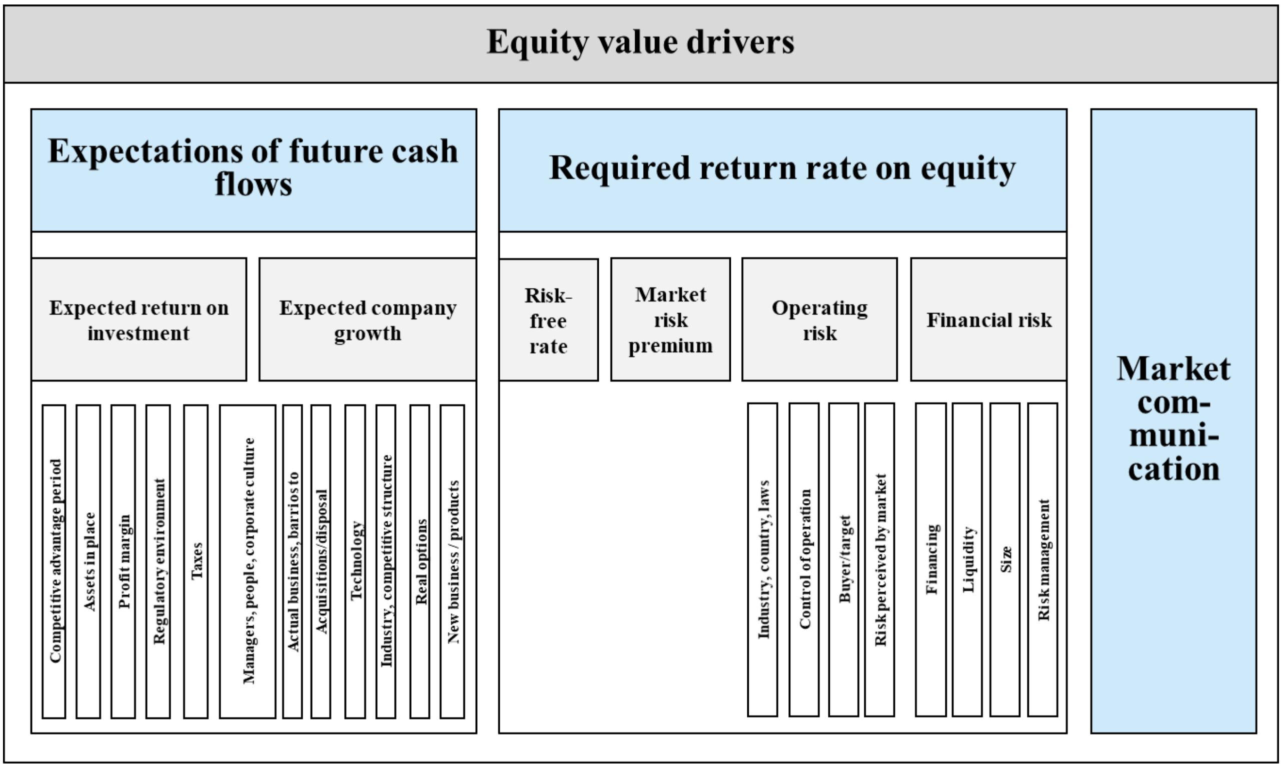
- Is this actual rate of return sufficient compared to the opportunity CoC?

The difference between the actual rate of return on capital and the require rate of return is defined as the performance spread. Over time, this spread is normally driven towards the required return rate, although there are remarkable businesses that can maintain higher spreads for decades (Arnold, 2013). In the case of RES-E investments, this concept seems to be an oversimplified view, since there are other, more dominant factors that drive the value.

The approaches described below are more suitable. They typically describe the key factors of determining value as *value drivers*. This can be confusing, since there are other authors who have described value drivers as factors that provide some competitive advantage (Arnold, 2013). To distinguish between the different types of value drivers, the names of the authors are used to describe them; for example, Rappaport’s value drivers and Fernandez’s value drivers.

Rappaport’s value drivers present set generic factors that determine value, including sales growth rate, operating profit margin, tax rate, fixed capital investment, working capital investment, the planning horizon, and the required return rate, as outlined in Rappaport’s landmark book (Rappaport, 1998). Fernandez has adapted this approach specifically for equity value, presenting primary, secondary, and tertiary equity value drivers (Figure 26). Fernandez’s three primary value drivers determine the equity value of an investment, including expectations of future cash flows, required return rate, and market communication. In turn, the expectations of future cash flows depend on secondary value drivers, such as expected returns on investment and the expected growth rate of the company. The required return rate depends on the risk-free rate and market risk premium (representing the CAPM formula) as well as operating risk and financial risk. Market communication refers to communication with all types of stakeholders, such as customers, employees, suppliers, authorities, shareholders, analysts, rating agencies, and partner companies (Fernandez, 2016). Furthermore, Fernandez (2016) has suggested further specifying those still general value drivers to identify the key parameters that influence value creation, since the parameters vary across different businesses and sectors.

Figure 26: Fernandez's value drivers (adopted from Fernandez, 2016).



2.6.2 Value, Price, and Influencing Factors

Apart from the stated value drivers, the literature has described factors that are deliberately applied as additional determinants to increase value, such as the valuation of the synergy potential, or rather intangible factors affecting valuation.

In many business transactions, successful acquisitions have to result in additional post-acquisition value due to the implementation of synergy potential (Orsag and McClure, 2013). However, the additional value from synergies is seldom delivered due to valuation failures, poor planning, or difficulties in its implementation in practice (Damodaran, 2005d). The usage of such synergies is not the sole purpose of investing in RES-E projects, nor is it a primary value driver. Nevertheless, it can still be regarded as a potential opportunity in valuation, if available, for instance, by consolidating operating maintenance service contracts and through commercial and technical management within a larger portfolio to receive lower costs for better quality.

Schlegel (2015) has studied the determinants of CoC within valuation. He has identified several influencing factors, mostly of an intangible nature to the valuators and decision makers, including firm characteristics (size and industry), investor structure (stock market listing and investor type), perceived cost-benefits, top management background, corporate culture, and organisational structure.

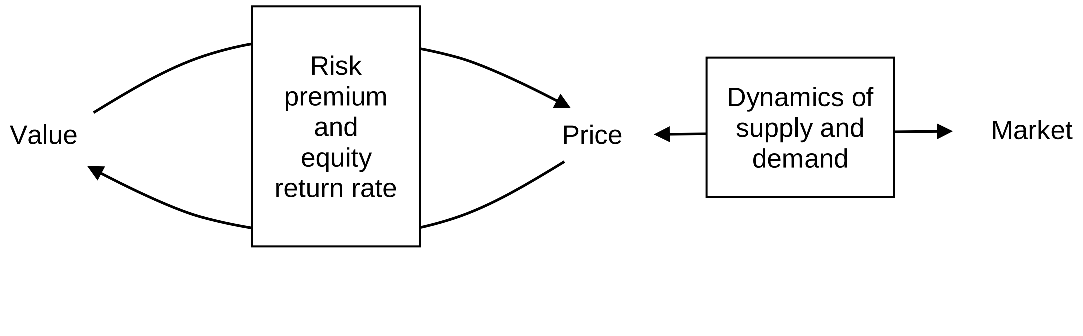
The motives for performing a valuation influence the results (Coenenberg and Schultze, 2002, Damodaran, 2012) (sections 2.1.2 and 2.3.3.2), thereby providing the basis for additional influencing factors. They vary for different types of buyers and different sale purpose, such as valuation for sale to a private entity, to a PTC, or for an initial public offering (Damodaran, 2012) 'due to economies of scales, economies of scope, or different perceptions of the industry and the company' (Fernandez, 2016:2), and based on whether the valuation is performed by a buyer or a seller (Fernandez, 2016). These characteristics have an influence on the agreed price.

Value and price have to be differentiated within investment appraisals. Value is the amount defined with a valuation process that varies between different buyers and may also differ between buyer and seller. The price is the agreed amount to be paid in the sale of the investment object by the buyer to the seller (Schindler, 2011, Fernandez, 2016). In practice, the calculated value might be a possible value range for the investment object as the basis for negotiating a possible price agreed between the seller and one buyer or a consortium of buyers, while communicating with the market (Fernandez, 2015, 2016) and being exposed to the dynamics of supply and demand—a principle in economics (Marshall, 1927).

For PTCs, pricing is a transparent process on the stock exchange. For liquid shares, a price is set in the trading hours at all times, and the liquidation of shares is simple and done at low costs (Damodaran, 2012). For NTAs, on the other hand, pricing is an obscure process, and research evidence from the market comes mainly from restricted stocks at PTCs (Damodaran, 2012). The liquidation of such assets is more time consuming and has generally higher costs (Amihud and Mendelson, 1986, Amihud et al., 2005, Damodaran, 2012, Ehrhardt and Brigham, 2016). From the perceptive of the extent of liquidity of assets, Damodaran (2012) has described the difference between the price and the value as illiquidity discount, which is higher for NTAs than PTCs. This illiquidity discount is also reported as a relevant risk premium determinant in section 2.3.2.

Since valuation for NTAs is able to consider all relevant risk premium determinants, including the illiquidity discount, it is argued that the calculated value can directly be applied as a possible price without having to take into account a possible difference between the value and price for the illiquidity of the assets. This view is described in Figure 27, which illustrates an iterative process between value, based on internal valuation processes, and price, established on the market exposed to supply and demand to set a final transaction price.

Figure 27: Iteration cycle during investment decision process between value and price (own illustration).



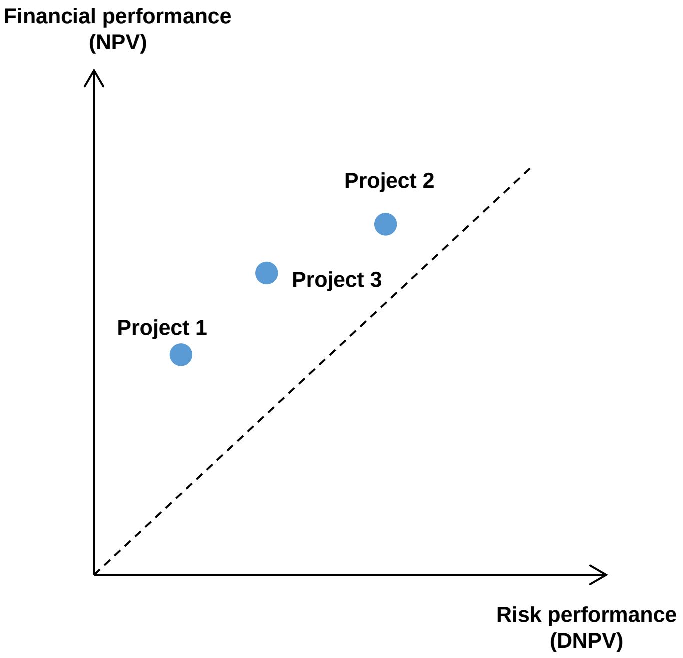
2.6.3 Feasibility and Viability Measures for Investments

Investment decisions involve allocating funds in projects in such a way as to receive higher cash flows and increase shareholder wealth, and this fund allocation, which is performed by managers, is one of the most important processes for many companies (Baker et al., 2010). Viability and feasibility are important aspects in investment appraisals (Carmichael, 2014). Viability is concerned with sustainability, and it is measured by means of business survival lengths. However, viability is also often measured with a feasibility study (Mohamed and McCowan, 2001). Within a feasibility study, the investment is evaluated with regard to its strengths and weaknesses, whether it is worthwhile and suitable to invest in (Carmichael, 2014), its opportunities, and its resources. The NPV, IRR, and PB are typical techniques used in feasibility studies (Mohamed and McCowan, 2001, Carmichael, 2014). In a probabilistic investment analysis, feasibility is expressed as a probability, while viability is examined in terms of a defined probability level that the decision makers are ready to accept (Carmichael, 2014).

There are different approaches to evaluate the feasibility and viability of investments, such as the growth/shrink-performance spread matrix of Arnold (2013); however, they are not suitable for RES-E investments because of their focus on the growth potential of the investing firm; for instance, the business growth in new markets or with new products. Investments in RES-E projects are typically unique investments with the benefit of securing new production sites for electricity with a favourable generation cost and revenue profile. They do not primarily add to the growth of the investing company.

An optimal feasibility measure approach for RES-E investments has been presented by Espinoza (2014), with a focus on the NPV measure. He has distinguished financial and risk performance metrics, which form the basis for determining the feasibility of projects for decision makers. On the one hand, the financial performance ratio compares the project's IRR with the investor's WACC or set hurdle rate to consider the investment company's CoC in relation to the financial metrics of the investment, i.e., to determine whether the project is financially feasible (IRR/WACC ≥ 1). On the other hand, the risk performance measure evaluates the IRR compared to the iRADR (section 2.4.4.4). The project's feasibility from a risk perspective is given if the IRR is higher than the iRADR (i.e. IRR/iRADR ≥ 1). For decision making, RES-E investment projects can be plotted on a financial versus risk performance chart from a value perspective (Figure 28) (Espinoza, 2014, Espinoza and Rojo, 2015).

Figure 28: Decision making based on a financial versus risk performance chart (NPV vs. DNPV) from a value perspective, illustrated with fictive project examples[43] (adopted from Espinoza and Rojo, 2015).



2.6.4 Non-numerical Factors and Managerial Judgements in Investment Appraisals

The aforementioned manifold numerical techniques for the quantitative analysis are typically only the starting point for investment appraisals, since in many real-world situations, additional qualitative factors must be taken into consideration (Arnold, 2013). Many risk components relevant to RES-E investments cannot be entirely described with numerical approaches. For instance, a risk assessment and subsequent feasibility study with a numerical valuation, including a probability analysis for environmental, social, political, and legal risk, is almost impossible (Mohamed and McCowan, 2001). Therefore, the incorporation of such non-monetary or intangible factors (see also section 2.5.2.3) in investment appraisals are crucial and can be key influence factors (Lopes and Flavell, 1998). They require careful analysis (Tweedale, 1993), applying judgemental expert knowledge (Power, 2004). In extreme cases, not adequately considering non-monetary and unquantifiable risk components could cause project failures despite favourable financial key factors (Uher and Toakley, 1999).

In any case, an examination of the numbers in valuation, and not focusing on low-digit percentage NPV deviations, is crucial (Tijdhof, 2007b). Moreover, since an exact risk assessment of projects is extremely difficult in practice and uncertainties in cash flows are experienced throughout everyday operations with sometimes unforeseen shocks, many practitioners 'fall back on their 'judgement'' (Arnold, 2013:715) to assess risk and to set appropriate discount rates within valuation. Judgement of the viability of project can be considered largely as an element of art that 'requires experience and perceptive thought' (Arnold, 2013:707) and includes some 'gut instinct' (Tijdhof, 2007b) when selecting projects. This is also the key approach when assessing stand-alone projects' risks and valuation outcomes with regard to their contribution to the investing firm's and/or investor's risk level, as introduced in section 2.3.3. Numerical project valuations are treated as supporting tools for their strategic decision making for investment (Tijdhof, 2007b), while good decisions come from knowing the limitations of the applied methods and the used input variables (Arnold, 2013). Having said that, it is understood that judgments that recognise the imperfection within reality often deliver better results than overly simplistic theoretical approaches (Arnold, 2013) As outlined in section 2.5.1, the CAPM formula can be used as a starting point (Arnold, 2013) by applying managerial judgement for additional risk components to define the appropriate discount rate. In doing so, the accuracy behind the numbers about the applied return rate is less important than knowing the margin of errors and the range of possible outcomes (Arnold, 2013). According to Arnold, 'the final number for the required rate of return is less important than the knowledge of the factors behind the calculation and likely size of the margin of error. Precision is less important than the knowledge of what is a reasonable range' (2013:692).

Furthermore, managerial judgment is also required in investment appraisals when considering the investment project in relation to the strategic direction of the investing firm, the social context in relation to the enthusiasm and commitment of the involved employees, the involved amount of DD and contract negotiation expenses until the closing of the transaction, and any other intangible benefits or drawbacks (Aharoni, 1966, Arnold, 2013).

2.7 Summary and Conceptualisation

2.7.1 Summary of Literature Review

After discussing the basic terms and concepts of uncertainty, risk, and pricing risk, the principle concepts in estimating expected returns and various corresponding capital budgeting techniques have been reviewed. It could be demonstrated that ERPs are the central variables of each of those return models. They are all derive from research about PTCs. By contrast, only a few CoC approaches for NTAs have been found in the literature. In addition, several key risk factors have been identified during the literature review and discussed in respect of their relevance for determining the expected returns of NTA and RES-E projects. Only a few research papers have been found regarding sector-specific characteristics as relevant ERP determinants. Based on the given risk definition, natural energy resources and their volatility have been introduced as relevant ERP determinants (value drivers) for RES-E investments.

Even if there are some empirical studies about returns for private equity companies, based on evaluating funds and listed companies that invest in private equity, the findings allow the conclusion that there is no general framework or formula to estimate or calculate the expected returns of NTA and RES-E investments. However, there are some articles that add specific determinants to principle models. This could be a starting point for building an enhanced model that is composed of the common key variables relevant to all investments, supplemented with the determinants or equity value drivers specifically crucial for RES-E investments.

2.7.2 Research Gaps

In relation to answering the research questions in section 1.2, the following research gaps could be identified in the literature review:

1. The valuation of project-specific NTAs are rarely empirically researched.
2. Empirical research has not been performed in the field of RES-E investments yet, and specific value drivers for RES-E projects have not been investigated.
3. The interaction between the risk/uncertainty assessment and valuation processes are rarely assessed—in particular, how specific risk determinants are considered in the valuation processes of RES-E investments.
4. The relevance of unsystematic risk is often ignored in valuation due to the influence of PTCs as the principle research objects.
5. A theory-practice gap has been identified for the application of the RADR approach, the CE method, and the combination of value creation and value protection methods.
6. A lack of theory has been identified for explaining the influence factors on valuation.
7. Empirical research of the German and Swiss populations for the valuation of NTAs and possible differences has not been conducted before.

Table 14 lists the found research gaps, how they are addressed in this thesis, and how this thesis contributes to the body of knowledge or practice.

The identified research gaps are the basis for the subsequent conceptualisation (section 2.7.3) in which a conceptual framework as well as initial subcategories and themes for the following preliminary qualitative research phase (section 4.2) are defined.

Table 14: Research gaps, issue addressing, and contribution to the body of knowledge and practice

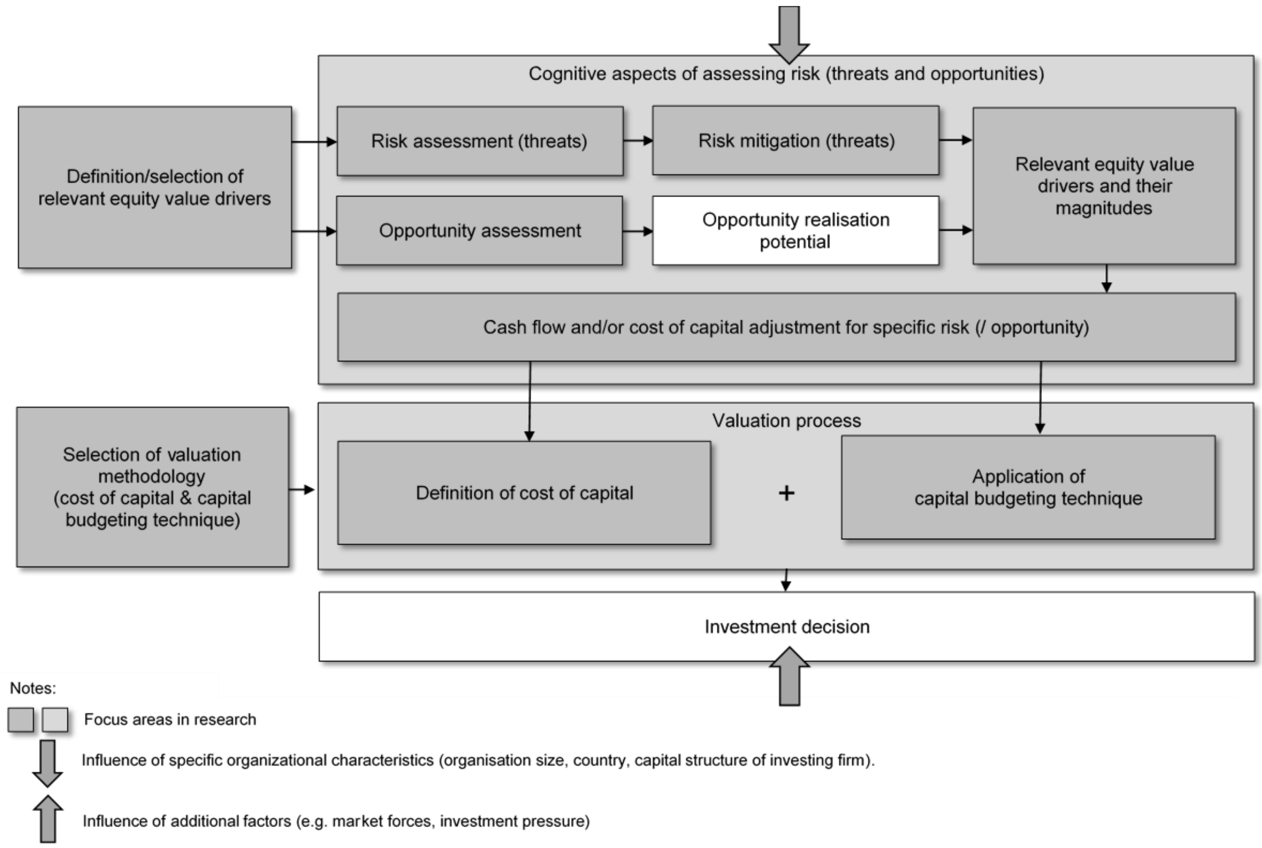
No.	Research gap	In scope	Addressing/contribution
1.	Rare empirical research about valuation of project-specific NTAs	X	Additional empirical quantitative and qualitative evidence for NTAs
2.	No empirical research for RES-E investments and determinations of corresponding value drivers	X	First empirical quantitative and qualitative evidence for RES-E investments in transactions
3.	Rare assessment of the interaction between risk/uncertainty assessment and valuation processes and of specific considerations in valuation processes	X	Quantitative assessments of how risk determinants are considered in valuation, either with cash flow or discount rate adjustments
4.	Unsystematic risk is often ignored in valuation processes	X	Quantitative assessments of all relevant risk components, systematic and unsystematic risks, with follow-up, in-depth qualitative analysis
5.	Theory-practice gap for the RADR approach, CE method, and combined value creation/protection methods	X	Finding reasons for theory-practice gap for RADR approach, CE method, and combined value creation/protection methods and whether they could be propagated more within practice
6.	Lack of theory to explain influence factors on valuation	X	Application of explanatory sequential MMR
7.	No empirical research about German and Swiss populations for valuation of NTAs and RES-E investments and for possible differences	X	First empirical quantitative and qualitative evidence for these two populations for NTAs and RES-E investments

2.7.3 Conceptual Framework

When trying to understand how valuation is performed in practice from a process point of view and what determinants are relevant, a conceptual framework is helpful. It is based on the learnings from the literature review, and it represents the basis for the ultimate investment decisions as a function of the definition of the relevant equity value drivers, risk, and opportunity assessment; the risk mitigation and opportunity realisation potential; the expected return (i.e., CoC); the chosen valuation methodology and the adjustment possibilities corresponding to the remaining business risks and potentially also to opportunities, as well as a variety of potential influence factors, mainly considered from a cognitive perspective (Figure 29).

A related framework, named the risk-adjusted project valuation (RAPV) concept, which was published in Hürlimann and Bengoa (2017a), conceptualises the adjustments for risk in valuation, either within the discount rate or in the cash flows (Appendix 3), from a different perspective, compared to Figure 29.

Figure 29: Conceptual framework about valuation and its possible influence factors (author's own illustration).



These influence factors belong mainly to the realm of cognitive aspects in assessing risk (threats and opportunities). Some of them have been identified in the literature review, as outlined in section 2.7.4 below.

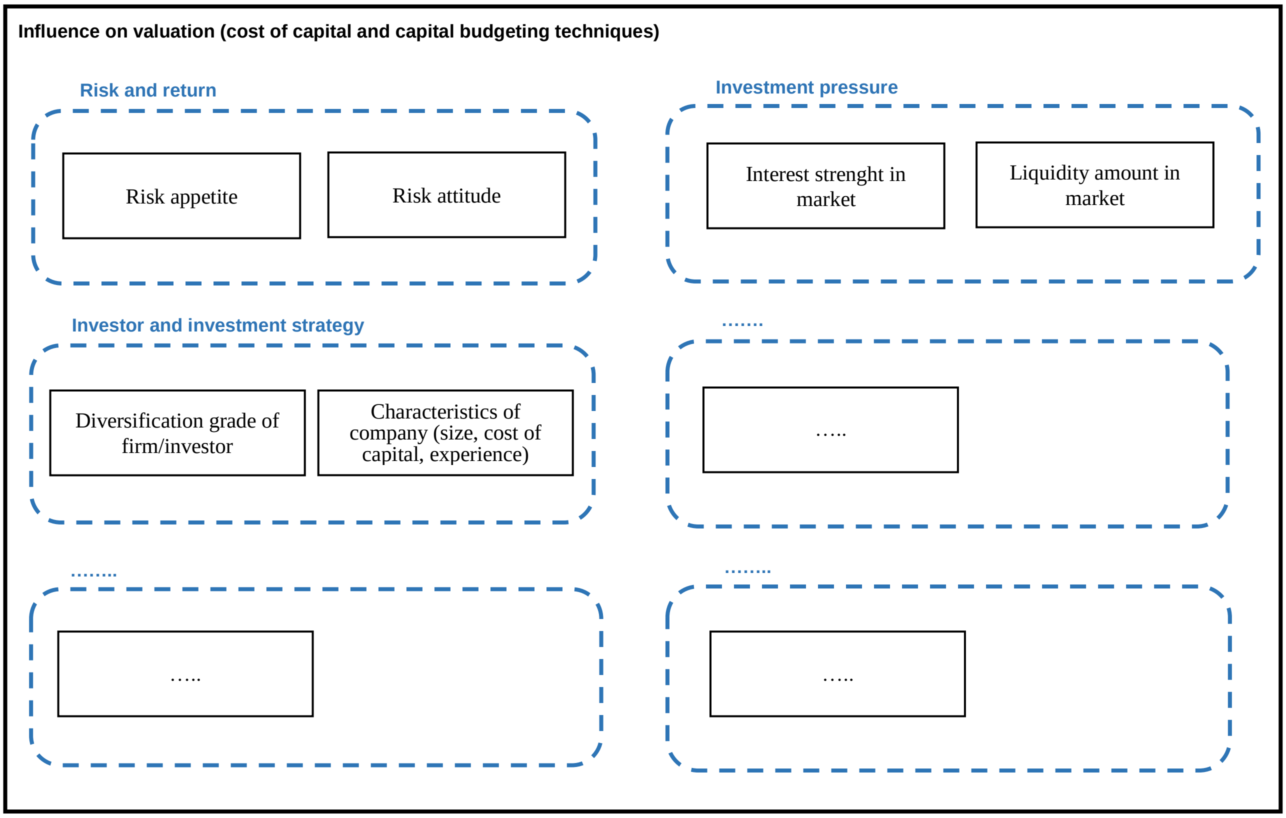
2.7.4 Initial Subcategories and Themes

The literature review could identify several topics that are relevant to valuation in general and to RES-E investments:

- Differentiation within the realm of valuation between capital budgeting techniques and CoC approaches (particularly for DCF-based methods).
- Existence of judgmental valuation approaches, apart from the mainly numerical valuation approaches that have been widely discussed in the academic literature.
- Discounted cash flow versus non-DCF-based capital budgeting techniques with different methods.
- Different CoC approaches, such as the CAPM, WACC, hurdle rate, and RADR.
- Risk considerations in valuation, including the definition of relevant risk components, risk assessment (scenario and sensitivity analysis, simulations, and PB), risk mitigation, and risk adjustments in valuation.

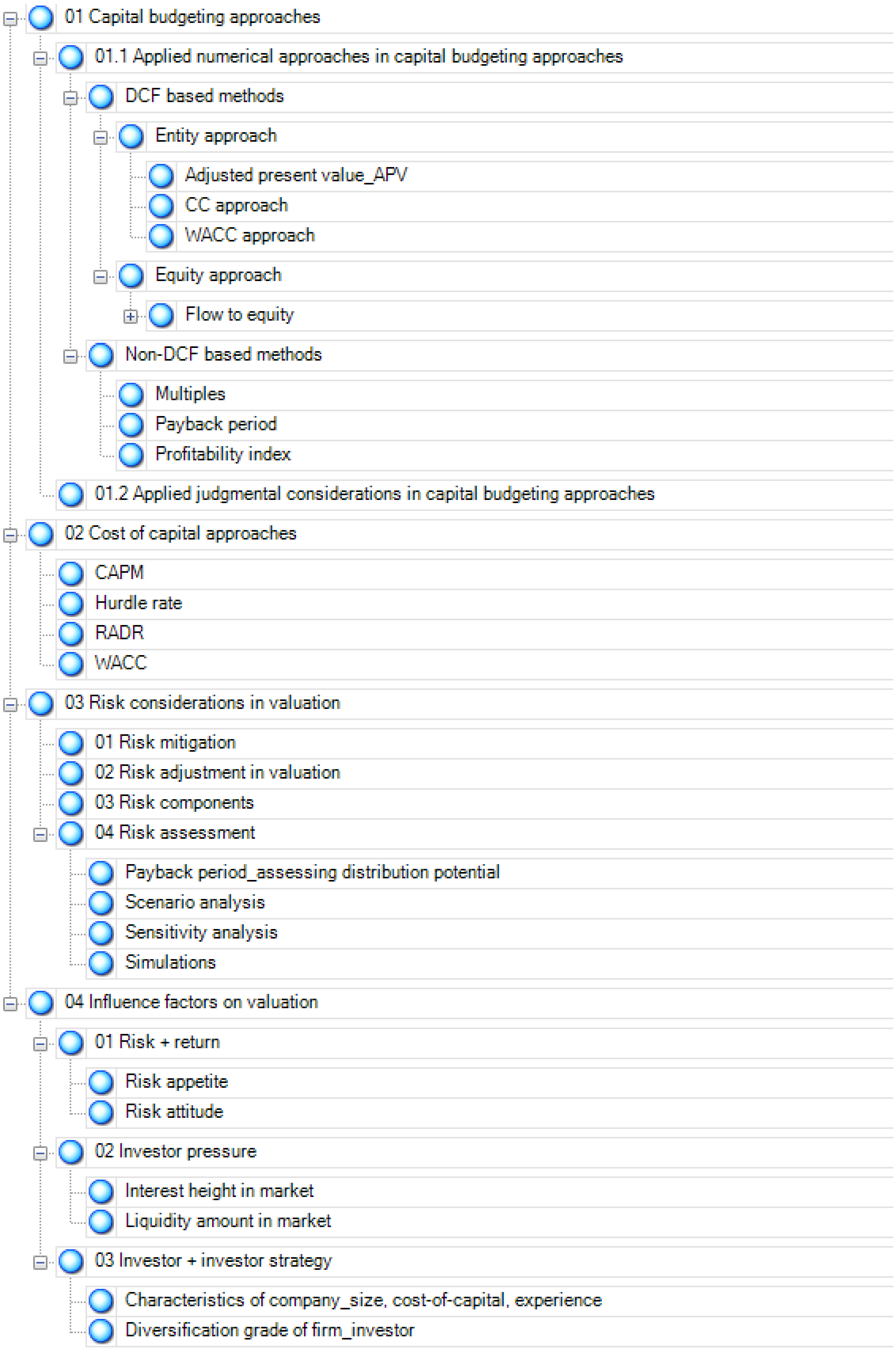
- Influence factors on valuation, such as the risk appetite, risk attitude, interest strength, and liquidity in market, as well as the characteristics of the investing company and diversification grade of the firm and investor. They are grouped into the following categories: 'risk and return', 'investor and investor strategy', and 'investment pressure'. This builds a preliminary concept, as illustrated in Figure 30, to be investigated in more detail and complemented in the forthcoming research phases.

Figure 30: General influence factors on valuation processes (capital budgeting processes and CoC approaches), presented in an initial concept map format.



In addition, the mentioned initial subcategories and themes (Figure 31) build the basis for investigations into the ongoing quantitative and qualitative research, particularly for the first exploratory research phase (section 4.2). In this phase, it is decided whether to assess the found topics using quantitative and/or qualitative analyses. In addition, the initial subcategories and themes are used to create an *initial coding frame* (ICF) which is subsequently updated in both the qual and QUAN phases to be later applied within the QUAL phase (section 4.4.3).

Figure 31: Preliminary subcategories and themes to investigated in more detail in the forthcoming research phases (ICF after literature review with knots in software nVivo10™).



3 RESEARCH PHILOSOPHY AND ETHICS

Before discussing the applied methods in this research in chapter 4, including the philosophical assumptions about the MMR approach, the chosen philosophical stance, the underlying philosophical assumptions, and the role of the researcher's value are discussed. The aim of this chapter is to outline the relevant parts of this topic for this research.

3.1 Research Philosophy

3.1.1 Research Philosophy in Literature

3.1.1.1 Definition and Relevance of a Philosophical Stance

The term 'research philosophy'[44] 'relates to the development of knowledge and the nature of that knowledge' (Saunders et al., 2009:107). It involves 'examining the nature of knowledge itself, how it comes into being and is transmitted through language' (Patton, 2002:92).

As in all professions and human activities, social researchers also perform their work based on a specific understanding of nature and reality and on their role in society. At the same time, the inquirers have a self-understanding about the meaning, purpose, and role of their research in society and the optimal form of competent study—whether this self-understanding is implicit or explicit (Greene and Hall, 2010). Having said that, the philosophy of science plays an important role for social inquirers (Biesta, 2010, Maxwell and Mittapalli, 2010). As recommended by Greene and Caracelli (1997), researchers applying MMR should be explicit about their research philosophy. However, 'how this philosophy is packaged' is less relevant (Greene and Hall, 2010:121). Instead, it is more practical to focus on individual philosophical assumptions, particularly on the two main concepts: ontology and epistemology (Biesta, 2010), as discussed in more detail below.

To illustrate this focus in terms of philosophy in more detail, Biesta (2010) has evaluated seven different levels, organised in a hierarchical order, to identify whether particular philosophical issues exist (Table 15). This evaluation has been performed, since the provided MMR typologies (section 4.1.1.4) provide valuable insights into how MMR works (section 4.1.1.4); however, it reveals little about both the ideas behind the typology and the philosophical aspects (Biesta, 2010).

Table 15: Several levels of MMR to identify philosophical issues (adopted from Biesta, 2010).

Level no.	Level	Philosophical issues
1	Data/sources	No particular problem arises in the numbers and text
2	Methods	No particular problem arises in the quantitative and qualitative data collection and analysis and its combination and interpretation
3	Design	Issue with interventionalist versus noninterventionalist designs, while, according to Biesta (2010), only with an interventionalist approach, can knowledge be gained, following pragmatism
4	Epistemology	No particular problem arises
5	Ontology	Mechanistic versus social ontology: mechanistic ontology looks at the world in terms of what causes events, whereas social ontology sees the world of meaning and interpretation without excluding the world of causes and effects.
6	Purpose of research	No particular problem arises within the relevant distinction whether the research objective is explanatory (seeks to explain) or interpretative (seeks to understand)
7	Practical roles of research	No particular issues arise while distinguishing between the technical versus cultural role of research, while the former provides practitioners methods and techniques to achieve their objectives and the latter different ways of viewing and understanding their practice

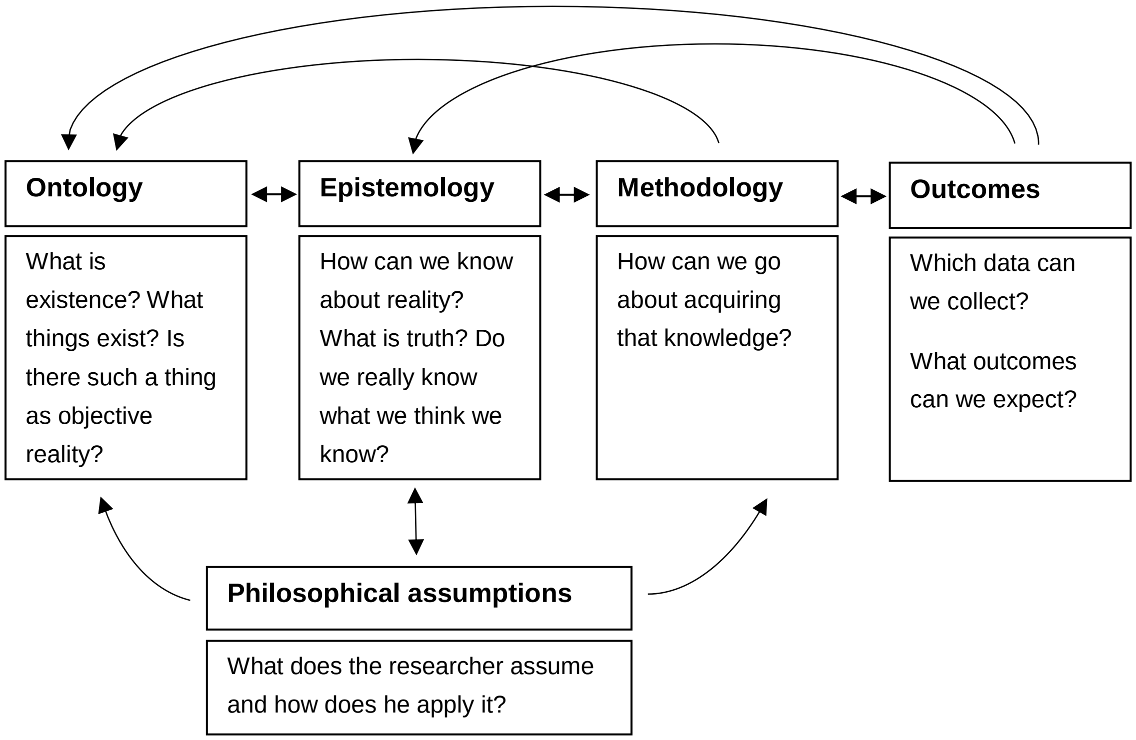
Ontology and epistemology are two key concepts in research philosophy. They define the individual philosophical assumptions, which are discussed in more detail below:

- *Ontology* is concerned with the researcher's individual perspective of the form and nature of reality, both from a physical as well as a social and political point of view. It is about the researcher's assumptions about how the world works and his or her commitment to a particular perspective (Heron and Reason, 1997, Hay, 2006, Carter and Little, 2007, Saunders et al., 2009, Easterby-Smith et al., 2012). 'Ontology is the starting point of all research' (Grix, 2002:177), logically followed by positions about epistemology, methodology, and outcomes (Figure 32).
- For *epistemology*, there are different definitions. On the one hand, it is about researchers' individual positions regarding the constitution of acceptable knowledge in a specific field of research (Saunders et al., 2009, Bryman and Bell, 2011) and the assumptions about the 'best ways of inquiring into the nature of the world' (Easterby-Smith et al., 2012:60), particularly regarding the methods applied, validation processes, and approaches to learn and gain knowledge of the social reality (Blaikie, 2000, Ritchie et al., 2013). On the other hand, a more widely used definition speaks about epistemology as the study of knowledge (Horrigan, 2007) which is closer to its word stem, based on the Greek terms 'episteme' (= knowledge) and 'logos' (= study). For both definitions, the researcher's epistemological position can be found by asking, 'what and how can we know about [reality]?' (Grix,

> 2002:180). In addition, it guides the researcher's methodological choices, and it is influenced by axiology (Carter and Little, 2007).[45] Measures of research quality, the form, and its representation in the analysis and the writing style provide insights into the researcher's epistemological position (Saunders et al., 2009).

Thinking about ontological and epistemological assumptions or choices before beginning to define the applied methodologies (chapter 4) in the research is essential. However, it is not only a one-directional process, as depicted in the simplified illustration by Grix (2002), but also a complex vice-versa process (Figure 32) in which the evaluated methodologies and the outcomes can influence the philosophical assumptions again (Cua and Garret, 2009).

Figure 32: The key building blocks of research with examples of fundamental questions and their interactive interrelationships (adopted from Grix, 2002, Cua and Garret, 2009).



3.1.1.2 Positivism versus Interpretivism

The literature about research philosophy provides a wide range of different philosophical positions and stances, as comprehensively outlined by Niglas (2001, 2017). Positivism and the opposite, a non-positivist stance, are predominantly discussed (e.g. Niglas, 2001, Monette et al., 2013) while Saunders et al. (2009) includes realism. Since a broad discussion of various paradigms is beyond the scope of this thesis, a brief contrast between the two opposite philosophical positions, namely positivism and interpretivism, is presented here, while realism and its variations are outlined in section 3.1.2.

Within *positivism*, the ontological assumption is based on *objectivism*, asserting that there is an externally existing world and that social entities are independent of the social actors' beliefs and perceptions of them (Saunders et al., 2009, Monette et al., 2013). The positivist's goal is to discover laws to explain the way the world works (Monette et al., 2013) and to create generalisable statements about cause-and-effect relationships (Kanellis and Papadopoulos, 2009). This means that a viable epistemological position for positivists can only be reached if the knowledge has been produced with the help of objective approaches that investigate the external existing world (Monette et al., 2013). Such research must be conducted in a value-free way, i.e., based on passive and neutral role, and without influence of past experience and social, moral, and cultural beliefs (Kanellis and Papadopoulos, 2009). This involves a 'non-normative, non-judgemental detachment of the researchers in relation to what they are studying.' (David and Sutton, 2011:76). Therefore, conducting research from a positivistic position is only possible if the methods adopted from natural sciences are applied to analyse the social reality (Bryman et al. (2008), (Kanellis and Papadopoulos, 2009).

The criticism of the traditional positivist perspective about reality allowed for the emergence of different alternatives, of which *interpretivism* is commonly stressed as the opposite stance of positivism (Bryman et al., 2008, Saunders et al., 2009, Monette et al., 2013). All the different intellectual traditions that are integrated into interpretivism take critical positions towards the approach to integrate models of natural sciences within social reality (Bryman et al., 2008). Instead, positivists perceive the social world and the knowledge about it to be created by the interpretation of human perception and shaped by exchange of meanings in social interactions (Monette et al., 2013). From an epistemological point of view, interpretivists place emphasis on gaining deeper knowledge of human thinking and behaviour by integrating the researcher's point of view and interest into the study (Bryman et al., 2008).

Interpretivists often argue that positivists do not properly consider the dimension of the social world, and they stress the necessity of a subjective understanding, in contrast to a superficial explanation of cause-and-effect relationships (Saunders et al., 2009, Monette et al., 2013). However, this criticism falls short in explaining positivists' understanding of reality, since they 'do not necessarily deny the existence or importance of subjective experiences, but they do question whether the subjective interpretations have scientific validity' (Monette et al., 2013:40).

The author of this thesis recognises the necessity of the various traditions and paradigms. After making the link between paradigms and methodology in the next section, the chosen philosophical stance is discussed in relation to other applicable traditions with MMR (section 3.1.2).

3.1.1.3 Connecting Philosophical Stances with Methodological Approaches

The position of having a link between a paradigm and the applied methodology has long been the traditional view in literature, particularly in which positivism is associated with quantitative and interpretivism with qualitative methods (Johnson and Gray, 2010). Although many researchers have traditionally viewed the difference between the two methods not as an issue of quantification, but as an issue in terms of their ontological and epistemological foundations (Guba and Lincoln, 1989, Bryman et al., 2008), and combining both would trigger major concerns within those paradigms[46], contemporary literature has increasingly been challenging this understanding of a strict and exclusive link between a philosophical stance and the applied methodology (e.g. Bazeley, 2004, Monette et al., 2013). In the current research world, with a multitude of approaches, an ‘overlap and mutual influence between different traditions’ (Niglas, 2001:2) is experienced. Therefore, it is argued that there is no longer such an exclusive connection and that the ‘landscape of social scientific inquiry is continuously changing so that the paradigm system cannot been seen as fixed but as evolving through time’ (Niglas, 2010:218). As Maxwell and Mittapalli (2010) outline, research practices either do not solely depend on or are determined by the selected philosophical stance. The chosen research design and methods might be influenced by more than one paradigm (Pitman and Maxwell, 1992, Greene, 2000). There has also been a long debate about the right paradigm in MMR (Hall, 2013). Many writers regard *pragmatism* as the main philosophical paradigm for MMR (e.g. Rossman and Wilson, 1985, Patton, 1990, Tashakkori and Teddlie, 1998, Biesta, 2010, Greene and Hall, 2010). In essence, they articulate that the research should be concerned with those applications that work and solve their stated problems.

Following this contemporary perspective within this thesis, the overlap of paradigms and between paradigms and methods is acknowledged, although a certain linkage between paradigm and method still exists. However, it is argued that pragmatists underestimate the influence of philosophical assumptions on the research methods, in particular for the combination of quantitative and qualitative approaches specific to the chosen MMR approach herein, and on the explicit and sometimes implicit objectives, purposes, and actions of the researcher (Maxwell and Mittapalli, 2010).

With regard to MMR, the defined prioritisation on either the quantitative or the qualitative phase (section 4.1.1.4) can be associated with particular philosophical stances. In the case of an emphasis on the quantitative phase, post-positivism is a typical philosophical stance of such a researcher, while emphasis on the qualitative phase is often found in the case of researchers following interpretivism (Creswell et al., 2003). However, this research puts an equal emphasis on the primary phases (section 4.1.2.1); therefore, the assumptions of both rather opposing philosophical stances must be considered in the same study and must subsequently shape the chosen paradigm for this research (section 3.1.2). This is supported by Creswell et al. (2003), who stress that MMR cannot be based on a single paradigm and that the paradigm should be chosen in line with applied MMR typology.

3.1.2 Philosophical Stance and Assumption of this Research

The chosen philosophical stance is chosen based on the author’s personal beliefs, which have been shaped during the course of conducting the research. The nature of the research topic itself has influenced the philosophical assumptions of the underlying research. Furthermore, theh chosen paradigm aims to best answer the research questions, applying the chosen specific research design.[47]

3.1.2.1 Critical Realism as Underlying Research Stance

C*ritical realism* is adopted as the underlying research stance of this thesis. Critical realism was largely established by the writings of the British philosopher Roy Baskhar (Bhaskar, 1975, 1979, 1989, Archer et al., 1998). Since critical realists today draw upon a pool of scholars (e.g. Archer, 1982, 1995, Archer et al., 1998, Bhaskar, 1975, 1979, 1982, Danermark et al., 2005, Gorski, 2013, Lawson, 1989, 1998, Sayer, 2000), critical realism is not composed of a uniform framework, methodology, or set of beliefs. It consists rather of 'a series of family resemblances in which there are various commonalities that exist between the members of a family, but these commonalities overlap and crisscross in different ways' (Archer et al., 2016:1). A normative agenda with genetic features unites it as a discrete metatheory, combining ontological realism, epistemic relativism, and judgmental rationality (Bhaskar, 1975, 1979, Archer et al., 2016).

Critical realism puts a strong focus on ontology. In doing so, *ontological realism*, as one of the major tenets of critical realism, states that much of reality exists independently of what we are aware of and what we think of it, and that reality therefore does not entirely respond to empirical surveys (Bhaskar, 1975, 1979, Archer, 1995). As stated within this research, critical realism puts particular attention on questions about what entities exist in the social world and features to overcome the historical focus of social sciences on sole empirical surveys with an insufficient amount of attention on epistemology at the expense of ontology.

Objectivism as an ontological position is an inherent concept of realism (in general) and positivism (Burrell and Morgan, 1979, Holden and Lynch, 2004, Saunders et al., 2009). Therefore, it can be argued that such collected data are less vulnerable to biases and are hence more objective (Saunders et al., 2009). Similarly, but still distinct from positivism—in which researchers are strictly not affected by the research subject (Remenyi et al., 1998)—in realism, objects in reality exist quite independently of the thoughts of humans, understanding, knowledge of their existence, or beliefs (Saunders et al., 2009, Ritchie et al., 2013). Realists try to advance to the one truth while being aware that the truth cannot be completely reached (Saunders et al., 2009). In addition, the realist perspective holds that beliefs are only an approximation of reality, whereas our understanding of reality is constantly improved with new observations (Blackburn, 2005). Therefore, realists have multiple perceptions about a single, mind-independent reality, in contrast to positivists searching for one concrete truth (Saunders et al., 2009).

Likewise, critical realists assume that reality is not composed of a single, observable, measurable, and determinable layer to be understood by observation, but that reality consists of multiple layers with structures and mechanisms influencing the aspects to be observed and experienced. Investigating these structures and mechanisms which cause facts and events, which are experienced and which can be empirically investigated builds the basis of critical realism to explore the social world. As such, to understand the investigated part of the social world while still critically reviewing causal models taken over from natural sciences, critical realists require a proper understanding of the social structure and mechanism that has caused the phenomena (Bhaskar, 1975, 1979, Sayer, 2000, 2004, McEvoy and Richards, 2006).

Since critical realists agree that we can only see a part of a whole picture, they consequently accept deficiencies in mental receptiveness and the fallibility of knowledge. According to critical realists, a full comprehension of reality is not possible, since our perception is influenced by our available theoretical resources and our research interest (Bhaskar, 1975, 2008). This is also due to the fact that the social world in the form of 'open systems' (Bhaskar, 1975:33) is far too complex to be fully understood. However, it is possible to receive empirical feedback from the accessible aspects in reality (Sayer, 2004). This differentiated perception about reality has shaped the author of this thesis, and it has led him from his originally positivistically shaped perception of reality, as a graduate of natural sciences—ontologically and particularly epitomologically—to a more differentiated perception of a critical realist within this research.

In addition and in line with the researcher's philosophical stance, Bhaskar (1975, 2008) and Archer et al. (1998) differentiate between two kinds of knowledge: the transitive and intransitive objects of knowledge. The latter consists of knowledge independent of human activities, and it refers to sciences based on causal mechanisms, such as gravity, matter, energy, life, and death, among other things. On the other hand, transitive objects of knowledge are invented by human beings and also refer to changing dimensions in sciences with regard to historical conceptions of reality, including philosophical stances, theories, models, and approaches. These objects of knowledge are usually situated within a context and/or concept, and they are transformed by human activities. In this research, transitive objects of knowledge are the central point. For instance, these objects of knowledge embrace both the understanding of uncertainty and risk within a certain cultural and social context and the developed and applied methodologies to assess risk and to monetarise risky objects and valuate assets. Having outlined these points, critical realists' understanding is best described as a form of *epistemic relativism* in which most objects of knowledge about reality are historical; socially and culturally embedded; and context-, concept-, and activity-related (Mingers, 2004, Wikgren, 2005, Bhaskar, 2008).

Although critical realists embrace an epistemic relativism, the search for knowledge must not be regarded as a futile effort by following this philosophical stance. It simply means that our conception of reality is always based on past facts and events, influenced by a specific perspective, and it can be fallible. To overcome these challenges, methodological pluralism needs to be applied (Bhaskar, 2010a, Næss, 2010:78, Archer et al., 2016) (section 3.1.2.2), as outlined as a rationale for the applied MMR design (section 4.1.1.2).

To illustrate the tenets of critical realism from another perspective, two different branches of realism are discussed in more detail. In *direct realism*—the first branch of realism—the truth is what humans can sense as reality, nothing more. The world is accurately portrayed by experiencing it through human senses, and there are no illusions (Blaikie, 2009, Saunders et al., 2009). What researchers with other philosophical positions call illusions are in fact—according to direct realists—inaccuracies in sensations due to insufficient access to the necessary information in order to appropriately understand the phenomena (Saunders et al., 2009). On the other hand, *critical realists* claim that many social phenomena in the real world are not directly experienced, but rather indirectly sensed through images or representations of the objects in reality (Bhaskar, 2008, Saunders et al., 2009). Often, there are illusions, since certain things in the real world can only by seen *through* sensations, representing the reality (Saunders et al., 2009). As such, for critical realists, three domains exist in reality, as Bhaskar (1975, 2008) outlines by stratifying ontology in ‘real’, ‘actual’ and ‘empirical’. The critical realist’s reality range hence from the directly observable (the empirical domain) and the reality that is directly observable or not (the actual domain) to the underlying real and deep mechanism generating events that are observable or not (the real domain) (Delorme, 1999, Mingers, 2004, Alvesson and Sköldberg, 2009).

Direct realists follow an approach relating to scientific inquiry to gain knowledge—similar to positivists (Saunders et al., 2009)—following an objectivistic view of epistemology (Johnson and Duberley, 2000, Coghlan and Brannick, 2014). Apart from reaching acceptable knowledge by observing ‘real’ objects (Saunders et al., 2009), credible data can also be provided by measuring social phenomena (Alvesson & Sköldberg, 2009) such as the feelings and attitudes of workers—which are normally attributed more to a constructivist stance—by investigating the gathered data from a more objective point of view and by presenting them in a statistical form (Saunders et al., 2009). As in positivism, realism in general follows a ‘scientific approach to the development of knowledge’ (Saunders et al., 2009:114), while analysing the external reality. In contrast to positivism, however, the epistemological approach of a realist does not primarily focus ‘on causality and law like generalisations [to gain knowledge while] reducing [the observed] phenomena to simplest elements’ (Saunders et al., 2009:119), and they focus on explanation within a context or contexts (Bhaskar, 1979, 2008). For realists, causality is a potential correlation of events, rather than an automatic process (Easterby-Smith et al., 2012).

For *critical realists*, however, acceptable knowledge is also built by following a more subjectivist view on epistemology, since the external world cannot only be accessed objectively (Coghlan & Brannick, 2014), in contrast to their objectivistic view on ontology (Saunders et al., 2009). Since business and management research is always about people being self-reflecting and taking decisions and about human organisations, and not about natural items, as in natural sciences, a complete objectivist approach to gain knowledge as positivists suggest is not entirely possible (Schutz, 1970, Bryman and Bell, 2011). This critical realists’ perspective can be illustrated with their two-step approach to the experiencing of reality. First, while observing the objects in the world, sensations are conveyed. Second, a mental process starts after the sensations are processed by researchers’ sensory organs (Saunders et al., 2009). Critical realists accept various forms of knowledge, such as material, psychological, social, and conceptual. Each of them must be analysed with different research methods (Mingers, 2004). In contrast, *direct realism* only works with the first step when directly observing the objects in the world (Saunders et al., 2009); i.e. only those phenomena that are processed by senses are relevant for science (Blaikie, 2009). This does not seem to include all possibilities to understand the social reality. Nevertheless, both realist schools embed their explanations of the real world within a context or contexts. Moreover, the perspective of direct realists on the world is on one level, such as the individual, the group, or the organisation, and they do not recognise that the chosen level can change reality. On the other hand, critical realists develop knowledge by conducting multi-level studies and by recognising both the capacity of the various levels, such as the individual, the group, and the organisation, to influence each other and the potential of influencing researchers` understanding of the reality being studied (Saunders et al., 2009). Moreover, critical realists argue that understanding the real world is only possible if the social structures that have determined the phenomena, and that are now the object of research, are understood (Bhaskar, 2010b). In addition, the real world is 'interpreted through social conditioning'[48] (Saunders et al., 2009:115). As such, the knowledge of the world cannot be acquired without incorporating the influence of social actors in those processes (Dobson, 2002). Furthermore, while direct realists see insufficient data as a means of inaccuracy in sensations, critical realists are generally more aware of the risk of misinterpretations of phenomena creating sensations (Saunders et al., 2009).

As a third tenet of critical realism, epistemic relativism is combined with *judgmental rationality*. This asserts that there are criteria for judging reality that are better or worse. The aim of each piece of research is to create a plausible model that tries to provide a descriptive or explanatory account of the objects of inquiry. However, since not all these accounts are created equally, we are required to choose between competing models while being able to affirm one model to another based on relative objective reasons. Having said that, critical realists are of the opinion that, in social science, knowledge of reality can be refined and improved over time. At the same time, they make statements about reality in a relatively justified manner, while knowledge about reality is still historical, context-dependent, and culturally and socially embedded (Niiniluoto, 1991, Bhaskar, 1998, Boyd, 2002).

3.1.2.2 Critical Realism and MMR

Based on the previous discussion, shaped by the various writings of Bhaskar (1975, 1979, 1989, 2008, 2010b, 2010a), Bhaskar et al. (2017), and Bhaskar in Archer et al. (1998), the author has both an objectivistic view on ontology (as an ontological realist, believing that a real world exists with certain deep features) and a subjectivistic view on epistemology (as an epistemic relativist, believing that all our knowledge is socially produced, transient, or fallible). These are combined with a judgmental rationality to develop a first model (section 2.7.3), describing the investigated social reality, to be improved both during the course of the research (section 5.5) as well as in further research to come—if set in different social contexts, both from a cultural point of view and from perspectives of different levels. This understanding also shaped the chosen research design.

To date, critical realism is relatively seldom applied in MMR (Maxwell and Mittapalli, 2010). However, in the last two decades, this paradigm has made it into MMR in related and similar topics to this research, such as accounting (Covaleski and Dirsmith, 1990, Brown and Brignall, 2007) and economics (Lawson, 1989, 1998, Fleetwood, 1999, Downward et al., 2002, Olsen, 2004). In line with Zachariadis et al. (2010), and based on Bhaskar (1975, 1979), critical realism is of particular interest for the studied topic and applied MMR design, addressing central concerns of both natural sciences (with regard to technological features in this research, including risk assessment and the mathematical display of risk as a monetary value) and social sciences (due to the topic's entanglement with the social context of organisations and the market).

As with Maxwell and Mittapalli, the author of this thesis views philosophical assumptions as 'lenses for viewing the world, revealing phenomena and generating insight that would be difficult to obtain with other lenses' (2010:147). A *dialectic stance* takes up this idea and pursues the goal of starting a dialogue between various points of view on the researched objective to deepen the understanding, instead of just broadening and triangulating findings. In addition, it looks at opposite paradigm attributes, such as value-neutral and value-involved as well as inductive and deductive attributes, 'as continua rather than dualism' (Greene and Hall, 2010:123). According to Maxwell and Mittapalli (2010), critical realism can also facilitate such a dialogue, and it eases the issues occurring in other philosophical stances. It contributes to an improved communication and cooperation between the essential methodological characteristics of MMR while combining quantitative and qualitative approaches. Critical realism thus has the major advantage of providing a dialogue between the quantitative and qualitative research approaches and easing the so-called *paradigm war* (Datta, 1994) (see section 4.1.2.3), in contrast to other philosophical stances that would see the combination rather as a problematic union.

Furthermore, MMR is applied to overcome the naïve attention on simple empirical surveys and the focus on epistemology (Archer et al., 2016), by applying different perspectives and critical methodological pluralism (Danermark et al., 2005) based on epistemic relativism (section 3.1.2.1) to analyse underlying social entities and their features. In addition, with regard to the ontological stratification (Bhaskar, 1975, 2008), also explained above, the author accepts that there is one *real* world, consisting of events that are sometimes able to be directly experienced or observed and sometimes not, and that there are accessible and inaccessible mechanisms and structures producing those events (Blaikie, 2009). The physical and social objects in reality are composed of certain structures and contain power, both of which cause change when activated. This change caused by the activation of power is referred to as *actual* (Zachariadis et al., 2010). This actual is triggered in this research in particular by discussing defined investment scenarios within the interview phases (section 4.4.1.2) to activate certain dynamics based on real circumstances and within the social context of organisations to get behind the scenes. In doing so, the goal is to investigate more than just the superficial *empirical*, which is the sole domain of observation within a quantitative survey (section 4.3.2). Therefore, the applied MMR design starts in a sequential succession: the empirical domain with the primary QUAN phase is investigated first, followed by the primary QUAL phase, to activate certain power during the interviews to reach parts of the actual domain.

Based on a critical realist's ultimate goal of research to develop an in-depth level of explanation and understanding, the applied sequential *explanatory* MMR (section 4.1.2.1) has been deliberately chosen. As such, the application of both quantitative and qualitative approaches could be an optimal choice to reach the research's goals, as critical realists do not predominantly focus on either determining generalisable laws (with quantitative approaches, such as in positivism) or identifying the beliefs or experiences of social actors (with qualitative approaches, such as in interpretivism) (Bhaskar, 1979, 2014). According to critical realists, the methods should be chosen by the nature of the research problem. Furthermore, those methods must fit the research objective, not the applied philosophical stance, and they can be quantitative or qualitative (McEvoy and Richards, 2006, Saunders et al., 2009). In many cases, an effective approach is also the combination of quantitative and qualitative methods (Olsen, 2002), as systematically performed in MMR designs. As such, the associated typical problems of 'paradigm switching' (McEvoy and Richards, 2006:66) can be avoided by adopting a critical realist's stance. Performing MMR as critical realists makes sense particularly in case of triangulation for completeness and confirmation (McEvoy and Richards, 2006), as has been applied in this research in the inference phase (section 4.5.2).

Since critical realists accept the importance of multi-level studies (i.e. on individual, group, and organisational levels), each of those levels can provide new insights while interacting with each other and can therefore have the capacity to change the understanding (Bhaskar, 1989). Therefore, this critical realists' understanding that the social reality can constantly change is much more in line with business reality and the purpose of business and management research (Saunders et al., 2009) to analyse current applications in use to find 'best practice' approaches and suggest improvements to practitioners. This multi-level understanding of and capacity for change can be optimally analysed with a sequential MMR approach in which, after the first primary phase (QUAN), the same topic can be investigated in a subsequent second primary phase (QUAL) from a different perspective and level while being prepared, as critical realists, that the potentially new insights can change the understanding.

3.1.2.3 Critical Realism and Researcher's Values

As critical realists, researchers are completely aware of being value laden and biased by their view of reality, their upbringing, and their education and cultural experiences, which could consequently have an impact on their research (Dobson, 2002, Saunders et al., 2009). During the research, this understanding must be constantly and carefully analysed to make necessary research choices about the structure of data gathering while reducing the individual biases of researchers' views on reality (Saunders et al., 2009). However, a complete value-free, strictly objective, and data-independent approach, such as positivists would suggest (Saunders et al., 2009), is not applicable to critical realists. Moreover, critical realists highly value personal interactions with participants (Saunders et al., 2009), which is ensured in this thesis through interviewing experienced practitioners as key data sources (section 4.4.1). In doing so, semi-structured interviews are the chosen data collection formats in the primary qualitative phases in this research (section 4.1.2.4). They are chosen to explore the social and psychological form of knowledge—relevant for a critical realist—and to receive an in-depth understanding why things are as they are (Mingers, 2004). Genuine in-depth interviews[49], which are regularly applied by constructivists, are not applied in this thesis due to their completely unstructured nature.

3.2 Research Ethics

Before starting any research project, the research design must consider any potential ethical issues to prevent any harm, embarrassment, and other material disadvantages to the researched population while gaining access to the data and conducting the entire research (Kemper et al., 2003, Saunders et al., 2009). Appropriate data access must be able to reveal the concerned reality in relation to the research objectives in order to "produce reliable and valid data" (Saunders et al., 2009:170). In doing so, various key ethical issues can arise. The researcher must be aware of various principles (Waldron, 1990, Kemper et al., 2003, Saunders et al., 2009) while complying with the following guidelines in the handbook of Research Ethics of the University of Gloucestershire (2008):

i) participants' privacy;
ii) the voluntary nature of participating in the research and the right to withdraw from a study, partially or completely;
iii) the participants' consent (Kemper et al., 2003);
iv) possible deception of participants;
v) confidentiality of data from individuals and their anonymity;
vi) participants' reactions regarding data collection techniques, including embarrassment, discomfort, stress, pain, and harm;
vii) intellectual property of participants and other researchers; and
viii) awareness of potential hidden agendas of other researchers in the literature review.

The applied MMR typology in this thesis, following an explanatory purpose with the timing (section 4.1.2.1) of a previous QUAN and subsequent QUAL phase, demands specific considerations in the study design regarding the use of the QUAN results for the QUAN and INF phases. Being a key point in predefining the study design before starting the first data collection (Bazeley, 2010), the following design configurations were employed to account for ethical issues:

- The survey in the QUAN phase asks the participants for permission to follow up with them for the subsequent research phase, incentivising the participants by offering them the research results (section 3.2.1).
- For those participants of the QUAL phase whose QUAN and QUAL results the researcher is interested in individually matching, the interviewees are explicitly asked for their consent (section 3.2.1).

3.2.1 Ethical Considerations in Quantitative Phase

In the performed survey, the research's ethical obligation is not only to protect the participants from any harm, but also to ensure data confidentiality and to obtain participants' consent (Kemper et al., 2003, Groves et al., 2011). Therefore, the survey design and its execution considered the following principles:

- The participants' informed consent was obtained on the first page of the survey. The participants were informed that all provided answers are kept strictly confidential, will not be passed on to third parties, and are used solely for the agreed purpose. The survey results are only used for academic research purposes. Moreover, it was ensured that identification of the participants and companies is not possible in publications.
- The collected data are only analysed on an aggregated level, and no individual answers were analysed.
- Regarding the participants' identification, email addresses were only optional fields, and individual names or company names were not asked for.
- It was ensured that the connection between identification possibilities and collected data is stored separately and only accessible by the researcher.
- Based on the applied sequential MMR design, i.e., with the link between the QUAN and the subsequent QUAL phases, the participants' consent was asked in order to be able to contact them again for a discussion of the survey results and a follow-up study.

3.2.2 Ethical Considerations in Qualitative Phases

Since qualitative methods take "the researcher into the real world where people live and work, and because in-depth interviewing opens up what is inside people—qualitative inquiry may be more intrusive and involve greater reactivity than surveys, tests, and other quantitative approaches" (Patton, 2002:402), there is a greater risk that the interviewees—in both the exploratory qual phase (section 4.2) and the primary QUAL phase (section 4.4)—can be harmed psychologically. However, assessing the potential ethical issues of this specific research topic reveals a lower risk of harming interviewees personally for two reasons. First, the research focuses on financial-technical questions and is fact-oriented and hence not emotion-oriented, for instance, when investigating personal and work situations. Second, the research focuses on business professionals who are familiar with such questions while producing arguments in internal investment decision-making processes.

In any case, the interviewees' rights must be respected, their informed consent must be obtained, and measures must be taken to protect the provided sensitive and confidential information by employing the following principles:

- At the beginning of the interview and before starting to audio record the interview, a mutual agreement was signed between the interviewee and the researcher about the researcher's handling of privacy of data and general confidentiality and the participants' consent to audio record the interview.

- The declaration given to the participants stated that all the collected data, including audio recordings and written notes, are only used for research purposes. Everything will be anonymous and kept confidential: neither the organisations' nor the participants' names are mentioned in the research study. To obscure participants' identities, pseudonyms are used. If direct quotes are used, any identifying information is removed to protect their identities. The data are stored securely (with no backups in cloud servers), and they are deleted 2 years after finishing the research. Even if the information gained in this study is published in research journals or presented at research conferences, participants' identities are still kept strictly confidential.
- The context of the interview was recorded in an electronic interview documentation sheet, archived separately from the interview content, as recommended by Flick (2014). This sheet includes the number and name of the candidate, his/her company, type of candidate (consultant or industry professional), type of employee, his/her position, academic qualification, professional experience in years and number of transactions, date, starting time, mode (face-to-face or telephone), location, and duration of interview.
- The same ethical considerations regarding confidentiality must be taken into account in the case of the mandated transcribers (Tilley and Powick, 2002) (section 4.4.2).

4 EMPIRICAL RESEARCH APPROACH AND METHODS

To answer the research questions as coherently and comprehensively as possible while exploring theory in practice, an MMR approach (Creswell et al., 2003, Teddlie and Tashakkori, 2009, Creswell and Plano Clark, 2011b) was applied. It begins with a detailed description of MMR and its purpose within this research (section 4.1), before illustrating each phase in the following subsections separately (sections 4.2, 4.3, 4.4 and 4.5). Designing the optimal methodological setup for this thesis follows the explanation as noted by Greene (2007:97): "methodology is ever the servant of purpose, never the master".

4.1 Data Collection and Data Analysis in MMR Design

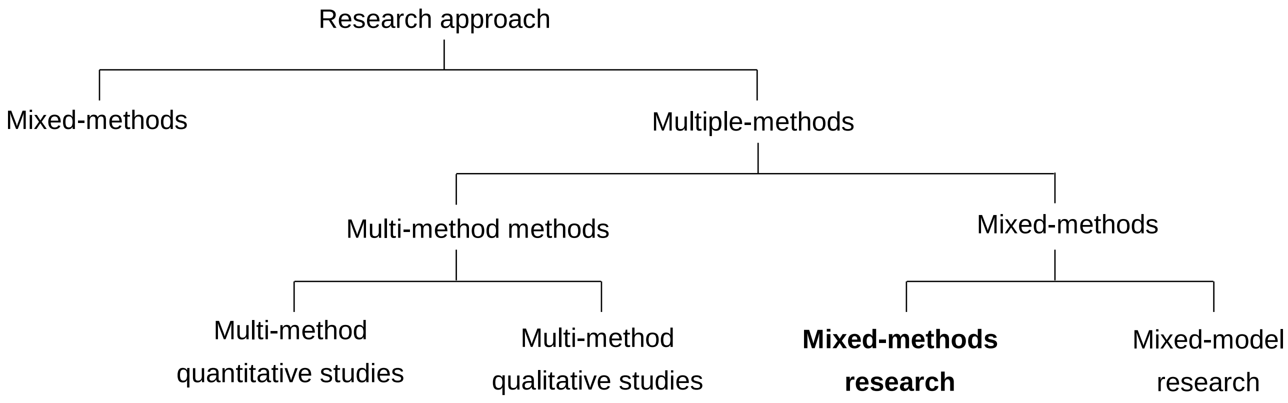
4.1.1 Mixed-Method Approach in Literature

4.1.1.1 Terminology

While the *MMR approach* is rather new in social science research (David and Sutton, 2011), some aspects about its epistemological basis and definition are still being discussed (Tashakkori and Teddlie, 1998, Erzberger and Kelle, 2003, David and Sutton, 2011). The first aspect comes from the perspective that an epistemological position between quantitative and qualitative methods is incompatible and subsequently a mix or combination of both approaches or—in other words—a triangulation between both approaches is not possible (e.g. Smith, 1983, Lincoln and Guba, 1985, Blaikie, 1991). Discussions about the combination of philosophical stances and methods are referred to as the 'paradigm debate' (Cook and Reichardt, 1979, Reichardt and Rallis, 1994). In the meantime, many issues with MMR have been discussed and are now no longer questioned, as outlined in several seminal books about MMR[50].

Even if there are still some authors who criticise the terminology for being confusing, for example, in some cases, the terms multiple approach[51] and MMR approach are used interchangeably (Bazeley, 2004, David and Sutton, 2011), Saunders et al. (2009) provide a comprehensive terminology and useful definitions (Figure 33): the *multiple method* is defined as a procedure using more than one data collection and data analysis technique, divided into the *multi-method* approach and the *MM approach*. The former term refers to using more than one technique, but either only qualitative or only quantitative techniques, while the latter applies both quantitative and qualitative elements (Saunders et al., 2009, Creswell, 2011, Schoonenboom and Johnson, 2017). Saunders et al. (2009) go even further and divide the MM approach into two different approaches. While MMR uses quantitative and qualitative methods at the same time, i.e., parallel or sequential, but does not combine them, the *mixed-model research* combines the two approaches. This means that in the mixed-model approach, it is possible to quantify qualitative data to be analysed statistically.

Figure 33: Research choices according to Saunders et al. (2009) (chosen approach in bold letters).



For this research, the mixed-methods (MM) approach in the manifestation of MMR was followed, whereby *mixing* is understood as a collective term for several procedures associated with linking, combing, integrating, and applying different methods (Creswell et al., 2003).

After having interviewed temporary leaders in MMR approaches, Johnson et al. (2007) provides the following definition:

> "*Mixed methods research* [italic letters are added] is an intellectual and practical synthesis based on qualitative and quantitative research; it is the third methodological or research paradigm (along with qualitative and quantitative research)" (129) .

This definition picks up some fundamental characteristics of the method, but lacks several key features of MMR, such as the nature of data collection (concurrent or sequential) or setting priority on the different research phases and the place of integrating the data, as outlined in more detail in section 4.1.1.4. A subsequent elaborate definition is provided by Creswell et al. (2003):

> "A *mixed methods study* involves the collection or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research" (212) .

In the literature, this understanding about the term MMR approach seems to be growing (Ivankova et al., 2006, Bryman, 2007, Saunders et al., 2009, Tashakkori and Teddlie, 2010, Creswell and Plano Clark, 2011b, Creswell, 2013); even in the past, many different names have been used; for example, multitrait-multimethod research (Campbell and Fiske, 1959), integrating qualitative and quantitative approach (Glik et al., 1986, Steckler et al., 1992), interrelating qualitative and quantitative data (Fielding and Fielding, 1986), and methodology triangulation (Morse, 1991). In addition, the increasing importance of MM approaches is underpinned by a specific journal about this newer science stream, named *Journal of Mixed Methods Research*.

In the academic literature, the term *triangulation* is often applied in close relation to or even as a synonym for the MM approach (Jick, 1979, Greene et al., 1989, Krishnaswamy et al., 2009). However, there are different understandings of this term, as summarised by Erzberger and Kelle (2003). It is no longer only understood in its original form within trigonometry (Erzberger and Kelle, 2003). Today, triangulation is an accepted concept meaning the cross-verification and mutual validation of the results by conducting studies from different perspectives and by employing multiple sources or data collection methods to reach higher and greater confidence and validity in the results and to reach a fuller and more complete picture of the studied phenomena with complementary results, in line with Erzberger and Kelle (2003), O'Donoghue and Punch (2003), Bogdan and Biklen (2007), Bryman (2007), David and Sutton (2011), and Cohen et al. (2013). Triangulation is an essential part for this research, applied explicitly within the INF phase (section 4.5).

4.1.1.2 Rationale for Choosing the MMR Approach

In addition to triangulation, there are several other reasons that an MMR approach is advantageous. The suitability of such rationales has been intensively discussed in the literature (e.g. Greene et al., 1989, Newman et al., 2003, Johnson and Onwuegbuzie, 2004, Bryman, 2006). Having evaluated various possible rationales, including those of Reichardt and Cook (1979) and Collins et al. (2006), this thesis follows the rationales for applying the MMR approach in line with the argumentation and findings, for example, of Greene et al. (1989), Bryman (2006), Plano Clark and Ivankova (2016), and Schoonenboom and Johnson (2017), as summarised in Table 16.

The integration of data and analysis in MMR, including quantitative and qualitative approaches, includes the combination of elements in such a way as to not only optimally answer the research questions, but also achieve the project goals. Mixed-methods research is able to generate findings that are greater than the simple sum of their components (Bazeley, 2010), thereby providing a more complete picture of the research problem (Greene et al., 1989, Tashakkori and Teddlie, 1998, Johnson and Turner, 2003) and offsetting or neutralising the limitations of the applied single methods (Creswell et al., 2003). The integration is not just a simple combination of qualitative and quantitative methods: “[…] they may indeed be more deeply intertwined” (Kane and Trochim, 2007:177). There seems to be a broad consensus that mixing different types of research methods is able to strengthen studies because the complexity of social phenomena can only be attempted to be understood with different and complementary methods (Greene and Caracelli, 1997, Johnson and Onwuegbuzie, 2004, Plano Clark and Ivankova, 2016). The combination and mixing of research strategies and understanding the strengths and weaknesses of performing MMR is based on what Johnson and Turner (2003:299) call the “fundamental principle of MM research”, which is shaped by the work of Brewer and Hunter (1989) and Tashakkori and Teddlie (1998). According to this principle, Johnson and Turner (2003:299) outline that “methods should be mixed in a way that has complementary strengths and nonoverlapping weaknesses”. The principle can be applied to all steps with a research process (Johnson and Turner, 2003, Johnson and Onwuegbuzie, 2004). Bryman adds that complementing quantitative results with qualitative findings is often referred to "as putting 'meat on the bones' of 'dry' quantitative" (2006:106) results. He also outlines that combining the two approaches leads to results and findings that are more useful for practitioners and that combining the researcher's and the participants' perspectives and combining both phases allow for the emergence of valuable findings through the diversity of views while uncovering hidden relationships and new meanings.

Table 16: Applied MMR rationales within this research (adopted from Greene et al., 1989, Greene and Caracelli, 1997, Erzberger and Kelle, 2003, Bryman, 2006, Plano Clark and Ivankova, 2016, Schoonenboom and Johnson, 2017).

No.	**Rationale**	**Description**	**Source**
1	Triangulation	Triangulation is understood as cross verification; research looks for convergent results and corroboration in outcomes from different applied methods.	Greene et al. (1989), Erzberger and Kelle (2003), Bryman (2006), Plano Clark and Ivankova (2016), Schoonenboom and Johnson (2017)
2	Offsetting strengths and weaknesses	Research seeks to offset the weaknesses of one method with strengths of the additional method.	Plano Clark and Ivankova (2016) Creswell et al. (2003)
3	Complementary	Research looks for enhancement, elaboration, clarification, and illustration of the outcomes of one method with the results of the additional method. The research findings are more than the sum of their parts.	Greene et al. (1989), Bryman (2006, 2007), Woolley (2008), Bazeley (2010), Yin (2014), Plano Clark and Ivankova (2016), Schoonenboom and Johnson (2017)
4	Development	Research looks to apply the outcomes from one method to develop or inform the subsequent method, for example, regarding the sampling.	Greene et al. (1989), Plano Clark and Ivankova (2016), Schoonenboom and Johnson (2017)
5	Expansion	More complete picture of research problem	Greene et al. (1989), Tashakkori and Teddlie (1998), Schoonenboom and Johnson (2017)
6	Strengthening	Study strengthening due to mixing different types of methods	Greene and Caracelli (1997)
7	Transformation	Transformative elements are included (see sections 4.1.1.2 and 4.1.2.1); however, no explicit action research is applied.	Greene and Caracelli (1997), Creswell et al. (2003)
8	Initiation	Research can also discover paradoxes, contractions and new perspectives.	Greene et al. (1989), Schoonenboom and Johnson (2017)
9	Validity and credibility	External and internal validity are both addressed in an efficient manner (section 4.6.1) while being able to enhance the integrity of the findings.	(Kemper et al., 2003), Bryman (2006), Schoonenboom and Johnson (2017)
10	Utility	Combining the two approaches will be more useful to practitioners	Bryman (2006)Schoonenboom and Johnson (2017)
11	Diversity of views	Combining researchers' and participants' perspectives can uncover hidden relationships between variables and reveal new meanings	Bryman (2006)

The rationales about the MMR approach are essential and build the foundation for subsequent research decisions, including timing (sequence) and priority (weighting) in the quantitative and qualitative research phases (strands), and regarding how to integrate quantitative and qualitative research components (Plano Clark and Ivankova, 2016).

4.1.1.3 Exclusion of Other Research Approaches

As outlined, applying a single method, for instance, a sole questionnaire or sole interview phase, would not be able to reveal as many insights as an MMR combing both phases. Therefore, a focus on a single approach is excluded. Furthermore, a *case study* approach (e.g. Tellis, 1997, Yin, 2011, 2014) would rather investigate the researched phenomena on a more theoretical basis; it could not analyse the 'application' of the researched objects in practice, nor could it include the knowledge of practitioners. *Focus groups* (e.g. Krueger and Casey, 1994, McLafferty, 2004, Rabiee, 2004) could be another way in which to investigate the researched phenomena, analysing the interaction between the group members in particular in relation to the research objects. However, studying interactions was not the focus of this research, which is why single interviews were preferred for the qualitative phases. Both previous approaches could still be complementary approaches in an alternative MMR setup.

Even if the applied research approach includes transformative elements (sections 4.1.1.2 and 4.1.2.1), a genuine *action research* (e.g. Reason and Bradbury, 2001, Fricke and Totterdill, 2004, Coghlan and Brannick, 2014) is not applied, since this research is not about implying mainly changes in an organisation, a certain group, or population. Instead, this research aims to make a profound contribution to the empirical literature and to the theoretical body of knowledge. In addition, it is about providing practitioners with additional knowledge and methods to solve practical issues while giving them additional food for thought to reflect on when applying valuation methods.

4.1.1.4 Mixed-Method Processes and Typology Design

The development and growing maturity of MMR as a separate research design type is also evident in the increasing number of authors applying and writing about MMR (Creswell et al., 2003, Miller and Cameron, 2011) as well as in the "evolution of procedural guidelines for mixed-methods studies" (Creswell et al., 2003:213), such as visual models, notification systems (e.g. Morse, 1991), and types of MMR designs (e.g. Greene et al., 1989, Patton, 1990, Morse, 1991, Steckler et al., 1992, Greene and Caracelli, 1997, Morgan, 1998, Tashakkori and Teddlie, 1998, Creswell, 1999, Patton, 2002). A historical reappraisal about MMR has been published elsewhere (e.g. Datta, 1994, Tashakkori and Teddlie, 1998, Creswell, 2002).

Mixed-method research approaches usually discuss the construction and application of certain, specific MMR designs. The term design is used either as a verb or a noun, while the activity of *designing* leads to the product *design*. Obeying strict rules in the process of designing can contribute to a strong design (Schoonenboom and Johnson, 2017), defined with different typologies, classifications, and taxonomy.

Mixed-method research designs can be classified into different types according to several proposed MMR typologies or taxonomy (e.g. Greene et al., 1989, Patton, 1990, Morse, 1991, Steckler et al., 1992, Greene and Caracelli, 1997, Morgan, 1998, Tashakkori and Teddlie, 1998, Creswell, 1999). Such typologies fulfil several purposes, such as providing practical guidance, legitimising the research field, and outlining new possibilities in performing MMR (Tashakkori and Teddlie, 1998). The MMR typologies must be selected for the chosen purpose, since not all of them are equally suitable (Schoonenboom and Johnson, 2017). Even if there is an ongoing debate about whether *MMR design typologies* are relevant and useful because they cannot capture all possible variations of the available design features, more complex variations of MMR designs, and the MMR designs of a larger iterative nature (Maxwell and Loomis, 2003, Greene, 2007, Hall and Howard, 2008, Guest, 2013), these typologies provide the researchers with valuable insights into choosing appropriate design features in relation to answering their research questions (Greene et al., 1989, Teddlie and Tashakkori, 2009, Creswell and Plano Clark, 2011b). However, there is a clear consensus that each MMR design is unique (Plano Clark and Ivankova, 2016), while some parts in its conceptualisation are still controversially discussed, such as whether setting priority is relevant (Plano Clark and Ivankova, 2016), whether the relative importance of one strand is predetermined based on the research questions (Greene, 2007, Leech and Onwuegbuzie, 2009, Creswell and Plano Clark, 2011b, Morgan, 2014), or whether a more flexible concept is developing itself during data collection and analysis (Teddlie and Tashakkori, 2009).

When following a typology-based approach (Plano Clark and Ivankova, 2016) and the corresponding straightforward visualisation concept of Morse (1991), additional assistance in determining the appropriate MMR typology for the considered study is given by the below-mentioned eight factors, or “dimensions” (Schoonenboom and Johnson, 2017:3), which are a combination of the seven factors of Schoonenboom and Johnson (2017) and the four decision criteria of Creswell et al. (2003). Three of those factors have already been introduced in section 4.1.1.1.

- The *purpose* of performing MMR is in essence about the rationale for choosing MMR, as outlined in section 4.1.1.2 (Schoonenboom and Johnson, 2017).
- *Timing or simultaneity and dependency (implementation).* The first term refers to the sequence of the qualitative and quantitative research phases in the data collection. Data collection of both phases can be either concurrent—occurring at the same time with no sequence—or sequential—taking place in phases over a period of time, with quantitative first or qualitative first (Greene et al., 1989, Morse, 1991, Morgan, 1998, Creswell et al., 2003, Schoonenboom and Johnson, 2017). The second term, dependency, is about whether the second phase is dependent on the results of the first phase (Schoonenboom and Johnson, 2017).
- To avoid leave the interpretation to the readers, setting the *priority* between the different research phases—either equal or with an emphasis on the quantitative or qualitative phase—is an essential part to be defined in the performed study (Creswell et al., 2003). Schoonenboom and Johnson (2017) use the term *theoretical drive* to describe and

distinguish between a qualitative dominant or qualitative driven, a quantitative dominant or quantitative driven, and an equal-status study. The decision about the weight may result from practical constraints in the research, such as access to participants, the amount of collected data, or the preference of the author or the audience (Creswell et al., 2003). Morse and Niehaus (2009) and Morgan (2014) did not allow the emphasised equal settings, which was criticised and later enhanced with the equal-status settings, as propagated by Greene (2015) and Schoonenboom and Johnson (2017).

- The *theoretical perspective* is another criterion that can either be implicit or explicit within an MMR study (Creswell et al., 2003). This perspective is the applied theoretical lens of the researcher, which includes the researcher's more informal philosophical lens on the topic, based on, for example, personal experience, history, culture, and gender; a more formal level; and the researcher's philosophical stance in research, as outlined in section 3. In particular, the implicit theoretical perspective can also include the use of transformative elements in the study, as advocated by Greene and Caracelli (1997). As such, the researcher might focus on bringing in change, which can directly be experienced by the study participants during data collection and/or after reading the final completed study (Creswell et al., 2003).
- The *stage or point of integration* (Creswell et al., 2003, Schoonenboom and Johnson, 2017), or the *point of interface* (Morse, 2003, Morse and Niehaus, 2009), is an essential step in MMR. Each genuine MMR has at least one stage of integration (Greene et al., 1989), Tashakkori and Teddlie (1998). The combination and integration of outcomes between quantitative and qualitative research within a single study at a particular stage in the research defines this step (Creswell et al., 2003), also known as making *INFs* (Erzberger and Kelle, 2003) (section 4.5). Inferences are the ultimate objectives of performing an MMR (Plano Clark and Ivankova, 2016). Inference can be broadly defined as "the process of drawing a conclusion from premises or assumptions, or, loosely, the conclusion so drawn" (Audi, 1999:427). Transferring this definition into MMR designs, "inferences are integrated study conclusions" being developed on the basis of interpreting quantitative and qualitative results in relation to answering the research questions (Teddlie and Tashakkori, 2009). It is a dynamic process in critically analysing the answers from the quantitative and qualitative phases to jointly answer the research questions (Plano Clark and Ivankova, 2016). While simultaneously examining the relevance and quality of the collected data (Plano Clark and Ivankova, 2016), "inference would consist of claiming that conclusions based on findings are indeed credible, warranted, or valid and are even "true" (Miller, 2003:426). Having said this, INF processes are ultimately engaged with making ontological claims (Miller, 2003), articulating what is out there to be known. As outlined in section 3.1.1.1, researchers' individual perspectives of the form and nature of reality are also influenced by defining how to acquire the knowledge, such as performing INFs and ensuring INF quality (Plano Clark and Ivankova, 2016). Such an integration can occur within the process of defining the

research questions, data collection procedures, and/or most typically in the data analysis processes and in the interpretation phase, after the data collection in the quantitative and qualitative phases has been finalised (Creswell et al., 2003, Morse and Niehaus, 2009, Teddlie and Tashakkori, 2009, Schoonenboom and Johnson, 2017). However, this classification might be too rough in certain cases, as outlined by Schoonenboom and Johnson (2017), for example, in the case of conducting interviews to improve questionnaires or selecting participants for the qualitative phase based on the pool of participants and the results of the previous questionnaire. Therefore, as an extension of Guest (2013), Schoonenboom and Johnson (2017) suggest defining the stages of integration as “any point in a study where two or more research components are mixed or connected in some way” (10) .

- Apart from the typological approach in MMR design, a distinction can be made between it and an *interactive/dynamic approach*, as frequently described in the literature with the approach of Maxwell and Loomis (2003). The former refers to design as a product, while the latter views design as a process (Schoonenboom and Johnson, 2017). Those two approaches have often been regarded as mutually exclusive. However, according to Schoonenboom and Johnson (2017), this view falls short in describing the process of applying design. It needs both approaches to construct the optimal design for MMR so that both can constantly check the fit of the different components to each other during the whole research process and, if necessary, adapt them (design as process). It also falls short in providing guidelines and indications, particularly for less experienced MM researchers, for how to optimally combine the different components (design as a product) (Schoonenboom and Johnson, 2017).
- An additional distinction can be made between a *planned and an emergent MMR design*. An emergent design (Creswell and Plano Clark, 2011b) can arise during the research process; for example, at the appearance of an inadequate component, a decision is taken to remedy this inadequacy with the subsequent application of a method of the other type (Morse and Niehaus, 2009). It is clear that such unforeseen events can by definition not be included in a planned design (Schoonenboom and Johnson, 2017).
- The differentiation between *partial and full MMR designs* describes the position on a continuum between mono-method design and full MMR design at each of its ends, while the partial MMR design is in the middle of both ends (Johnson and Onwuegbuzie, 2004). The full MMR design achieves the highest degree of mixing research methods in a single study, including combining quantitative and qualitative approaches to set “(a) research objectives […], (b) type of data and operations, (c) type of analysis, and (d) type of inferences (Leech and Onwuegbuzie, 2009:267).
- Furthermore, MMR designs can be distinguished by their grade of *complexity*. There are various ways in which to distinguish between simple and complex designs (Schoonenboom and Johnson, 2017). A division in simple designs with only one point of integration and in

complex designs with multiple points of integration is a common approach (Guest, 2013). Other distinctions regarding complexity are built on other grounds, such as in the case of multilevel mixed designs involving multiple levels of realities (Teddlie and Tashakkori, 2009); for example, data collection and analysis from the workforce and management in various organisations, and fully-integrated mixed designs with multiple points of integration, as presented by (Teddlie and Tashakkori, 2009).

4.1.2 Applied MM in this Research

4.1.2.1 Applied Explanatory Sequential Design

Being aware of the limitation of the typology-based approach and the fact that each MMR study, including the presented one, is unique, for instance, in setting the exact timing and the priority of the two strands and in determining how to perform their integration to answer the research questions, these generic types are understood as guidelines while still being able to apply certain flexibility to adjust and innovate within the selected MMR type, as outlined by Creswell et al. (2003).

Based on the above-mentioned eight dimensions for defining an appropriate MMR approach for a particular study (section 4.1.1.4), this research implements an *explanatory sequential MMR design (Quan → Qual)* (Creswell et al., 2003, Teddlie and Tashakkori, 2009, Creswell and Plano Clark, 2011b) (Creswell et al., 2003, Hanson et al., 2005, Teddlie and Tashakkori, 2009, Creswell and Plano Clark, 2011b) as the primary generic typology. This typology is primarily chosen because of its focus on explanation (Creswell et al., 2003), its comprehensibility (Biesta, 2010), and its ease to implement (Creswell et al., 2003). Additional reasons for this choice of typology, which provide further details about the applied characteristics of the applied typology, are given based on the eight dimensions (Table 17):

Timing or simultaneity and dependency (implementation). The choice for a sequential timing or research procedure occurring in chronical phases has the advantage of being straightforward—applying a step-after-step approach (Creswell et al., 2003)—and subsequently performed by one researcher (Ivankova et al., 2006, Creswell and Plano Clark, 2011b). After having initially collected quantitative results, it enables one to obtain in-depth qualitative descriptions. The chosen typology follows an earlier sequential model with the *explanatory purpose* of Steckler et al. (1992) in which a follow-up qualitative method provides the possibility “to assist in explaining and interpreting the finding of the primarily quantitative study” (Creswell et al., 2003:227); this is particularly interesting for exploring unexpected results in the quantitative study in detail (Morse, 1991). As such, one of the main purposes of this applied MMR design is to explain and interpret (Morse, 1991, Creswell et al., 2003). In doing this, this typology suggests selecting the most appropriate participants for the qualitative phase from the group of participants taking part in the previous survey (Creswell and Plano Clark, 2011a, Plano Clark and Ivankova, 2016), as outlined in more detail in section 4.1.3.3. The stated disadvantages of sequential typologies concerning the length of the implementation of the research, particularly for designs with equal priority settings (Creswell et al., 2003), as outlined below, and the challenges of contacting survey participants again in the subsequent qualitative strand (Plano Clark and Ivankova, 2016) are used in this research to its advantage while considering the involved ethical challenges (section 3.2). The length of the research afforded the researcher enough time to study this complex topic while being able to contact those survey participants with specifically interesting answers and interest in the topic again, as indicated in the questionnaire. Regarding dependency, the later QUAL phase depends on, emerges from, or builds on the previous QUAN phase. As such, there is an interrelation between the research questions regarding the quantitative and qualitative phases (Schoonenboom and Johnson, 2017).

Priority (theoretical drive). The setting of the priority, however, was not defined at the time of choosing the appropriate typology for this research. The setting of the priority followed a rather flexible, dynamic approach after having performed and evaluated both strands (section 4.6.5): they are now regarded as equally important, with major emphasis. This equality is also given because of the applied research duration spent on the data collection and data analysis of quantitative and qualitative phases. Both primary phases (QUAN and QUAL) are indicated in capital letters, based on the notification system of Morse (1991). Since the author of this study was aware of the risk regarding the length of the research (Creswell et al., 2003) due to the sequential typology and the structuring of the probable equal emphasis on primary quantitative and qualitative phases at the time of study, the structure of the research was worked out in detail to perform the research in a single study. The research lasted approximately 12 months in each primary phase, with the quantitative data collection and analysis mainly occurring in 2016 and the subsequent qualitative analysis mainly in 2017.

Figure 34 and Table 17 illustrate the chosen and applied general “sequential explanatory design” (Creswell et al., 2003:223) based on the notification system of Morse (1991): the sequence of the QUAN preceding the QUAL phase is explained with an arrow (→), while the uppercase letters for the quantitative and qualitative phases indicate the major emphasis of the study (priority) on data collection and analysis.

Figure 34: General sequential explanatory design, applied with equal, major priority setting (adopted from Creswell et al., 2003).

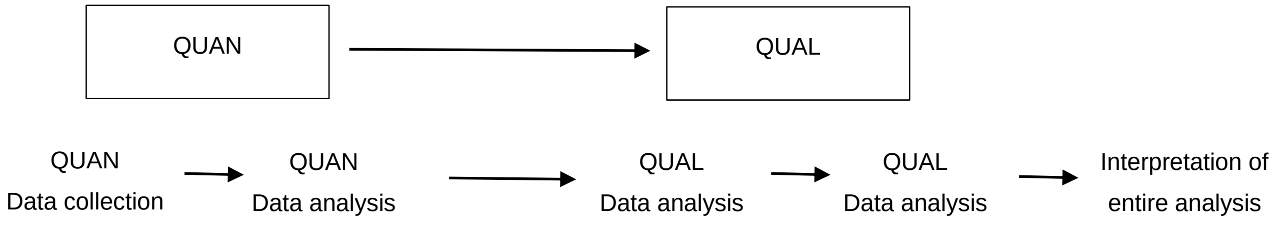


Table 17: Sequential explanatory design, described by eight decision criteria to determine the appropriate MMR typology for this research (adopted from Creswell et al., 2003, Schoonenboom and Johnson, 2017).

Decision criteria	**Choice for this research**
Purpose	Explanation and interpretation
Simultaneity and dependency	Sequential and dependent
Priority (theoretical drive)	Equality
Theoretical perspective	Transformation
Stage/points of integration	Interpretation phase
Typological vs. interactive design	Typological
Planned vs. emergent design	Planned
Partial vs. full MMR design	Almost full MMR design
Complexity	Simple approach (in general)

Theoretical perspective. The theoretical drive in this research is shaped by the chosen philosophical stance (section 3.1.2.1) and the interest in transformative elements of the research design to bring about a direct change to the views and opinions of the participants during the data collection procedure (e.g. section 5.3.3.5) and/or to the audience reading the results of this study.

Stage/point of integration. In principle, the selected MMR approach design follows a straightforward and typically found approach regarding the stages of integration and making INFs (Creswell et al., 2003): the primary stage of integration occurs in the interpretation phase, after the data collection of the QUAN and QUAL phases have been finalised (section 4.5.2). While also allowing a wider sense of combining, connecting, and making INFs between the phases in line with arguments of Guest (2013) and Schoonenboom and Johnson (2017) (section 4.1.1.4), the participant selection for the QUAL phase is based on the pool of participants of the QUAN phase. In addition, an analogical logic is also applied to define the appropriate interview questions in the QUAL phase based on the findings from the QUAN phase, in line with the explanatory drive of the study. Moreover, a selective number of interviews are performed in the exploratory qual phase (section 4.2) to find interesting key topics for the QUAN and QUAL phases and to improve the questionnaire for the QUAN phase (see paragraph *Complexity* below, sections 4.3.2.1 and 4.5.1).

Typological vs. interactive design. The typological design is the predominant criteria in this research, since it provides the essential guidelines for optimally combining the different parts of the MMR, although the fit of the different components is checked to a certain extent.

Planned vs. emergent design. A planned design is chosen, and no particular emergent patterns have been initially expected. Also, none are then encountered.

Partial vs. full MMR design. A full MMR design cannot completely be reached, even if the research objectives, type of data, operations, and analysis are based on the quantitative and qualitative approaches. However, INF analyses are only performed with qualitative methodologies (section 4.5).

Complexity. In general, the chosen MMR design is straightforward, easy to implement, and comprehensible. However, a certain amount of complexity in this study is added by introducing an additional minor emphasised qual phase before the primary QUAN phase, which is the basis for building the questionnaire of the QUAN phase and preselects and predefines those questions to be asked in the QUAN and/or QUAL phase.

4.1.2.2 Overview and Research Stages

Since this MMR approach begins with an initial exploratory qual phase, the developed explanatory sequential MMR design for this research is composed of four distinct phases, including the final INF phase (Figure 35). After having performed initial exploratory interviews (qual) to explore the applied valuation methods and some first determinants for performing a valuation within the area of RES-E investments, the first primary phase (QUAN) is composed of a survey to identify the relevance of the available valuation methods and determinants. This quantitative data collection and quantitative data analysis approach is performed on a representative sample for the German and Swiss RES-E investment population (see section 4.1.3). In the subsequent second primary phase (QUAL), qualitative interviews with experienced professionals, based on a purposefully selective sample of the survey participants, are conducted to investigate specific and more complex issues in the valuation of RES-E investments, identifying additional factors and triangulating the quantitative results. The results of the two main approaches are merged in a combined analysis within the final INF phase.

Figure 35: Overview of the applied research design (adopted from Greene and Hall, 2010, Creswell, 2013).

Explanatory sequential MMR design (qual→QUAN→QUAL)

Initial exploratory qualitative interview phase	**Primary quantitative survey phase**	**Primary qualitative interview phase**	**Inference**
▪ Qualitative ▪ Unstructured/semi-structured interviews ▪ Selective sample ▪ Main objectives: - Provide exploratory results - Explore and identify determinants and valuation methods (updated initial coding frame) - Identify interesting phenomena and possible explanations - Define further analysis in QUAN, QUAN, or both phases ▪ Rather inductive	▪ Quantitative ▪ Online survey ▪ Representative sample (random stratified sample) ▪ Main objectives: - Provide quantitative, statistically analysed results - Identify the relevance of available valuation methods - Identify determinants and other influence factors - Identify follow-up questions for QUAL phase ▪ Rather deductive	▪ Qualitative ▪ Semi-structured interviews ▪ Discussion of three provided investment scenarios ▪ Purposefully selective sample based on survey participants (heterogeneous sample) ▪ Main objectives: - Focus on specific issues - Identify additional influence factors - Triangulate quantitative results ▪ Rather inductive	▪ Interpretation, discussion, and explanation of the quantitative and qualitative results ▪ Main objective: find convergent, divergent, and/or complementary outcomes ▪ Limitation of research ▪ Implication for practice ▪ Implication for theory ▪ Further research
qual Data Collection	QUAN Data Collection; QUAN Data Analysis	QUAL Data Collection; QUAL Data Analysis	INF Interpretation of entire analysis

a) Initial explanatory interviews (qual): To gain in-depth knowledge and understanding of different perspectives of the participants about this rather complex topic, a combination of unstructured and semi-structured interviews were applied in an initial exploratory phase, indicated in small letters (qual), including both open- and semi-close-ended questions, to identify questions to be asked in additional data collection phases and to provide feedback to the research design (Blaikie, 2009). The focus lies more on data collection and less on a profound analysis of the answers. The interviews were conducted with a limited number of key participants. This initial phase enhances the original sequential exploratory MMR design. Its purpose is to specify interesting topics in valuation, to find worthwhile open-ended questions to be asked in the QUAN and/or in the subsequent QUAL phase, and to define the population to be asked.

b) Primary quantitative survey phase (QUAN): In the first main stage, the data collection was conducted with an online questionnaire to gather statistical, analysable primary data to identify determinants and other influence factors. Its results reveal additional questions and issues to be asked in the following QUAL phase. The survey has a rather deductive character.

c) Primary qualitative interview phase (QUAL): In the subsequent phase, interviews with experience practitioners were performed with semi-structured interviews, mainly with face-to-face interactions. These enabled a dialogue between the interviewer and interviewee, and they allowed for the exploration of key topics, which might not have been considered to be relevant from the beginning on (Robson, 2002), to gather rich mainly qualitative empirical data, including individual, group, and cultural differences in risk perception.

d) Inference (INF): In this final stage, the separately analysed QUAN and QUAL phases were combined, discussed, and interpreted, focusing also on seeking additional explanations for the QUAN results. Apart from this primary stage of integration, minor stages of integration were also performed during the whole MMR research process, as outlined in more detail in section 4.5.

4.1.2.3 Justification for the Chosen Approach

It is a common practice to divide data collection and data analysis into quantitative and qualitative methods, and their differences and the orientation to either one have been an old debate in research (Johnson and Turner, 2003, Kemper et al., 2003). The pure qualitative and pure quantitative approaches can be understood as the two opposite poles on a continuum, where “pure qualitative research is defined as exploratory, inductive, unstructured, open-ended, naturalistic, and free-flowing research that results in qualitative data. [On the other hand,…] pure quantitative research is defined as confirmatory, deductive, closed-ended, controlled, and linear research that results in quantitative data.” (Johnson and Turner, 2003:297). In other words, the former type of approach is concerned with exploring the meaning and interpretations of social actors while generating and analysing descriptions and data in the form of words, whereas the latter is about measuring, counting, generating, and analysing numbers about aspects in the social reality. (Blaikie, 2009, Saunders et al., 2009). The specific approach to use can be guided by the type of research questions and reasoning approaches (Blaikie, 2009). There are also less extreme versions than the pure approaches between those poles of the continuum (Johnson and Turner, 2003) or the mixed approaches, as in this research.

The rationale for applying mixed quantitative and qualitative approaches in this research is that, on their own, neither of the two types are sufficient to capture the details of the studied phenomena, including the complexity and dynamics of valuation within transactions. The integration of data and analysis in MMR, including quantitative and qualitative approaches, includes the combination of elements in such a way as to not only optimally answer the research questions, but also achieve the project goals, thereby generating findings that are greater than the simple sum of their components (Bazeley, 2010) and providing a more complete and accurate picture of the research problem (Greene et al., 1989, Tashakkori and Teddlie, 1998, Johnson and Turner, 2003). The integration is not just a simple combination of qualitative and quantitative methods: "[…] they may indeed be more deeply intertwined" (Kane and Trochim, 2007:177). Furthermore, an MMR approach (Saunders et al., 2009) is applied for an enhanced data collection procedure to gather data from a rich set of available sources, including surveys and subsequent interviews in this research. In doing so, the quantitative data and analysis provide an overview of the applied valuation methods in RES-E investments and some influence factors, worked out from the literature, while the qualitative data and their analysis provide the opportunity to dig deeper into the topic with thoroughly selected professionals experienced in the research field to explain the results from the previous part; to gain a more profound understanding of the topic; and to discuss influence factors, deficiencies, issues, and possible improvement steps. The use of a follow-up interview after responses to structured surveys is one of the most common data-gathering strategies applied within MMR (Bryman, 2006). This approach also eases criticism of the positivistic view of ontology and epistemology and consequently the sole focus on quantitative methods (Saunders et al., 2009). This research combines both of them by applying an MMR approach to obtain the best of both and to eliminate either of their drawbacks. As an additional objective, the subsequent QUAL phase provides the possibility of performing a triangulation of the previous results (Bryman, 2007, David and Sutton, 2011).

Moreover, as critical realists, it is essential that the chosen methods fit the subject matter and do not stick strictly to one method (Mingers, 2004, Saunders et al., 2009). In this research, the reality was examined with all available data that can best describe the real world and answer the research questions most coherently (Carter and Little, 2007).

4.1.2.4 Applied Data Collection and Analysis Methods

Within the applied explanatory sequential MMR design, the three distinct phases were analysed separately, as is typically seen for sequential MMR designs (Creswell et al., 2003):

a) In the QUAN phase, the collected quantitative data within the *online survey* were analysed with statistical methods. This approach evaluates several variables at a time by applying the software IBM SPSS Statistics. The purpose of this analysis was to assess the significance of the empirical data about risk factors and their priorities in relation to return rates and the possible influence of certain independent variables (IVs) on the found results. Appropriate quantitative statistical tests were applied (Creswell et al., 2003), such as the independent sample t-test and the analysis of variances (ANOVA).

b) In the qual and QUAL phases, *interviews* were conducted to "gather valid and reliable data that are relevant to [the] research question(s) and objectives" (Saunders et al., 2009:318). Interviews are advantageous for complex topics. The audio recorded qualitative data were analysed using a *content analysis*, which is a bundle of systematic text analysis techniques, to discover key words and themes; their frequency of occurrences; theme treatment and presentation; and linkage to outside variables, such as gender, work experience, role in organisation, and cultural background in the content and context of the analysed data (Lincoln and Guba, 1985, Robson, 2002). The goals were to find new indicators and drivers, to confirm known ones, to evaluate their priorities and importance—all of them can be variables of a future framework—and to better understand the relationship between risk perceptions and return expectations. Additional themes include internal organisation processes and/or constraints, and judgmental assessments can be studied in more detail in the qualitative phase. In contrast to the former QUAN phase, the qual and QUAN phases were not able to make a generalisation based on statistics to the entire survey population (Saunders et al., 2009). During data analysis, the original transcripts were constantly checked to ensure authenticity and to minimise biases. For a more efficient data analysis, the qualitative data analysis (QDA) software nVivo10™ was applied (see section 5.1).

This thesis based its research on collecting new data, known as primary data, specifically for the purpose of this research. Methods about collecting primary data are discussed in more detail below (see sections 4.2 to 4.4).

To analyse data, most collection methods require a subsequent step of manipulating the data into the appropriate form—known as data reduction techniques (Blaikie, 2009). To minimise the application of data reduction techniques and corresponding efforts, the coding scheme was established before collecting the data, and it was introduced into the data collection methods, for example, by introducing an index or a scale as a coding category (Blaikie, 2009). This approach was introduced in this research while performing interviews. Even in those cases, the collected data must usually be rearranged by change the order or by combining coding categories (Blaikie, 2009). To analyse the qualitative data with a content analysis (section 4.4.3.1), a set of coding categories were deployed (David and Sutton, 2011). Usually, such qualitative data reduction and data analysis techniques cannot be separated, since they merge into one approach, mostly into cycling processes (Blaikie, 2009).

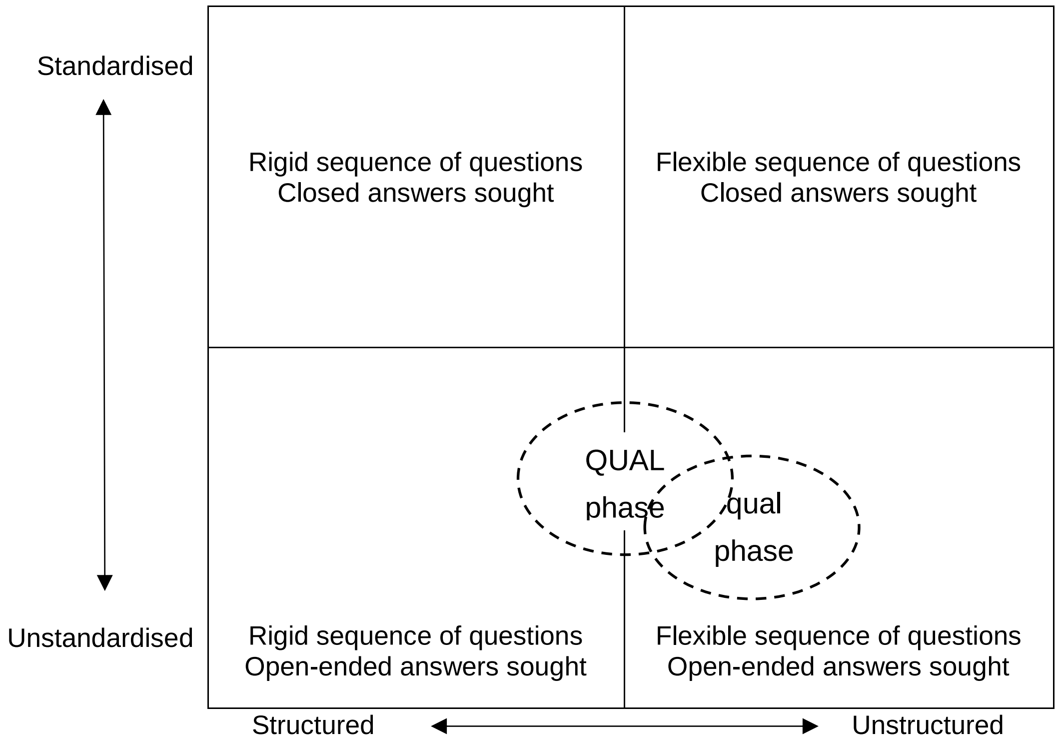
There are certain aspects that cannot be measured directly (Saunders et al., 2009), such as the assessment of risk in this research. Therefore, a list of indicators were introduced before beginning to collect quantitative data by measuring it with the help of a *Likert-style rating scale* (Likert, 1932, Allen and Seaman, 2007), or a Likert-type scale, asking respondents about their level of agreement or disagreement (Saunders et al., 2009). This frequently applied rating question technique is used to ask respondents about the degree of significance of risk indicators. This Likert scale is less complicated to analyse than the alternative *semantic differential rating scale* (Heise, 1970), in which the respondents have to rate a question on a bipolar rating scale. To rate their attitudes, the respondents provide their ratings on a scale with a “pair of opposite adjectives” (Saunders et al., 2009:381) on each end.

To set up the optimal interview approach for the qual and QUAL phases, the interview protocols are developed along two dimensions in their characteristics, ranging from *standardised to unstandardised* and from *structured and unstructured* interviews (King, 2004, David and Sutton, 2011) (Figure 36), either for exploratory or explanatory purposes. In both phases, the applied open-ended answers seek replies that do not only require *yes* or *no* answers to obtain detailed verbal and textual data material (transcripts of interview and written investment scenarios) and to “allow for greater depth and personal detail, but [they] are harder to compare numerically” (David and Sutton, 2011:120). The predominantly applied semi-structured interviews are based on a predefined list of themes, issues, and general questions to be covered during the interview while adjusting the particular interview to the organisational context and to the course of the conversation by focusing on certain additional themes, omitting certain questions, or changing the order of the question in search of open-ended answers (Patton, 2002, Saunders et al., 2009, Flick, 2014).

a) In the qual phase, *unstructured/semi-structured, unstandardised interviews* were used to be the most flexible and adaptive within the sequence and type of questions adopted to receive open-ended answers (David and Sutton, 2011), with a flexible sequence of questions in search of open-ended answers for *exploratory purposes* “to get a feel for the key issues before using a questionnaire to collect descriptive or explanatory data” (Saunders et al., 2009:153) or to “probe answers, where you want [the] interviewees to explain, or build on their responses” (Saunders et al., 2009:333). As such, areas were discussed that were not previously considered “to seek new insights” (Robson, 2002:59) while allowing for the emergence of new ideas or hidden issues (Saunders et al., 2009), identifying questions to be asked in the further QUAN and/or QUAL phases, and providing feedback on the overall research design (Blaikie, 2009).

b) Then, in the QUAL phase, following a more structured and standardised interview protocol than in the qual phase, *semi-structured, unstandardised interviews* were conducted with an average flexible/rigid sequence of questions again in search of open-ended answers to better understand the QUAN results and to receive answers in combination with the QUAN results for *explanatory purposes* by being able to explain the found first relationships between the variables of the QUAN phase (Healey and Rawlinson, 1994, Saunders et al., 2009) within the answers of the QUAL phase (Creswell et al., 2003) (section 4.1.2.1). Similar to the qual phase, the sequences of the questions can be adjusted, and additional detailed questions can be asked, if it appears opportune, to seek in-depth insights and explanations within particularly interesting topics.

Figure 36: Degree of standardisation and structuring of questions and answers in interviews (adopted from David and Sutton, 2011).



4.1.3 Targeted Population and Sampling Strategy

The target population in this research comprises active participants in the RES-E investment market in Switzerland and Germany, composed of equity investors, such as utilities, independent power producers (IPPs)[52], project developers, fund managers, other financial investors, and financial advisors exclusively mandated by investors, as well as debt financing institutes, i.e. banks, to obtain interesting insights and opportunities to compare—even if questions about discount rates are difficult for banks to answer. Those professionals hold senior positions within their organisations and are involved in RES-E investment projects on the multimillion EUR scale. Therefore, the study does not included households that invest in RES-E projects on their premises. Furthermore, this research does not investigate the diversified group of industrial companies which also invest in RES-E projects (section 2.1.2)[53].

Since the whole populations can usually not be evaluated due to their substantial sizes, time constraints, and cost concerns, sampling approaches were applied. Sampling is the procedure for defining a sample (Kemper et al., 2003, Saunders et al., 2009) which is a “unit of observation/analysis of who or what is being studied” (Tashakkori and Teddlie, 1998:61), for example people, groups, or narrative segments. Creating an appropriate sample is key for any research, since it is the foundation for the whole study (Kemper et al., 2003, Saunders et al., 2009). Two main sampling types are usually distinguished: probability or representative sampling and purposive, non-probability or judgemental sampling:

a) *Probability sampling* is usually associated with quantitative research and statistical INFs from a representative sample, reaching generalisability (external validity, section 4.6) as a research goal by being able to extrapolate the research outcome from the defined sample of the population to the larger amount of the targeted population. It is often about maximising the sample size to reach a higher probability of achieving higher accuracy from extrapolating findings from the data (Kemper et al., 2003, Saunders et al., 2009). The following three assumptions of probability sampling were considered in creating the sample for the performed quantitative phase: i) the size of the sample is large enough that the encountered random errors offset each other ii) to be able to plausibly produce a reasonable estimated outcome of the population at large, and iii) the distribution of the population is known or normal so that statistical measures can be applied (section 4.3.4) (Tashakkori and Teddlie, 1998, Kemper et al., 2003).

b) *Non-probability sampling,* on the other hand, usually refers to qualitative research without being able to generalise for the population based on statistics (Kemper et al., 2003, Saunders et al., 2009). According to Patton (1990), “the logic and power of purposive sampling lies in selecting information-rich cases for study in depth”. In line with the literature sampling (e.g. Kemper et al., 2003, Saunders et al., 2009) and in contrast to probability sampling, the performed purposive sampling approach chooses only a small sample size and only those participants and specific cases of particular interest to provide the most information, to illuminate, and to most appropriately answer the research question.

Neither sampling types are the sole domain of quantitative or qualitative research approaches. An MM study can blend those sampling types with the goal of appropriately answering the research question (Kemper et al., 2003). Having said that, both sampling types were employed in this MMR. The applied sampling technique for each of the research phases is specified in the following subsections, as defined in various publications (e.g. Patton, 1990, Tashakkori and Teddlie, 1998, Kemper et al., 2003, Saunders et al., 2009).

The employed sampling scheme follows the guidelines of Kemper et al. (2003), derived from the work of Miles and Huberman (1994) and Curtis et al. (2000), as presented in following list of key parameters:

a) The sampling strategy is derived directly from the research questions (section 1.2) and presented conceptual framework (section 2.7.3), thereby generating valid means to answer the research questions. The research questions are defined in a manner to be mainly addressed either by the QUAN, QUAL, or INF phase.

b) The applied sampling schemes allow for the production of an adequate database to study the researched phenomena. The study is about understanding and explaining the researched topic and generating data in the QUAN phase from a representative, larger sample to generalise the findings, which allows for the possibility of transferring the outcomes to the other, comparable settings. The QUAN results were then triangulated, challenged, and explained in more detail in the QUAL phase with specifically interesting participants from the pool of the previously surveyed participants in the QUAN phase. (section 4.1.3).

c) The sample permits the author to draw clear INFs from the data and credible explanations. The first point is about receiving internal validity due to being confident that the outcomes (effects) change because of IV (cause) and not any other causal variable (Cook et al., 1979). For obtaining credible explanations, the assessments of the researcher's explanations are introduced as "checkers" (Kemper et al., 2003:276) in the QUAL phase in particular.

d) The applied sampling strategy follows strict ethical considerations (section 3.2).

e) The applied sampling scheme is based on a feasible concept, ensuring that the research is able to access the data and the researcher has the ability to perform this research.

f) The sample is applied in an efficient and a practical manner to control for time and cost while still being able to collect the adequate quality and amount of data.

4.1.3.1 Sampling Technique in Exploratory qual Phase

Since the purpose of the qual phase is only exploratory, the *self-selection sampling* was applied. It is an appropriate non-probability approach for such a purpose, as proposed by Saunders et al. (2009). More precisely, a convenience sampling approach was applied in this phase by selecting easily accessible and/or volunteering participants (Kemper et al., 2003) to identify where the points of interest in the research topic lie with relatively little time expenditure and low costs. However, the author was fully aware that this sampling approach can result in "spurious conclusions" (Kemper et al., 2003:280) and is therefore not an appropriate sampling approach for the two subsequent primary QUAN and QUAL phases.

Four exploratory interviews were conducted from April to June 2015 in Switzerland, in the Swiss-German dialect. An additional three interviews followed between September and August 2015 in Germany, in High German. The seven participants belong to the research population and are employees from utilities, special fund managers, financial advisors, and project developers. To avoid biasing the following research in one or another direction, they were not chosen as participants for the following QUAN and QUAL phases.

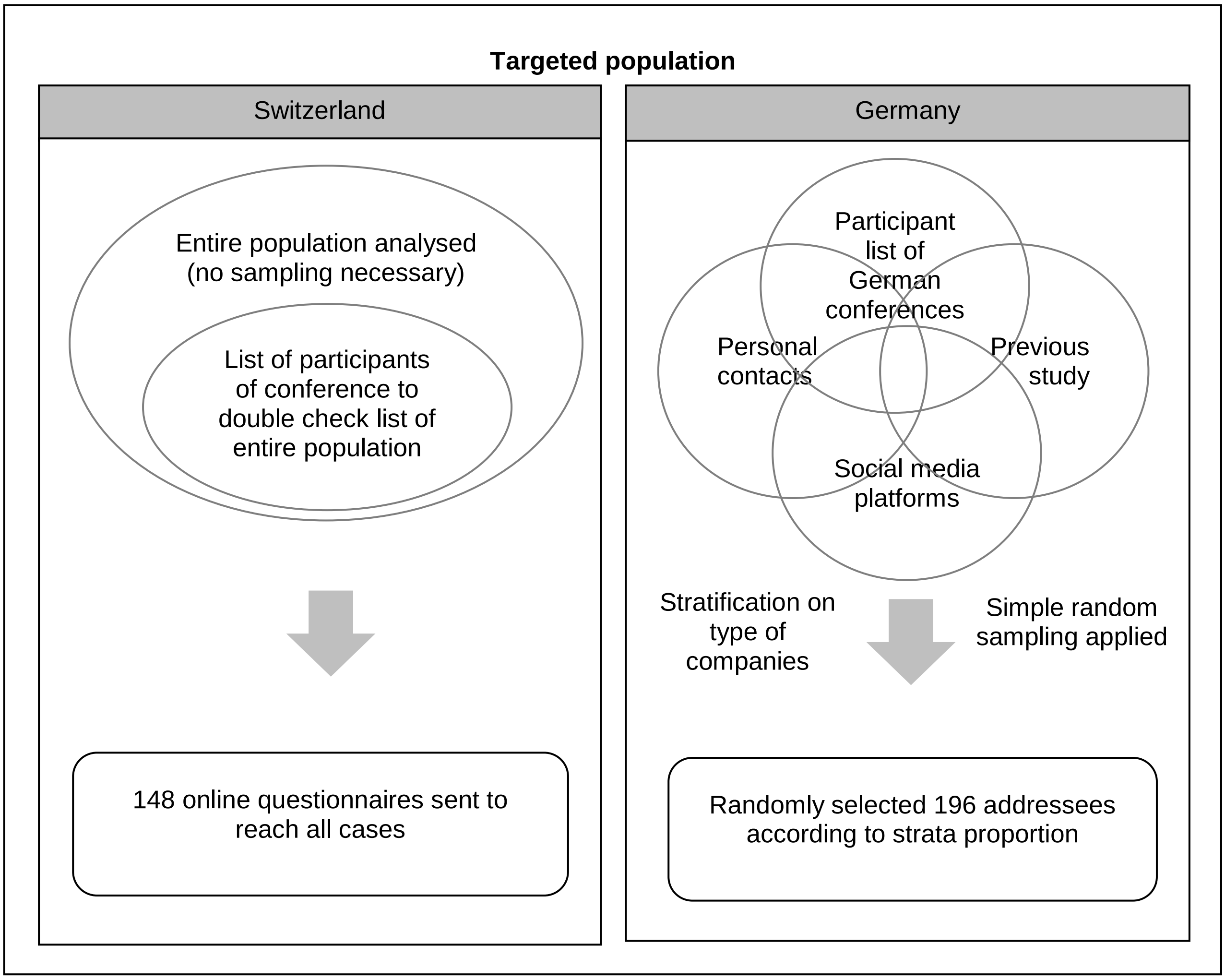
4.1.3.2 Sampling Technique in QUAN Phase

In the QUAN phase, different sampling approaches were applied for the two countries due to the size of the considered population in order to reach an optimal representation of the population in both cases. In Switzerland, there is no need to create a sample at all, since the targeted population was known to the researcher due to the restricted number of potential actors in this country. This knowledge is based on his professional background and practical experience. Furthermore, it is supported by the annual conference in Switzerland, called the New Energy Investor Summit, in which almost all Swiss participants in this area partake, and for which the participant lists of the previous eight conferences were consulted. This sampling approach is supported by Henry (1990), who suggests not applying probability sampling for populations lower than 50 cases and instead analysing the entire population. Even if the number of cases in Switzerland is slightly higher, it is regarded as “an ideal world” (Kemper et al., 2003:274) to try to access the entire studied population in the area of interest. Also, to reach all these Swiss cases, a higher number of online questionnaires than cases had to be sent out.

This situation is different for the German population, since the amount and diversity of the considered investors are obviously much larger or wider respectively. Therefore, a sample frame was applied that consists of a comprehensive list of all the available cases of the targeted population and a procedure to contact the selected companies and survey participants (Fowler, 2009). The compiled list of all cases in Germany is based on the following: analysing the participant lists of several major German conferences on RES-E investments, such as ‘InterSolar’, ‘Windenergietage’, and ‘Handelsblatt-Tagung Erneuerbare Energien’; a search within social media platforms, such as LinkedIn and Xing; the participant lists of previous studies (Watts, 2011); and personal contacts. The missing contact data were collected in a laborious process by searching for information published on the open Internet and in professional social media platforms. Then, a *proportional stratified random sampling approach* was chosen, which divides the population into different subsets, or strata (Kemper et al., 2003, Saunders et al., 2009), based on the types of companies. From each of the strata, a simple random sample was drawn that is suitable for few hundreds of cases. The proportion of each strata is the same as the proportion in the researched population (Kemper et al., 2003). The objective of this sampling approach is to build a sample that is more likely to represent the targeted population by ensuring that each strata is proportionally represented in the selected sample (Saunders et al., 2009). The stratification is done on the type of companies, i.e., utilities, project developers, institutional investors, and specialised funds. The proportionality of each strata is ensured with the study results of BWE (2015) and Wind:Research (2012) in Neue Energie (2014) about investors in Wind onshore, which is one of the main foci in RES-E technologies from an investor point of view and is assumed to represent diversity and the proportion of investors in this sector. In addition, banks providing debt financing and investment consultants were also included for comparison reasons.

In the case of Switzerland, 148 online questionnaires were sent to the whole targeted population in the QUAN phase. In addition, based on the sampling frame and the chosen sampling technique for the targeted German population, 196 addressees were contacted to fill out the online questionnaire by email. Additional features of the quantitative data collection are discussed in section 4.3.2.2.

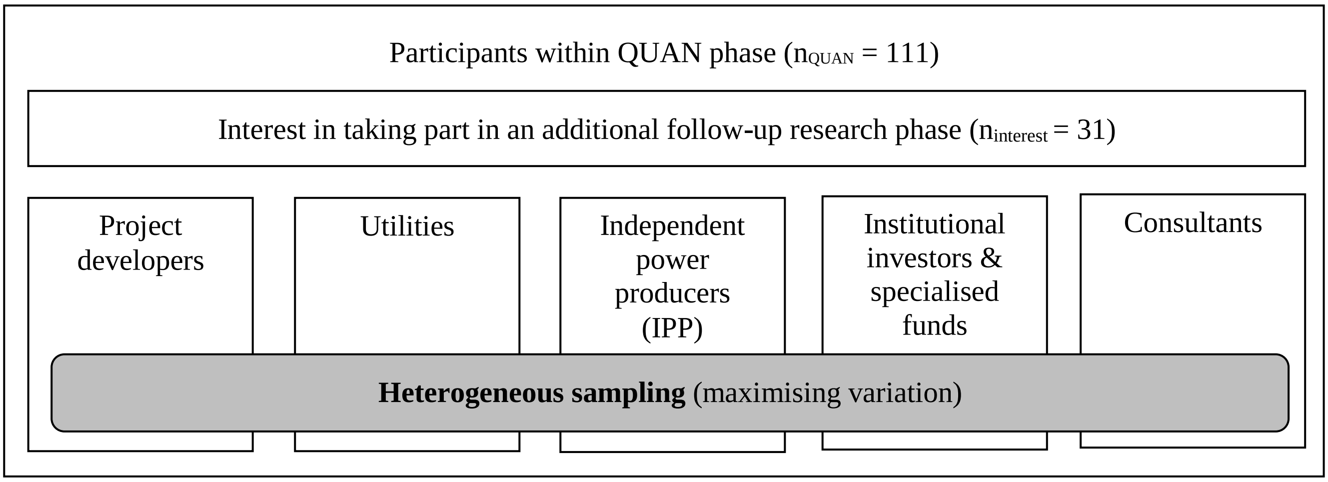
Figure 37: Sampling strategy for the QUAN phase, surveying entire population and sample frame, and proportional stratified random sampling for the German population (author's own illustration).



4.1.3.3 Sampling Technique in QUAL Phase

In line with the requirements of the selected typology *explanatory sequential MM approach*, the participants for the follow-up qualitative phase were identified from the previous survey phase (Creswell and Plano Clark, 2011a, Plano Clark and Ivankova, 2016), which is a subset of those participants and hence a smaller size than in the QUAN phase (Creswell and Plano Clark, 2011b). Having said that, a *purposive sampling* approach was applied, by purposefully selecting the participants, with a particular focus on key themes and significant results in the previous QUAN phase and with regard to retrieving in-depth information, while allowing for the emergence of patterns of particular interest and value (Creswell and Plano Clark, 2011b). The most appropriate sampling approach for this research is the *heterogeneous sampling* (or maximum variation sampling) (Kemper et al., 2003, Saunders et al., 2009), which is performed by selecting participants based on specific criteria (Patton, 2002).

Figure 38: Sampling strategy for QUAL phase (author's own illustration).



Applying the *heterogeneous sampling* approach within the QUAL phase, a pool of possible candidates ($n_{interest}$ = 31) for the interview phase was built by asking the participants in the previous QUAN phase whether they would be interested in taking part in the planned follow-up research phase (Figure 38). The sample (Table 18) and its size, with 16 participants, were defined in accordance with recommendations for a sufficient number of participants in purposive, heterogeneous sampling and with reaching data saturation (Kuzel, 1992, Luborsky and Rubinstein, 1995, Guest et al., 2006, Mason, 2010, Fusch and Ness, 2015). Data saturation was reached after 14 participants; however, to ensure the achievement of this saturation, two additional interviews were performed. Likewise, heterogeneity of the sample was maintained by considering five types of employers (Figure 38: project developers, utilities, IPPs, institutional investors and specialised funds, and consultants) and by covering various types of candidates with different master or doctorate degrees, different professional seniority and positions, and an equal number of participants from each of the two countries. By doing so, the aims were to study a wide range of individual characteristics and companies and to maximise the variation in the sample. The candidates with experience from various types of employers were regarded as specifically valuable, since they provided a wider range of professional experience in valuation. In addition, some participants were chosen for their valuable, more external views on acquisition teams, such as a Head of Asset Management.

Regarding the collected smaller number of German participants, compared to the Swiss ones in the QUAN phase (section 5.2.1), the ongoing research with the QUAL phase attempted to equalise and balance out this misrepresentation (in addition to the applied statistical tests) by choosing an equal number of Swiss and German participants for this phase and by triangulating the QUAN results with the findings of the QUAL phase. Therefore, the sample of the selected 16 participants consisted of eight candidates from Switzerland and eight from Germany. It included four employees from project developers; five consultants, of whom two worked as project developers and one in the area of specialised funds; five candidates working for utilities; and two employees in the area of specialised funds for institutional investors. The specialised funds only focus on investments in RES-E projects. Within the sample, 12 candidates have a master's degree and four a doctorate. The range of valuation professional valuation experience, measured with the number of performed acquisitions and years of experience in the area of RES-E projects, is from 12 to more than 50 transactions and five to 13 or more years of relevant work experience.

Table 18: Interview candidates in QUAL phase (full table in Appendix 4 in Table 34).

No.	Country	Type of candidates	Type of employer	Current position	Academic qualification	Experience (no. of acquisitions)	Experience (year)
1	Germany	Consultant	Finance advisory (previously project developer and spe-cialized funds for retail customers)	Managing director	Master	>50	>10
2	Switzerland	Consultant	Finance advisory (previously specialized funds)	Managing director	Master	50	10
3	Switzerland	Industrial professional	Project developer	Director	Doctorate	20	7
4	Switzerland	Industrial professional	Project developer	Director	Master	40	6
5	Germany	Industrial professional	Project developer / IPP	Head of M&A	Master	40	9
6	Germany	Industrial professional	Project developer	Manager project financing	Doctorate	20	7
7	Switzerland	Industrial professional	Utility	Director / CFO	Doctorate	12	13
8	Germany	Industrial professional	Specialized funds for institutional investors	Director	Master	>50	>12
9	Switzerland	Industrial professional	Specialized funds for institutional investors	Investment manager	Master	12	5
10	Switzerland	Consultant	Finance advisory	Managing director	Master	>10	5
11	Germany	Consultant	Finance advisory	Managing director	Doctorate	15	6
12	Germany	Consultant	Finance advisory (previously project developer)	Managing director	Master	25	11
13	Germany	Industrial professional	Utility	Managing director	Master	20	10
14	Germany	Industrial professional	Utility	Head of Asset Mgt	Master	>50	24
15	Switzerland	Industrial professional	Utility / IPP	Head of Asset Mgt	Master	40	3.5
16	Switzerland	Industrial professional	Utility	Head of Asset Mgt	Master	>20	5

IPP: Independent power producer

4.2 Initial Exploratory Qualitative (qual) Interview Phase

4.2.1 Data Collection Exploring Process

The valuation approaches applied in practice were explored in this phase with several exploratory *unstructured/semi-structured and unstandardised interviews* (section 4.1.2.4). The goal of this phase was to determine which questions and answer options are worth asking or providing respectively in order to simplify the questionnaire in the QUAN phase and interview questions in the QUAL phase.

Several questions asked in those interviews are based on survey questions and the corresponding scales of previous studies, such as widely respected studies in corporate finance by Graham and Harvey (2001) and Brounen et al. (2004) and a risk study concerning investments in renewable energy (RE) by Watts (2011). In addition, this phase explored whether the developed RAPV approach (section 2.7.3) builds an optimal basis for evaluating, in the QUAN phase, the way in which valuation adjustments for risk and correspondingly risk components are performed (section 4.3.3.5). It also investigated whether certain approaches, such as the APV approach—an optimal valuation for RES-E investment valuation—are known by potential study participants and whether it would be better to assess their frequency of application in the QUAN phase or discuss them in the subsequent QUAL phase.

4.2.2 Initial Data Analysis

Each interview was transcribed within the software nVivo10™ to become accustomed to this content analysis software and as preliminary work for subsequent data analysis processes in the primary QUAL phase (section 4.4.3). The collected information in the exploratory interviews were used for the following reasons:

- to refine the preliminary subcategories and themes from the literature review in order to update the ICF (section 2.7.4) for the QUAL phase,
- to decide whether to analyse the subcategories and themed topics in the quantitative and/or qualitative analyses, and
- to receive inputs for performing the QUAN phase, i.e., to create the questionnaire (section 4.3.3).

4.3 Primary Quantitative (QUAN) Survey Phase

4.3.1 Research Hypotheses

After the literature review, a conceptual framework was built as a guideline for developing the research design. Based on the findings of the initial exploratory qual study, and following a deductive reasoning approach within the QUAN phase, the following testable hypotheses were formulated:

H1: Apart from systematic risk components, unsystematic risks are relevant components in RES-E project investments to be considered in valuation processes.

H2: Volume-related risk components, such as wind resources, sun irradiation, and the amount of water, are considered to be the most important risk components and relevant unsystematic risk components for RES-E projects and corresponding valuations.

H3: Political risk is regarded as the most crucial systematic risk component in RES-E projects, particularly due to the applied RES-E supporting regimes.

H4: The assessment of risk components in RES-E projects differs in relation to the various project stages involved.

H5: Experiences of particular risk materialisations influence risk assessment and the prioritising of risk components in RES-E project investments.

H6: Having experienced the materialising of certain risk components, corresponding risk mitigation measures become more relevant.

H7: Discounted cash flow-based capital budgeting techniques are the predominantly applied valuation methods in RES-E transactions.

H8: The RADR is regarded as the most appropriate capital budgeting technique.

H9: The investment company's WACC as the required return rate or as the basis for defining a required return rate is not regarded as an appropriate CoC approach in RES-E investments.

H10: The CE method is known to be an appropriate alternative approach in valuation, particularly focusing on value protection.

H11: A company's risk management processes provide the basis for valuation processes.

H12: Apart from considering the downside potential (threat) of RES-E investments, possible positive deviations from the target value are also considered in valuation processes.

H13: The valuation of RES-E projects is adjusted for risk and either in the cash flows or discount rates, depending on the considered risk component.

H14: There are cultural differences in valuation, and valuation is influenced by the type of investment company.

4.3.2 Quantitative Data Collection

4.3.2.1 Designing the Questionnaire

The quantitative data collection was performed with the use of a questionnaire, which is a 'self-report data collection instrument that is filled out by the research participants' (Johnson and Turner, 2003:303). This survey is based on operationalising the preliminary conceptual framework, presented in section 2.7.3 and Figure 29, into quantitatively measurable variables (Holden and Lynch, 2004) by formulating appropriate questions and a corresponding scale. Each formulated question in the data collection phases aims to describe the relationship between the variables in the defined model.

The survey is composed of nine[54] groups of questions, elaborated from the literature review, and it is structured in line with the questionnaire layout suggestions from the literature (De Vaus, 2002, Saunders et al., 2009). First, general questions about RES-E investments were asked regarding the invested countries and technologies and the entry level of investment, such as the developing, building, or operating stage. Second, questions were posed about risk, the significance of risk components and risk stages in RES-E investments, whether certain risk would materialise, and which risk mitigation measures would be applied. Third, capital budgeting techniques were investigated, followed by a fourth group of questions about estimations of CoC. These two latter groups of questions are in a similar vein to the famous studies of Graham and Harvey (2001) and Brounen et al. (2004), since the questions and applied scales have proven their validity. However, each adopted question was adjusted to match the scope of this study. Fifth, the risk adjustment processes were evaluated, assessing how general and specific risk components are handled in RES-E investment processes. Finally, the questionnaire concluded with questions for demographic variables by asking the investors about characteristics of their companies (type, size, and leverage) and demographic figures of the survey participants, including education, experience in investments, gender, and age. The detailed structure of the questionnaire is presented in section 4.3.3.

Table 19: Structure of the questionnaire.

Questionnaire section		Hypotheses/purpose
1	General question about RES-E investments	Delimitation of scope
2	Risk assessment	Relevant risk components, H1, H2, H3, H4, H5, H11
3	Valuation	H7, H12, H13
4	Cost of capital / discount rates	H8, H9, H10
5	Materialisation of risk and mitigation	H5, H6, H11
6	Participant's company	Company characteristics, H14 *
7	Participant's function and experience	Participant characteristics, H14 *
8	Socio-demographic questions	Demographic information *
9	Conclusion	Interest in further information and research participation

* Questions reveal potentially IVs within statistical analysis.

While constructing the questionnaire, the 13 basic principles of questionnaire development by Johnson and Turner (2003) were considered. When structuring the questionnaire, care was taken to put a first set of interesting questions at the beginning to draw the interest of the respondents, and rather uninteresting socio-demographic questions were placed at the end of the questionnaire. More difficult questions were positioned in the first third of the questionnaire to ensure that the respondent still has a high level of concentration, and the whole questionnaire should not take more than 25 minutes to complete. The questionnaire was designed for a high response rate and low dropout rate; for example, distinct questions about applied return rates were not included, since they are highly confidential pieces of information to every organisation. A particular focus was also placed on the online survey introduction, which was created based on the suggestion of Penwarden (2013). Based on the evaluated relations presented in the conceptual framework (section 2.7.3) and their complexity, the decision was made to analyse more complex relations with interviews, instead of within the questionnaire, since more in-depth evaluation is necessary. This concerns, for example, the influence of portfolio effects on the subject matter and in-depth explanations for why certain methods are applied or not. In this survey, verbal frequency scales were applied using five words to assess how often the action has been performed or the situation has occurred. They are similar to the Likert scale in order to evaluate the strength of agreements for capital budgeting techniques and CoC approaches. The advantage of verbal frequency scales is in their ease of assessment and response by the survey participants. Their disadvantage is in their limitation regarding precision. However, they are particular appropriate if participants are unable to provide exact percentages (Baker et al., 2010). In this survey, the verbal frequency scales were complemented with a scale from 1 to 5. In addition, the applied frequency scales in the survey always start with the smallest value on the left side and the highest value on the right side, similar to a coordinates system. For the assessment of risk components, a Likert scale was applied.

The final questionnaire was prepared in English to be sent to Germany and all three language areas of Switzerland as an online survey (Appendix 5), running on the LimeSurvey software, version 2.0[55]. The questionnaire was then proofread by an English native academic. Next, to test whether the wording was understood and the survey structure made sense, pilot surveys were conducted with five additional professionals in the research field who work for utility companies and specialised fund management companies. In these interviews, the respondents completed the questionnaire while being able to directly ask questions and clarify ambiguities. These answers were then analysed qualitatively within nVivo10™ again. Furthermore, three scholars tested the survey and provided valuable comments.

The findings from piloting the questionnaire demonstrated that the questionnaire and the questions were too long, and the questions must be stated more precisely, giving less possibilities for different interpretations; therefore, certain questions were simplified, and brief explanations were added. Moreover, the layout had to be adjusted for the question to fit on one line and for the questionnaire section to be presented in one browser page, if possible, without having to scroll down before finding the ‘Next’ button to reach the subsequent questionnaire section. More specifically, after piloting the question, ‘How frequently does your firm use the following techniques when deciding which RE projects or acquisitions to pursue?’, the answer option ‘Adjusted present value (APV)’ was deleted, since it is already included in the ‘Net present value (NPV)’ method. The answer option ‘Accounting rate of return (ARR)’, as suggested by Brounen et al. (2004), was eliminated, since it is rarely used in RES-E investments—as identified in the exploratory interviews. Furthermore, the answer option ‘Discounted payback period (DPB)’ was eliminated, since it is already covered in ‘Payback period’, is not expected to be used often in RES-E valuations, and does not provide much insight into this research. In the same question, the answer option ‘Real options’ was defined, since the term was not familiar to all participants in this phase. Moreover, the answer option ‘Project/investment-specific return rates’ was eliminated because it asked about the ‘Cost of capital and discount rate’ in the following sections of questions.

4.3.2.2 Performed Quantitative Data Collection

Based on a list of possible survey participants representing the surveyed population (section 4.1.3.2), 328 questionnaires were sent out by email directly to corresponding contacts holding senior positions in their organisations in the period between November 25, 2015 and February 28, 2016. Approximately three weeks after sending out the questionnaire, the non-respondents were contacted again by phone or email, reminding them to fill out the questionnaire and/or to offer them support. This telephonic and email effort lasted until March 25, 2016, and the last response was received on March 30, 2016.

Despite repeated requests and additional information about the purpose and the benefit of the survey to reach sufficient numbers of answers from both countries, the German organisations remained more reluctant to take part in the survey, compared to their Swiss peers, although an additional collection effort was made for the German population. Nevertheless, two Swiss organisations also declined to fill out the questionnaire for strategic and confidentiality reasons. In general, in both countries, the reasons for rejections to participate in the survey within phone conversations included concerns regarding confidentiality and time restrictions. In one case, the stated reason was no interest in receiving the survey results, since this topic is well known to the contacted firm and consequently no adjustments to the methodology are necessary. The survey period was not extended to collect more responses, since the survey also included questions regarding investment attractiveness (to be analysed in the further research phase) to avoid biasing the results by external effects from the market environment, such as changing interest rates, which could change the investment behaviour of the investors.

A total of 111 responses were received, of which 100% were collected by email and the online survey. The overall response rate is considered high at 32.8%, given the length and depth of the questionnaire and the required time to be able to sufficiently answer the sometimes complex questions, as well as the restrictions of some investment firms to participate for confidentiality reasons. Apart from that, the survey dropout rate (13.3%) is considered to be low.

4.3.3 Structure of Survey Questionnaire

For each of the following parts in the investigation, the sample size allows to control for different organisation characteristics in order to link the results to differences in type, size, financing structure (private vs. public ownership, leverage), invested project stage and previously materialised risk.

4.3.3.1 Risk Assessment

This section analyses the way in which investors rate predefined risk categories in RES-E investments, in general, as outlined by Hürlimann and Bengoa (2017a). The specific handling of risk components in valuation is considered in section 4.3.3.5. The evaluated risk categories (Table 20) in this survey are based on the corresponding literature review (section 2.3.2) consist not only of undiversifiable systematic risk, but also of not completely diversifiable unsystematic risk (section 2.2.5).

Table 20: Risk categories belonging either to systematic and unsystematic risks (adopted from Hürlimann and Bengoa, 2017a).

Risk categories belonging to systematic risks	Risk categories belonging to unsystematic risks
Financial risk[20] (for example, access to capital, currency changes, and change in interest rates affecting profitability)	Business/strategic risk (for example, technological obsolescence)
Political/regulatory risk (for example, change in public policy affecting profitability, excl. tax risk)	Building and testing risks (for example, unproven technology, and construction delays due to unexpected difficulties [for instances, archaeological findings])
Tax risk (for example, change in tax laws and rules affecting profitability)	Operational risk (for example, plant damage/component failure or plant closure to resource unavailability)
Market risk (for example, decrease in power prices or increase in commodity prices)	Weather-related volume risk (for example, lack of wind, sunshine or water)
-	Environmental risk (other than weather-related vol. risk, e.g. liability for environmental damage)
-	Risk of subsidiaries not being under corporate control (for example, in case of minority participations)

Furthermore, the surveyed participants are asked to assess the overall degree of risk associated with different stages of developing, building and operating RE power plants (section 2.2.4.3). Respondents are asked to score how they rate the significance of each of the risk categories in relation to those project stages on five-level ordinal Likert scaled responses (risk rating: 1 meaning very low, 5 meaning very high) (Vogt, 1999). The applied scale for the level of risk examines the combination of the two dimensions of risk – consequence and probability of occurrence – for a specific risk (Bullen, 2013). This simple, one-dimensional scale has been deliberately chosen in contrast to more sophisticated scales in risk assessments (e.g. NGO Security, 2010) in order to keep the questionnaire as straightforward as possible and to lower the risk of dropouts. While changes in risk attitudes and risk preferences can potentially affect risk behaviours (section 2.2.3), tests are performed whether the responses about the scored risk components are significantly different conditional on materialised risk.

4.3.3.2 Risk Mitigation

This section studies how firms mitigate risk (section 2.3.4). The survey participants are asked to identify which risk mitigation measures have been used in the past five years. The question consists of twelve dichotomous answer options, providing checkboxes to be ticked if the provided choice is applicable. There is also the possibility to note other risk mitigation measures. The answers include: internal DD, external DD of investment projects, reduce operational risks, arrange for insurance, reduce market risks with FIT and/or long-term PPA, standardisation of procedures, the company's risk management function, check of the type of suppliers and/or contractual clauses within contracts with suppliers, making co-investments with partners, arrange for financial products, implement emergency services, and arrange for weather protection insurance. Similar to the previous risk assessments, risk mitigation measures are set in relation to materialised risk. This allows again for scope into the generic orientation to risk (Rohrmann, 2005).

4.3.3.3 Capital Budgeting Techniques

This section examines the way in which investors in RE valuate investment projects, focusing on the applied capital budgeting techniques. Similar to the techniques offered in the questionnaires by Graham and Harvey (2001) and Brounen et al. (2004), this survey goes beyond the basic DCF-based techniques, such as IRR and NPV analysis (Brealey et al., 2011), by including a wide variety of capital budgeting techniques, as summarized in Hürlimann and Bengoa (2017a). In doing so, the survey includes PB, PI, hurdle rate of return, MA and more advanced methods which expands the previously mentioned deterministic approaches to techniques which particularly consider uncertainty with probabilistic approaches (e.g. Moschandreas and Karuchit, 2005, Rentizelas et al., 2007, Carmichael, 2014), like VaR, sensitivity analysis, scenario analysis (for example, base case, worst case, and best case) and simulations, for example, Monte Carlo simulations (Mooney, 1997). Moreover, the survey analyses the usage and understanding of the cash flow projection or free cash flow to firm (FCFF), and the DCF-based approach in general, which are the prerequisites for various methods. The relevance of ROV (section 2.4.2.4) is also examined for valuating RES-E projects. Finally, it was investigated if valuing opportunities and synergy possibilities are deliberately considered in RES-E valuation which are components that are seldom addressed or even completely ignored in empirical literature. Respondents are asked to score how frequently they use the different capital budgeting techniques based on a five-level ordinal, Likert-type scale (1 meaning never, 5 meaning always).

4.3.3.4 Cost of Capital

This section analyses the investors' approaches of determining the CoC and applying discount rates in RES-E investments.

The first question about CoC determination techniques offers various techniques as answers. The answer list includes typical methods, such as the WACC of the investment company and the Sharp-Lintner CAPM (section 2.5.1). Although CAPM and alternative multifactor models (for example, APM) have been developed specifically for analysing PTC and are therefore a less adequate CoC approach for the typically non-traded RES-E investments (Hürlimann and Bengoa, 2017a), their use is evaluated in this study. Based on the literature review and in similar vein as Graham and Harvey (2001) and Brounen et al. (2004), alternative approaches are provided as answer options, such as formal risk analysis, a modified CAPM including additional risk factors, average historical returns on common stock, current market return adjusted for risk, discount rates set by regulatory decisions, dividend discount model, earnings/price ratio, cost of debt plus a risk premium, benchmarking approaches with comparable companies or comparable investments, and whatever our investors tell us they require. Furthermore, respondents have the choice to rate concepts discussed within finance theory, including that discount rates are at least as high as defined hurdle rates (section 2.4.3.3) and the more flexible and robust CE method (section 2.4.4.3).

Having analysed how discount rates are defined, a second question evaluates how discount rates are applied, providing answer options based on simple to more sophisticated approaches. Since project financing banks do not apply discount rates in their assessment of projects, in general, their data is excluded in the analysis. The simpler approaches include the use of a single discount rate for the entire company for all investment projects, a divisional discount rate, a discount rate based on the cost of financing of the company and a discount rate based on the past experience of the company. More advanced approaches consist of a specific discount rate for the considered country, for the applied technology/concerned industry and the concerned project stage. The most sophisticated approaches to be evaluated are the application of different discount rates for each component cash flow that has a different risk characteristic and the RADR concept (section 2.4.4.1) for the particular investment project.

Respondents are asked in both questions to score how frequently they use the different CoC or discount rate approaches, respectively, again on the five-level ordinal, Likert-type scale (1 meaning never, 5 meaning always).

In addition, participants are asked how frequently their companies re-estimate return rate requirements for investment projects, showing different answer options in line with previous studies (Gitman and Mercurio, 1982, Gitman and Vandenberg, 2000, Truong et al., 2008).

4.3.3.5 Valuation Adjustments for Specific Risk Components

This section investigates how various sources of risk other than general market risk are treated in project valuation. The rationale of this question is based on the approach of valuation adjustments for specific risk factors which cannot be completely diversified (unsystematic risks), as proposed within the RAPV concept (Hürlimann and Bengoa, 2017a) and after having explored it in the qual phase (sections 4.2.1 and 5.1.1). The respondents are asked whether firms adjust the discount rate, the cash flows, both or neither in valuation processes in response of the presented risk factors (risk components) in line with previous studies (Petty et al., 1975, Gitman and Mercurio, 1982, Payne et al., 1999, Gitman and Vandenberg, 2000, Graham and Harvey, 2001, Brounen et al., 2004). The selection of the proposed risk components to be evaluated (Table 21) is based on both the performed literature review (section 2.2.2 and Hürlimann and Bengoa, 2017a) and the verification of their relevancies for RES-E investment projects during the qual phase (section 5.1.1). Not found risk components in the provided list of choices can be added as text, separately either for discount rate or cash flow adjustments.

Table 21: Risk components evaluated in questionnaire (S: systematic risk, U: unsystematic risk) (adopted from Hürlimann and Bengoa, 2017a).

Risk components evaluated in questionnaire	**Type of risk**	**Comments and examples**	**Sources (academic literature and empirical surveys among practitioners)**
Risk of unexpected inflation	S	-	Graham and Harvey (2001), Brounen et al. (2004)
Momentum	S	Recent stock price performance	Jegadeesh and Titman (1993), Carhart (1997), Graham and Harvey (2001)
Political/regulatory risk (governmental policy risk and country risk)	S	Change in public policy affecting profitability, excl. tax risk	Bekaert et al. (1997), Böttcher (2009), Pastor and Veronesi (2011), Watts (2011), Damodaran (2013)
Tax risk	S	Change in tax laws and rules affecting profitability (separated from political/regulatory risk in the survey to find its specific influence as variable)	-
Financial risk (leverage)	U	Debt / equity ratio of RES-E project	Hamada (1972), Bhandari (1988), Dhaliwal et al. (2006), Penman et al. (2007), Dimitrov and Jain (2008), Adamia et al. (2010), Korteweg (2010), Watts (2011)
Interest rate risk	U	Change of general level of interest rate	Graham and Harvey (2001), Böttcher (2009)
Term structure risk	U	Long-term vs. short-term interest rate	Chen et al. (1986), Ferson and Harvey (1991)
Operational risk	U	Plant damage / component failure, lower technical availability, plant closure to resource unavailability or unclear cost development, illiquidity (cash flows)	Welsh et al. (1982), McMahon and Stanger (1995), Böttcher (2009), Böttcher and Blattner (2010), Brealey et al. (2011), Hawawini and Viallet (2011), Watts (2011)
Project termination risk	U	Missing operating permit or no acceptance to a bid in tender process	Böttcher (2009)
Foreign exchange risk	U	Currency changes	Graham and Harvey (2001), Böttcher (2009)
Size / small cap risk	U	Small firm being riskier	Banz (1981), Levy (1990), Fama and French (1992), Graham and Harvey (2001)

Table 21*: (continued).*

Risk components evaluated in questionnaire	Type of risk	Comments and examples	Sources (academic literature and empirical surveys among practitioners)
Market-to-book ratio / book to market premium	U	Ratio of market value of firm to book value of assets	Fama and French (1992), Graham and Harvey (2001)
Illiquidity of investment project	U	Lack of market for asset type	Amihud and Mendelson (1986), Acharya and Pedersen (2005), Amihud et al. (2005), Damodaran (2005a, 2010, 2012), Franzoni et al. (2012), Cheng et al. (2013), Damodaran (2013), Ping et al. (2013), Ehrhardt and Brigham (2016)
Lack of information	U	Information asymmetry increases the risk of not evaluating properly the assets of private targets	Akerlof (1970), Capron and Shen (2007)
Distress of investment target	U	Probability of bankruptcy	Graham and Harvey (2001)
Weather-related volume risk (e.g. lack of water, wind, sun, waves)	U	Lack of water, wind, sun, waves, a key factor for RES-E investments due their high impact on the business performance and possible high volatility	Böttcher (2009), Watts (2011), Boland et al. (2012), Agrawal et al. (2013a), Agrawal et al. (2013b)
Other natural resource risk (e.g. lack of geothermal heat or biomass supplies)	U	Lack of geothermal heat or biomass supplies, also a key factor for RES-E investments due their high impact on the business performance and possible high volatility	Böttcher (2009), Watts (2011), Boland et al. (2012), Agrawal et al. (2013a), Agrawal et al. (2013b)
Commodity price risk	U	Could be relevant for biomass energy projects	Graham and Harvey (2001), Böttcher (2009), Watts (2011), Pereira et al. (2012)
Credit standing of involved partners	U	In case of RES-E projects: project developer, contractor, maintenance and service companies	Böttcher (2009)
Complexity of organisational structure of investment	U	Many owners, different shareholder interests and inter-correlations between shareholders and suppliers	Author's own experience
Risk of subsidiaries not being under corporate control	U	In case of minority participations	McMahon and Stanger (1995)

4.3.4 Statistical Analysis

Before performing statistical analysis, each of the specification and assumptions of the available tests are studied in detail and verified in relation to available data and data types, as summarized in Table 22.

4.3.4.1 Data Processing before Analysis

Before starting the statistical analysis, the answer option 'I do not know/not applicable' is defined as missing values within SPSS – in addition to real missing values – in order not to distort arithmetic means (Brosius, 1998). All other data are analysed and shown in the following table, also those results which are not significant.

For further analysis, the different types of institutional investors are merged to one single group in the further statistical analysis. In relation to size, two groups are define – a group of large and small firms while large firms have more than 500 employees. Similarly, participants are divided according to their education into a group of participants having an MBA vs. other qualification) and according to their experiences into two groups, while the group with the high experience has performed more than 10 transaction being defined as having high experience).

4.3.4.2 Performed Statistical Analysis

For testing the correlations between demographic variables (section 5.2.1), the Pearson χ^2 test is applied based on 2x2 cross tabulations to test the independence of categorical variables (such as organisation type, country, leverage, stock exchange listing, age, gender, and experience in acquisitions). In case of groups with cell frequencies below 5, Fisher's exact test is applied instead. While the Pearson χ^2 or the Fisher's exact test show whether there is a relationship between the variables, the applied phi coefficient measures the effect size strength (UZH, 2016d). Cohen (1988) provides a rule of thumb stating that the effect size is small for a phi coefficient of 0.1, moderate for a value of 0.3 and large for value of 0.5. Likewise, Pearson χ^2 or Fisher's exact tests are performed on contingency tables with multivariate distributions of two categorical variables (Michael, 2001), testing independencies between firm characteristics and risk mitigation measures (section 0) as well as the provided risk adjustment strategies, cash flow or discount rate adjustments or both or neither, for each of the given risk factors/categories (section 5.2.2.5). In case of significant results in the applied test, standardized residuals are computed to show how far the outcome differs from the expected value, i.e. which cell contributes the most to the significant result if the value in absolute term is higher than the value of 1.96 (with a significance level of .05). This is a type of post-hoc test (Agresti and Kateri, 2011, TheRMUoHP Biostatistics Resource Channel, 2012).

For analysing mean differences (sections 5.2.2.1, 5.2.2.3 and 5.2.2.4), parametric statistical tests with either ANOVA (Analysis of Variances) or independent t-tests are performed. Both compare levels of a single factor based on single continuous response variable. In doing so, Likert-type scales are considered as a continuous variable, in line with Carifio and Perla (2007) and Grace-Martin (2016). Applying a one-way independent ANOVA, mean differences of one dependent variable (DV) are set in relation to organisation types with six levels (i.e. groups or categories), while the independent t-test is applied for those analysis with a predictor of only two levels, i.e. dichotomous data (Brosius, 1998, Field, 2013, Lund_Research_Ltd, 2013, Taylor, 2014a, UZH, 2016a, c), such as country (Germany or Switzerland), leverage (high >40% or low <=40% debt ratios), stock exchange listing (yes or no) and specific project stages. In addition, t-test is employed for additional IVs having consolidated them in two independent groups. This type of IV includes organisation size (big > 500 employees vs. small), education (MBA-educated or non-MBA-educated) and experiences (high > 10 transactions vs. low). Due to the non-normality of the distribution of the majority of the outcome in this study, ANOVA robustness is ensured with the two-tailed study, and with consideration of sample size equality and/or for homogeneity of variances (how2stats, 2012, 2015), without having to perform prior data transformation (Field, 2013). The t-test's robustness is ensured with bootstrapping (Efron and Tibshirani, 1993, Field, 2013) to keep its power, likewise without having to perform prior data transformation, and employing Welch's t-test in case heterogeneity of variances. Since the alternative non-parametric Mann-Whitney U and Kruskal-Wallis H tests for t-test or one-way ANOVA, respectively, are regarded as less powerful (Field, 2013, how2stats, 2014) and are based on other restrictive assumptions, they are not applied within this survey. Testing heterogeneity of variances, Levene's F test and non-parametric Levene's test in case of non-normal distribution are applied at 5% significance level (how2stats, 2011b). For ANOVA, post-hoc-tests are applied to see where the exact differences are. For this research, Bonferroni tests is chosen to control for type one errors, a conservative test with a good statistical power to detect really differences, particularly in case of low numbers of comparison (Maynard, 2013, Grande, 2015b). After having evaluated the post-hoc tests (Appendix 6 Table 35), the Bonferroni test is generally a good choice for this setup even very conservative, while other adequate tests, such as Gabriel and Hochberg's GT2, need equal variances (Maynard, 2013, Grande, 2015b).

For each of the presented results from ANOVA, t-test and Pearson χ^2, test the significance value are stated with in the presented tables, using the symbols ***, **, * which denote a significant difference at the 1% ($p<0.01$), 5% ($p<0.05$), and 10% ($p<0.10$) level, respectively.

Table 22: *Considered statistical tests (adopted from Brosius, 1998, Field, 2013, UZH, 2016a, c, d).*

	Pearson χ^2 test	**χ^2 Goodness of Fit Test**	**Spearman's rank order correlation**	**Mann-Whitney-*U*-Test**	**Kruskal-Wallis-Test**
			Non-parametric test		
Type of analysis	Relations between two variables	Relation between observed and expected set of frequencies	Non-parametric equivalent to Pearson's correlation measuring the relationship between two ranked variables	Non-parametric equivalent to t-test	Non-parametric equivalent to one-way ANOVA
Independent variable(s)	Two variables either independent and/or dependent	Just one variable	Two variables either independent and/or dependent	1 variable, 2 groups	1 variable, ≥2 groups
Dependent variables(s)				1 at least ordinal scaled variable	1 at least ordinal scaled variable
Assumptions	Independent observations; no random sampling needed; mutually exclusive row and columns; large expected frequencies	One categorical variable (either dichotomous, nominal or ordinal); independence of observations; groups of the categorical variable must be mutually exclusive; must be at least 5 expected frequencies in each group of your categorical variable	Variables are either ordinal, interval or ratio. Spearman correlation can be used when the assumptions of the Pearson correlation are markedly violated.	DV is at least ordinal scaled; data points are independent of each other; random selection of the participants of the population; distributions in each group (i.e., the distribution of scores for each group of the IV) have the same shape (which also means the same variability).	DV is at least ordinal scaled; data points are independent of each other; random selection of the participants of the population; distributions in each group (i.e., the distribution of scores for each group of the IV) have the same shape (which also means the same variability).
Application in survey	Relations between firm characteristics and adjustment for risk factors (0 Tables 47 and 48; several non-response bias tests and robustness check (Appendix 10)	Non-response bias tests by comparing characteristics of responding firms to characteristics for the population at large (Appendix 10)	Appendix 10 Table 54	Not applied in this analysis since not enough powerful	Not applied in this analysis since not enough powerful
Statistical measurements	Significance level (1%, 5%, 10%); Fisher's exact test in case of groups with cell frequencies < 5; standardized residuals >1.96 at 5% significance level; Cramer's phi coefficient (effect size strength);	n.a.	Apply bootstrap coefficient 95% interval to get robust intervals	n.a.	n.a.

Table 22: (continued).

	Pearson's product-momentum correlation[2]	**Independent sample t-test**	**One-way ANOVA**
		Parametric test	
Type of analysis	Linear relationship between two variables	Differences and central tendencies	Differences and central tendencies
Independent variable(s)	Two variables either independent and/or dependent	1 variable, 2 groups	1 categorical variable, ≥2 groups
Dependent variables(s)		1 continuous variable[1]	1 continuous variable[1]
Assumptions	Variables are at least interval scaled, normally distributed, studied relationship must be linear	DV is interval or ratio scaled; IV (factor) is categorical (nominal or ordinal scaled); groups built by the factor are independent; DV is normally distributed within each of the groups[1]; homogeneity of variances (see below).	DV is interval or ratio scaled; IV (factor) is categorical (nominal or ordinal scaled); groups built by the factor are independent; DV is normally distributed within each of the groups[1]; homogeneity of variances (see below).
Application in survey	Appendix 10 Table 54	Analysing effects of IVs with two groups (organisation size, country leverage, stock exchange listing, project phases; Appendix 9 Tables 36 to 46)	Analysing effects of organisation types (with several groups) Robustness check (non-size characteristics); Appendix 9 Tables 36, 37, 38, 40, 42, 44 and 46)
Statistical measurements	In case of non-normality apply bootstrap coefficient 95% interval (or take Spearman's correlation)	Significance level (1%, 5%, 10%); bootstrapped t-test applied due to non-normal distribution of samples or bootstrapped Welch's t-test in case of heterogeneity of variances ($p < .05$) and non-normal distribution.	Significance level (1%, 5%, 10%); in case of heterogeneity of variances (→Levene's test, $p < .05$): Welch-F test and/or Brown-Forsythe-test; post-hoc tests for finding significant mean differences between groups (Bonferroni)

[1] *In case of >25 respondents per group for ANOVA or <30 respondents per group for the t-test, the violation of this rule is less problematic.*

[2] *equivalent to correlation according to Bravais-Pearson.*

4.4 Primary Qualitative (QUAL) Interview Phase

4.4.1 Research Design of Qualitative Research

4.4.1.1 Interview Protocol Development

To efficiently and effectively collect data and to ensure a high data gathering quality (section 4.6.2), the interviews in the QUAL phase were structured in two parts: a first part as *semi-structured and unstandardised interviews*, as outlined in section 4.1.2.4, and a second part with a discussion about three investments scenarios (section 4.4.1.2). Based on the chosen sequential MMR typology (section 4.1.2.1), the content of the interview protocol for both parts was based on the results in the previous QUAN phase (section 5.2).

This first interview part is divided into several sections (see Appendix 6). To reflect the main results of the QUAN phase with the interviewee, the first section uses five questions to explore additional features and potentially controversial topics in capital budgeting methods and CoC approaches. Three additional questions explore the influence of uncertainty/risk, risk assessment and risk mitigation, and their integration into valuation and/or investment decisions. A specific question aims to understand the puzzling result from the quantitative phase about the risk components in relation to project stages. Additional questions investigate the effect of various influence factors—apart from the organisation type, size, leverage, stock exchange listing, and project stages asked in the quantitative phase—such as an existing portfolio of the investment company, the integration of synergies and/or opportunities within valuation, and/or investment decision making. The last group of questions seeks to identify encountered problems in valuation processes. Therefore, the issue of having the time value of money and the risk in one input variable, namely the discount rate, applied within valuation is presented and discussed while introducing the CE approach as a possible theoretical solution to this issue.

4.4.1.2 Investment scenarios

To collect an additional rich set of data and even deeper insights into the topic – in line with the researcher's chosen philosophical stance (section 3.1.2.2), as well as to triangulate the answers of the first interview phase (section 4.6.2), the second interview part assesses the judgement and decisions of the interviewees based on three investment scenarios. It does not follow related methods, such as case study research, which would focus on an in-depth analysis of specific cases (Eisenhardt, 1989, Yin, 2011). The chosen approach with a discussion of investment scenarios reflects, as much as possible, the reality of performing a valuation to ensure high-quality answers (section 4.6.2).

To challenge the decision making of the interviewees and thoroughly explore valuation approaches in RES-E investments, three similar investments were presented (Appendix 8). The investment scenarios are based mainly on numerical key figures (descriptions and input data for the valuation) and numerical results of the performed valuation based on the various methodological approaches. For preparation purposes, the investment scenarios were sent to the interviewees, along with appropriate instructions, prior to the interview (about four to seven days before the scheduled interview date) to allow the interviewees enough time to understand the cases, perform their valuations, and make a decision, if possible. This approach limits the interview time. The three presented investment scenarios are based on real but anonymised investment opportunities in the year 2016, presented by sellers to a wide investment community. These projects were chosen because they seemed to be attractive in relation to their applied technology, country location, and available relevant natural resources, as demonstrated within the survey (section 5.2.1), thereby ensuring that the interviewees carefully weighed their decisions and were forced to use as much of the available data and information to make a judgment. Some information was intentionally not provided, for example details about the manufacturer of the turbines and details about service agreements and the suppliers, to force the interviewees to react to these missing data and recognise how relevant this information is.

As preparation, the following questions were stated on the previously sent sheet, along with the investment scenarios, to discuss them during the interview:

- Are you able to present your investment proposal to your decision-making body based on the provided information?
- On what basis do you justify your proposal?
- Are certain key figures and analysis/used methods missing?
- Which key figures, used methods, and analysis results are not necessary to make the proposal and take a decision?
- Do you consider additional circumstances that are not based on valuation and figures in your investment proposal?

4.4.2 Qualitative Data Collection and Documentation Process

The interviews in the QUAL phase were conducted between December 2016 and May 2017, ensuring that ethical obligations and appropriately defined processes are considered (section 3.2.2). The researcher personally conducted all the interviews with the selected participants (section 4.1.3.3), mainly face-to-face where possible and economically feasible (75%). In some cases, telephone interviews were performed (25%). Face-to-face interviews are regarded as advantageous for conducting a dialogue and recognising non-verbal communication (Saunders et al., 2009), although the latter is not over-claimed in this research, since appropriate justifications are complex for persons who are inappropriately trained in psychological analysis. Many interviewees also prefer personal contact and are only willing to spend more time in face-to-face interviews (Saunders et al., 2009), even if telephone interviews are advantageous for many managers due to their flexibility in terms of scheduling (Gläser and Laudel, 2010). Nevertheless, the face-to-face interview was the preferred procedure suggested to all chosen interviewees, and telephone interviews were performed only if face-to-face interviews were not possible for travel, budget, or scheduling reasons. Nevertheless, several studies, summarised in Cassell (2009), could not demonstrate any quality differences in the collected data between the two interview procedures.

The interviews were all performed and transcribed in High German. The translation from German to English was performed on the coding level, i.e., the knots in nVivo10™, which represents the themes, subthemes, and categories for the coding in English. This approach aims to minimise the adverse effect of the translation as much as possible. All the subsequent findings, including citations, are presented in English. To ensure a high quality standard for all transcripts, a detailed transcription procedure is introduced, as presented in section 4.6.2.

4.4.3 Qualitative Data Analysis

The applied QDA goes a step further than just sorting text responses to particular questions by a categorical variable with a spreadsheet and then finding, for example, interesting quotes to be cited (Bazeley, 2010). Performing a QDA is about allowing themes and categories to emerge from the data, rather than providing them before the data collection process (David and Sutton, 2011). The use of follow-up interviews after responses to structure surveys is one of the most common data-gathering strategies applied within MMR (Bryman, 2006). The following two sections highlight the applied coding approaches and the used infrastructure. The procedure for analysing the qualitative data was specifically developed for the QUAL part of this quan-QUAN-QUAL sequential MMR. It follows a four-step approach, as outlined in Figure 39.

Figure 39: Applied four-step QUAL analysis procedure in quan-QUAN-QUAL MM approach.

Step	Input	Results
1. Preparation	Insights from literature review Findings from qual phase Findings from QUAN phase	Initial coding frame (ICF) (with knots in nVivo™)
2. Coding	Transcripts Initial coding frame (ICF) (with knots in nVivo™)	Updated coding frame Code matrix
3. Categorisation	Code matrix	Categorised code matrix
4. Conceptualisation	Categorised code matrix	Concept map

4.4.3.1 Coding Qualitative Data

As a subsequent step after data collection, coding is an integral part of quantitative research and a key element of content analysis (Saunders et al., 2009, David and Sutton, 2011). It consists of a process in which text pieces are matched to codes with the aim of finding similarities and/or differences between and within the transcribed interviews (David and Sutton, 2011). The codes can be keywords, themes, phrases, or complete sentences. As outlined in section 4.1.2.4, coding is a data reduction method that narrows the researcher’s focus of attention from a whole piece of text to the areas of interest and significance (David and Sutton, 2011). It allows for the mapping of patterns. However, researchers must pay attention to not abstract the coded segments from their context to prevent a loss of the original meaning.

As stated above, the translation from German to English was performed during the coding process, which seemed to be the most efficient approach for presenting the study results in English based on the data in German.

To understand the different approaches for performing the coding, David and Sutton (2011) present several pairs of coding types, indicating a continuum between each of the two extremes. Along this spectrum of each of those pairs, the corresponding coding is applied, which enables the process of exploration and the emergence of linkages between chunks of texts and new recognitions (David and Sutton, 2011).

Within the quantitative phase of this research, the explicit coding approach was analysed in relation to those pairs of coding (Table 23), and a distinction was made between an initial coding phase and a detailed coding phase:

- The initial coding phase included the predefined ICF. Before finalising the complete data collection phase and before starting the coding, the ICF with a tree structure, including a hierarchy of codes, was developed after the literature review and updated in the qual phase (section 5.1.2) to identify patterns within the research text pieces (Saunders et al., 2009, David and Sutton, 2011). It was based on the findings from the literature review (section 2.7.4), the initial qual phase (section 5.1), and the previous QUAN phase (section 5.2). This coding frame was constantly enhanced during the coding process of approximately the first six transcribed interviews.
- In the subsequent detailed coding phase, the updated coding frame was kept unchanged, and it was applied to all the transcribed interviews, including those that were previously studied in the initial coding phase, to research all available data with—as much as possible—the same depth and rigour.

The following pairs of coding types were identified and applied to various extents within the two previously described coding phases, based on the outlines of David and Sutton (2011):

- *Manifest coding* refers to specific terms with the text itself, and it is applied in the initial and detailed final coding processes, while the *latent coding* is about finding terms or themes beneath the text, and it is predominantly applied in the detailed final coding process.
- *In vivo coding* involves the use of those texts with their language as provided by the interviewee, while *sociological coding* refers to the themes in the language of the researcher him- or herself. The in vivo coding is applied in both the initial coding and detailed coding phases, while the sociological coding is mainly applied in the detailed final coding phase in which the coding patterns of the researcher have been manifested.
- *Deductive coding* includes the development and application of a list of categories that has been created before commencing with the coding process, while *inductive coding* refers to a coding process that starts after gathering and first reading the collected data. As with all pairs, the applied reality in this study lies somewhere between those two extremes.
- *Summary coding* is also referred to as first-level coding, since it focuses on obvious characteristics within the population, the sample, and the researched situations. On the other hand, *pattern coding* goes a step further and digs deeper into the subject, trying to discover underlying patterns in the studied transcriptions to study specific relationships within the encountered context. Summary coding is applied in both coding phases, while the pattern coding is only applied in the detailed coding phase to all available transcriptions.
- *Systematic coding* involves the researching of themes that are regarded as key within the research. *Axial coding* attempts to identify all emerging topics within the researched texts, trying to apply selection and data reduction as well as to anticipate core issues within the research more slowly. As suggested by David and Sutton (2011), a pragmatic equilibrium must be found between those two extremes because of the inevitable necessity within the research to perform selection and data reduction in order to stress those points that are relevant versus irrelevant for the researcher.

Table 23: Applied types of coding in the quantitative analysis (in accordance with the classification of David and Sutton, 2011).

Types of coding	**Initial coding[1]**	**Detailed final coding**	**Comment**
Manifest coding vs.	X	X	
Latent coding	-	X	
In vivo coding vs.	X	X	
Sociological coding	-	X	
Deductive coding vs.	X (only first level)	X (only first level)	
Inductive coding	X (all hierarchical levels)	X (all hierarchical levels)	
Summary coding vs.	X	X	
Pattern coding	-	X	
Systematic coding vs.	X	X	Pragmatic balance between both coding types
Axial coding	-	X	

[1] started already before ending data collection phase.

4.4.3.2 Computer-Assistant QDA Software (CAQDAS)

The QDA applied in this research is supported with a CAQDAS. Therefore, nVivo10™ is chosen, since it is a widely used computer software specialising in QDA.

Using a specific CAQDAS, it is possible to analyse more complex responses, thereby enabling detailed coding and even revised coding to additional categories while digging deeper into the responses, allowing new and finer categories to emerge and be coded on, finding relationships, and revealing new insights and concepts (Bazeley, 2010, David and Sutton, 2011). The CAQDAS provides an optimal structural environment in which to analyse interview transcripts in the most flexible way, either by allowing issues and categories to emerge while coding or by basing the coding on predefined categories resulting from a prior survey (Bazeley, 2010). Additional advantages of a CAQDAS are its ability to sort coded text passages by categorised texts, demographic data, or ratings based on scaled responses while linking the gathered data with additional information on an individual basis to enable ‘a richer and potentially more valid analysis […]. Variations in responses can be better understood, and anomalies and alternative explanations examined’ (Bazeley, 2010:438). Critics challenge the advantages of performing the coding faster because QDA should take time to allow the relevant results to emerge—this is often described as a craft. In addition, due to fact that CAQDAS simplifies the storage and analysis of large amounts of data while spending less time with the data, some researchers have been led to state and analyse meaningless questions and outputs. This can also happen without software; however, it can occur more easily with software packages. Similar criticisms exist in applying statistical software packages to a quantitative analysis. In any case, the work of analysis should not solely be technical. Therefore, the software 'should never be used in a «push-button» manner but rather in a reflexive way' (Rihoux et al., 2009:173). Despite the mentioned points of criticism, nowadays, CAQDAS, such as nVivo™, Atlas.ti™, N6™, and HyperRESEARCH™, are de facto taken for granted, since the advantages outweigh the drawbacks (David and Sutton, 2011). Computer-assistant QDA software allows the data to be optimally stored, accessed, organised, explored, coded on, and evaluated to better recognise the relationships between them, even latent ones (Bazeley, 2010), while providing powerful tools to manage the research project (Lewins and Silver, 2009). QSR's nVivo™, in its available 10th version (nVivo10™) at that time, was chosen due to its powerful software evaluation and searching routines (Saunders et al., 2009) and its popularity in the research community (David and Sutton, 2011) in order to be able to exchange with other researchers.

4.4.3.3 Presentation of Findings of Qualitative Analysis

After performing a thorough analysis in nVivo™, the findings are presented as a discussion, in common prose writing, and they are supported by meaningful and translated quotes from the interview dialogues. Also, each section contains a table summarising the findings. This latter selected procedure with tables is regarded as an optimal approach to summarise the findings—also for the QUAN phase—although this presentation format is rather common for quantitative approaches. A deliberate decision was made to include the quantitative elements in the QUAL phase, demonstrating also the MMR characteristics in presenting the findings. As illustrated in Figure 39 in step 3, the presented tables of findings are categorised code matrices in a simple format, with aggregating codes to categories showing grey cells for the participants' approval and the categories' relevancies by counting the number of underlying codes per category (Table 24). In one case, the findings are illustrated in an advanced format of categorised code matrix, showing the type of approval or denial with specific icons for each participant (Table 25) in which similar content or meaning were grouped into categories of codes. The categorisation of the codes for aggregation purposes was minimised as much as possible to prevent unnecessary data reduction and hence a loss of relevant information. As indicated in step 4 of Figure 39, these categorised code matrices build the basis for a subsequent concept map, as initially drafted after the literature review in Figure 30 (section 2.7.1).

Table 24: Aggregation of codes to categories to receive categorised code matrix, demonstrating the approval of the participants with grey cells (example of findings presented here for illustration purposes).

No.	**Themes/categories**	**Participant no.**																**#**
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
01	Missing or inadequate information																	
01.1	Resource assessments and data																	4
01.2	Market value of electricity production																	1
01.3	Supplier/manufacturer of technology and type of engine																	12
01.4	OPEX details, influences, and compensation measurements																	11

Table 25: Alternative presentation of categorised code matrix, with specific icons representing the type of approval or denial of each participant (example of findings presented here for illustration purposes).

No.	Themes/categories	Participant no.															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
01	IRR approach	+	+	+		+	+/-	+	+	+	+	+	+	+	+	+	+
02	NPV approach		-				+/-			-			-				+
03	Equity return rate	+	+	+	+	+	+	+	+	+	+	+/-	+	+	+	+	+

4.5 Inference Phase

The chosen MMR design typology, both sequential and explanatory, provides the foundation for specific points of integration in this research while combining quantitative and qualitative phases. Points of integration or INFs were made at different stages in the research process, as outlined in sections 4.1.1.4 and 4.1.2.1. Within this research, they are divided into the minor and primary stages of integration.

4.5.1 Minor Stages of Integration

In line with the wider sense of understanding the integration points between the different research phases and types, several minor stages of integrations are encountered. Within these minor stages, the integration is not much more than a combination of different research phases, in contrast to the primary stages below:

a) To improve the questionnaire for the QUAN phase, the questionnaire was piloted using informal interviews (section 4.3.2.1)
b) Interesting phenomena were collected in the exploratory qual phase to be studied in the QUAN and QUAL phases (section 5.1)
c) Interesting phenomena of the QUAN phase were studied in more detail in the QUAL phase (section 5.2.5)
d) Selection of the interviewee for the QUAL phase was from the pool of survey participants (section 4.1.3.3)

4.5.2 Primary Stage of Integration

The final research phase of integrating, interpreting, explaining, and discussing the connected results of the QUAN and QUAL phases is regarded as the primary stage of integration of this study—also called *inferences* in the closer sense of its meaning, and abbreviated with the term INF in this research. It is called *primary* because it delivers the main research outcomes. In addition to combining different research phases, as in the minor integration stages, this primary integration point aims to discuss, interpret, and explain the integrated outcomes in detail. Due to the chosen explanatory research purpose, the latter INF objective is key within the integration process. Therefore, all the INF outcomes were interpreted regarding whether the QUAL phase provides additional explanation, thereby increasing and deepening knowledge about the found results of the previous QUAN phase.

Three possible outcomes can arise when integrating the results of the QUAN and QUAL phases (Chesla, 1989, Erzberger and Prein, 1997, Erzberger, 1998, Kelle and Erzberger, 1999, Erzberger and Kelle, 2003) with regard to triangulation for completeness and confirmation (McEvoy and Richards, 2006):

1. Convergence of results, i.e., the QUAN and QUAL results lead to the same conclusions.
2. Complementary results, i.e., the QUAN and QUAL results supplement each other.
3. Divergence of results, i.e., the QUAN and QUAL results are divergent and contradictory.

4.5.3 Inference Analysis and Framework Development

Inference analyses were performed for minor and primary integration stages, applying in essence qualitative methodologies. The following two INF processes were formally performed in nVivo10™:

a) Some results of the QUAN phase build the basis for the coding with the QUAL phase
b) Both QUAN and QUAL results were coded simultaneously to the INF outcomes

In the case of a), interesting QUAN results for the QUAL phase were coded to new knot classifications. In the case of b), each single result of the QUAN and QUAL phases was evaluated—while comparing the outcomes of the different phases—regarding whether the results are converging, complementary, and diverging to each other and whether the QUAL results provide additional explanations of the QUAN phase. Each compared result was then labelled with the corresponding outcome type and an answer to whether it provides explanations.

Together with the findings from the literature review, the INF findings provided the basis for developing and presenting three frameworks and models to be specifically applied in the valuation of RES-E investments:

i. an equity value driver and influencing factor (EVDIF) model to understand the relevant determinants in valuation,

ii. an uncertainty/risk consideration model to be able to appropriately manage the different uncertainties and risks, and

iii. an integrated equity value creation and value protection (EVCaP) model to perform a coherent valuation, considering the diversification level of the investing firm and the investor.

4.6 Quality, Validation, and Credibility of Research

4.6.1 Mixed-Methods Research Quality

Ensuring the quality of the performed research is a key topic in research, as Curry and Nunez-Smith (2015:183) noticed: ‘It is essential that the chosen study design is well suited to generate quantitative, qualitative, and integrated data that are directly relevant to answering the study questions’. Quality also refers to validation processes ensuring the rigor of the applied methodological procedure (Plano Clark and Ivankova, 2016). In other areas of assessing and ensuring the quality of MMR, there are various debates among scholars, such as how to perform a quality assessment (Bryman et al., 2008), whether to define quality assessment standards, or the time in the research to perform quality assessments (Creswell and Plano Clark, 2011b, Plano Clark and Ivankova, 2016). Within MMR, scholars (Dellinger and Leech, 2007, Greene, 2007, Teddlie and Tashakkori, 2009, Creswell and Plano Clark, 2011b) agree that the quality of each strand directly affects the quality of the INFs. As such, assessing the quality of the research, i.e. the data and results, of the quantitative and qualitative phases with the typical processes applied for each of those two strands is recommended as a basis for reaching a high quality of the INFs (Greene, 2007, Teddlie and Tashakkori, 2009, Creswell and Plano Clark, 2011b, Curry and Nunez-Smith, 2015, Ivankova, 2015). Apart from differentiating the quality standards applied between the quantitative and qualitative phases, Greene (2007) suggests assessing the quality of the INF phase separately. In addition, the approaches to ensure MMR quality are directly interlinked with decisions about defining the MMR design and processes (Plano Clark and Ivankova, 2016). As such, three interlinked levels are differentiated within MMR quality assessments: the quality of (i) the individual quantitative and qualitative strands; (ii) the generated INF; and (iii) the specifically applied MMR design, its features, and implementation (Plano Clark and Ivankova, 2016), as discussed in separate sections below. These lead to the development of a straightforward quality assessment framework, as presented in Table 26, which is a simpler framework than the ones from Teddlie and Tashakkori (2009) or O’Cathain (2010).

Conducting high-quality research is also associated with the terms validity and valid research (Johnson and Turner, 2003, Plano Clark and Ivankova, 2016). According to Johnson and Christensen (2000), valid research is described as ‘plausible, credible, trustworthy, and therefore defensible’. As such, researchers are interested in providing trustworthy findings, defined as outcomes that others accept as persuasive (Plano Clark and Ivankova, 2016:167) and ‘worth paying attention to’ (Lincoln and Guba, 1985:290), i.e., whether experts in the field of research consider the research to be good and worth reading (Johnson and Turner, 2003). Trustworthiness is a concept particularly applied in qualitative research phases (Plano Clark and Ivankova, 2016). Every research component, such as design, data collection, data analysis, interpretation, and writing, can be checked for validity or trustworthiness (Johnson and Turner, 2003).

Of the various validity concepts, the validity types that distinguish between internal and external validity, first introduced by Campbell (1957), are widely applied and accepted, particularly in approaching quantitative research outcomes (Plano Clark and Ivankova, 2016). However, this differentiation is sometimes not clear-cut, such as for internal validity (Kemper et al., 2003).

Internal validity is also referred to as 'causal validity' (Johnson and Turner, 2003:301), and it is the degree of approximate truth of the taken causal conclusions of the reality studied. Other authors (e.g. Kemper et al., 2003) associate internal validity with the term trustworthiness. Mathematically expressed, internal validity is about reducing systematic errors or biases (Brewer and Crano, 2000). As propagated by Yin (2014), this causal validity was considered in all research phases of this MMR. In the case of the quantitative phase, non-response bias and robustness checks were performed (section 4.6.3). A first corresponding validity measurement strategy is known as content-related validation or content validity (Cooper and Schindler, 2003, Johnson and Turner, 2003), and it is the degree of the 'adequate coverage' (Saunders et al., 2009:404) of the research field within the asked questions in the questionnaire and interviews. This was ensured in this research with a thorough literature review of the finance theory and previous empirical studies; through prior discussions with peers, as recommended by Saunders et al. (2009); and via the performed initial exploratory qualitative phase (section 4.2) to determine which questions were worth asking to collect data most efficiently.

Table 26: Quality assessment framework within this MMR.

Phase / level	**Approach**	**Brief description**	**Source**
1a Quantitative strand	Established statistical methods to ensure internal (causal validity) and external validity (generalization)	• Choice for powerful and robust methods, including Chi-square-test, t-test and ANOVA, test for type I error, test for various bias types • Checking for threats in terms of internal and external validity	Ivankova (2015), Plano Clark and Ivankova (2016)
1b Qualitative strand	Ensuring trustworthiness and credibility to ensure internal (causal validity) and in particular descriptive, interpretive and theoretical validity	• Checking for threats in terms of internal (and if possible external) validity • Ensuring consistency, transparency and authencity in coding with only one transcription expert and the researcher's personal coding (descriptive validity) • Ensuring trustworthiness and credibility with appropriate strategies including data triangulation and peer debriefing (interpretive validity) • Ensuring plausible data analysis outcomes by the researcher's developed theoretical concepts. This is ensured by discussing the found results rigorously with the available literature. (theoretical validity)	Lincoln and Guba (1985), Maxwell (1992, 1996), Onwuegbuzie and Johnson (2006), Bazeley (2010), Creswell and Plano Clark (2011b), Ivankova (2015), Plano Clark and Ivankova (2016)
2 Inference	Integrative framework for inference quality	• Ensuring inference quality by engaging in dialogues with stakeholders, such as practitioners, and by rigorously judging how inferences contributes to an improved understanding of the research topic in literature and practice • Continuous evaluation of applied procedures with feedback loops to ensure the consistency of research objectives and the outcomes of the inferences. • Application of coding software to facilitate the integration, coding and interpretation process (overall quality)	Onwuegbuzie and Johnson (2006), Greene (2007), O'Cathain (2010)
3 Design and implementation	Emphasis on the consistency of the applied methods and processes with the research design	Design and implementation quality is ensured with: • Design suitability • Design fidelity • Within-design consistency • Analytical adequacy • Justification for the design choices and transparency how to perform the research (planning quality) • Performing rigorous data collection and analysis procedures	Teddlie and Tashakkori (2009), Creswell and Plano Clark (2011b)

External validity is about the ability to generalise the research outcomes to other settings, places, participants, and times (Johnson and Turner, 2003) while ensuring the transferability of the results (Kemper et al., 2003). This was a key criterion in the quantitative phase (Ryan et al., 2002), and it was met through established statistical procedures (section 4.3.4) to ensure a generalisation of the results.

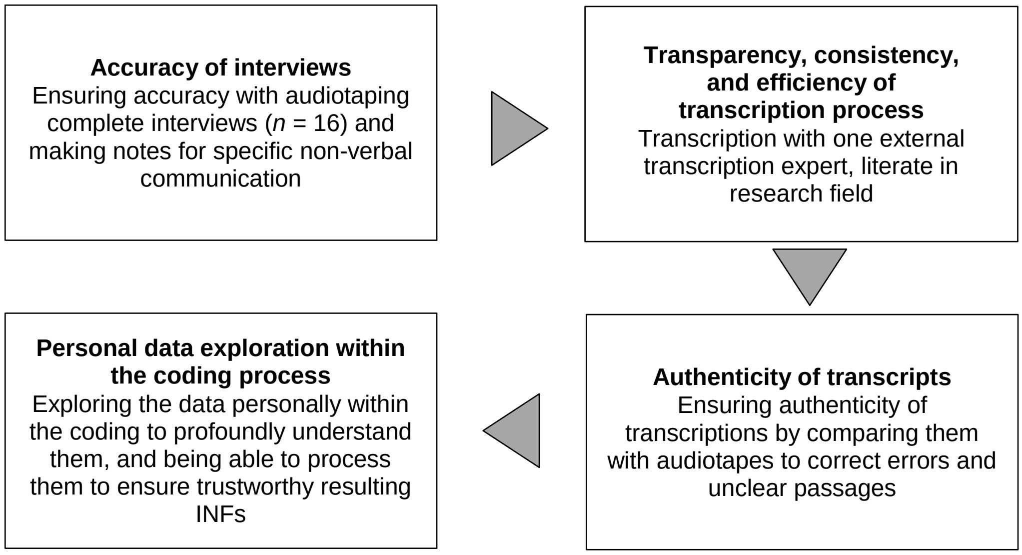
The first major approach in assessing the quality of the MMR includes the discussion about the validity of qualitative and quantitative strands, as outlined in the following two sections.

4.6.2 Assuring Validity of the Qualitative Phases

In addition to the discussion about the optimal validity concepts above, the performed qualitative research followed the three validity types presented by Maxwell (1992, 1996). First, the *descriptive validity* was ensured by carefully collecting and corroborating descriptive information during data collection (Johnson and Turner, 2003). Accuracy was subsequently ensured by audiotaping and then transcribing the performed interviews word by word; this was also done by making additional notes about any particular non-verbal communication during the interview while considering the stated limitation regarding the processing of non-verbal communication (section 4.4.2). The key question to be asked is ‘did we indeed capture the phenomenon or attribute that we intended to (or we believe we captured)’ (Tashakkori and Teddlie, 2003:694).

Particular attention was paid to transparency and consistency issues in capturing the dialogues, performing transcriptions of the interviews, and coding (Bazeley, 2010) (Figure 40). Transcription of the interviews was performed with the help of a mandated professional transcriber to address the trustworthiness, which is an umbrella term for quality in qualitative research (Lincoln and Guba, 1985), of the transcription in general (Dressler and Kreuz, 2000) while introducing a transparent and efficient procedure. To ensure high quality, a high level of trustworthiness, consistency across all the transcripts, and ethical considerations (section 3.2.2), the same transcriber, who is literate in financial topics, performed the task and was instructed about the purpose of the research, its objectives, research terminologies, and the transcription requirements, as proposed by Tilley and Powick (2002), McLellan et al. (2003), and Davidson (2009). In addition, to ensure the highest levels of trustworthiness, authenticity, and consistency across all interviews, the researcher personally proofread and double-checked all the transcripts with the corresponding audio material to correct errors or adjust unclear words (MacLean et al., 2004), if necessary, before personally coding the collected data to explore and understand them. By maximising the study’s trustworthiness, sampling for heterogeneity was applied in the QUAL phase (section 4.1.3.3).

Figure 40: Quality management in qualitative data collection and processing (author's own illustration).



The second type accounts for the *interpretive validity* to present the view of the participants and perspective of the researcher (Johnson and Turner, 2003). This also refers to the credibility of the research, which is one of the criteria of validity, described as 'the extent to which the qualitative findings are perceived as accurately conveying the study participants' experiences' (Plano Clark and Ivankova, 2016:167). The interpretive validity and credibility checks were performed by employing two strategies: i) the data triangulation between the QUAN and QUAL phases (section 4.1.1.1) and between the first and second parts (investment scenario discussion) of the interviews in the QUAL phase (section 4.4.1.2) and ii) a peer debriefing (Lincoln and Guba, 1985, Teddlie and Tashakkori, 2009, Creswell and Plano Clark, 2011b, Plano Clark and Ivankova, 2016) by presenting to and discussing the results with an academic audience in conferences (sections 1.5, 6.2 and 6.6) and doing the same with practitioners in workshops (section 6.6). The discussion of the investment scenarios also reduced the agent problem of the participants by decreasing the risk of whether their responses about views and opinions are really translated into actions (section 6.4). The applied data triangulation was also applied 'to avoid misinterpretations of quantitative data due to misguided common-sense knowledge' (Erzberger and Kelle, 2003:473). As such, qualitative data helped to understand the empirical results from the statistical data analysis (Rossman and Wilson, 1985, Erzberger and Kelle, 2003) of the QUAN phase. Although these two strategies are extensively used for qualitative findings, they are regarded as optimal standards to ensure a high degree of internal and external validity of both quantitative and qualitative strands, as propagated by Onwuegbuzie and Johnson (2006).

As a last type, the *theoretical validity* measures check whether the researcher's developed theoretical concepts can plausibly explain the collected and analysed data. This was ensured by comparing the found results rigorously with the available literature after the INF phase (section 4.6.4).

4.6.3 Validity Check of the Quantitative Phases

The quantitative phase places particular emphasis on maximising external validity with larger and representative samples and ensuring credibility by assessing the accuracy of the measuring scores (Plano Clark and Ivankova, 2016). The validity and credibility of the quantitative data were assessed with a statistical analysis, which is the typical procedure applied for quantitative studies (Plano Clark and Ivankova, 2016) (section 4.3.4). In addition, further validity checks of the survey were performed, including non-response bias and several robustness checks, as discussed in more detail below. The results of the validity check are presented in section 5.2.3.

4.6.3.1 Non-Response Bias

A particular focus in this thesis is on the analyses for potential non-response biases by performing several tests. A first test, suggested by Wallace and Mellor (1988), analysed whether there were any differences between on-time (i.e., until January 30, 2016) and late replies (i.e., after January 30, 2016). The participants who did not answer the survey on time can be thought of as a sample of a non-response group, since they did not answer until being reminded, convinced, and pestered again. Based on Pearson's χ^2- test, each of the 118 questions that is not related to firms' and participants' characteristics was analysed to determine whether the mean differs significantly from the early to the late responses.

In line with Moore and Reichert (1983), possible non-response bias was investigated by comparing the characteristics of responding firms to those of the population at large. If the characteristics between the two groups match, then the sample can be thought of as representing the population. Based on χ^2 goodness-of-fit analysis (Grande, 2015a), the sample was compared to the population, based on the characteristic 'organisation type'. Although the freely available information about the number of corporate investors in Germany and Switzerland who invest in RE is restricted, the comparison could be performed on the amount and type of active corporate investors (such as utility, project developer, IPPs, and institutional investor), based on several studies (Bergek et al., 2013, Global Capital Finance, 2014, Wassmann et al., 2016) and the participant lists of major RES-E conferences[56].

4.6.3.2 Robustness of Results

The reliability of the survey was tested using a robustness check for internal consistency (Mitchell, 1996)[57]. It is based on the performed evaluations for correlations between demographic variables in section 5.2.1, and it involves correlating responses between subgroups, based on different selective firm and participant characteristics, looking for significant correlations and their strengths (phi coefficients).

Since size is correlated with different factors, including organisation types, leverage, stock exchange listing, and country, a robustness check for the non-size characteristics was performed by applying a one-way ANOVA and splitting the sample into large versus small firms. If the reliability of the factors was not confirmed, i.e., if organisation size has a strong influence on the considered factors and the mean differences of non-size IVs are significantly influenced by the size, then it was correspondingly marked in the tables for those data with mean differences at a 10% significance level and lower, and it was not reported in writing within the thesis.

The same procedure was performed for education, which correlates with different factors, such as country, leverage, and stock exchange listing, by dividing the sample into responses of MBA-educated and non-MBA-educated participants. On each size subsample, we repeated the analysis of the responses, conditional on firm characteristics other than size and education, and we compared the subsamples to each other and to the total sample. This robustness check was passed if finance theory's suggested methods are applied significantly more often by MBA-educated participants and/or participants with high levels of experience with mergers and acquisitions (M&As). An additional robustness check was performed in relation to education and experience, evaluating whether MBA-educated and higher M&A-experienced participants demonstrate equal or higher response rates.

Moreover, the reliability of responses was checked by comparing specific results with the underlying basic theoretical concepts to test the participants' understanding of corporate finance. This robustness check is based on the theory that a company has a single WACC, and its correlation to other related factors was checked by applying both the bootstrapped Pearson's correlation and the Spearman's rank order correlation (Field, 2013, UZH, 2016b). The bootstrapped Pearson's coefficient is applied to compensate for a lack of normality at a 95% confidence interval, while the bootstrapped Spearman's coefficient provides more robust results (Field, 2013). The lower of both coefficients is shown.

In addition, internal consistency was checked for related questions about applying discount rates. In both cases, the sample was split into specific subgroups to test for significant differences between them, where a Pearson χ^2 test was applied, complemented by Fisher's exact test in the case of group sizes below five, and the phi coefficient was calculated to define the effect size (strength).

Furthermore, a principal component analysis (PCA) was performed to find related components, which have not been found in the initial analysis, and to reveal latent structures (Grande, 2014b). The PCA was applied to the questions with Likert-scale-type answers to determine whether questions measure and load on the same concept. In a first phase, a PCA was performed separately for each respective group of questions about risk assessment, valuation, and cost of capital, as well as between groups of questions about risk assessment and risk adjustment and between groups of questions about valuation and cost of capital. In additional phases, a PCA was performed again only for items with correlations to other items higher than 0.5. In doing so, several iterations have been performed to find higher correlations. Correlations higher than 0.8 would indicate a multicollinear variable, i.e. a highly related variable.

Last but not least, Cronbach's alpha was calculated to check whether a group of questions in the survey reliably measures the same latent variable (Cronbach, 1951, how2stats, 2011a, Tavakol and Dennick, 2011, Copur, 2015). Cronbach's alpha is a popular test if Likert-type scales are applied (Grande, 2014a).

All the presented tables and figures include the complete set of results. However, only findings that are significant and representative, and which pass the robustness checks, are reported in writing.

4.6.4 Assuring the INF Quality

In the second major approach in assessing the MMR quality, the INFs were evaluated to assess whether the integration of the qualitative and quantitative phases produce high qualitative INFs (Plano Clark and Ivankova, 2016), described by the term 'inference quality' (Tashakkori and Teddlie, 1998:77) and ensured, for instance, by the 'Integrative framework for inference quality' (Teddlie and Tashakkori, 2009:300) regarding the quality of both the generated INFs and the research design elements (section 4.6.5).

In line with the argumentation of Greene (2007) in judging MMR quality, INF quality was evaluated in this research by engaging in dialogues with stakeholders, such as practitioners (section 6.6), and by rigorously judging how the INFs contribute to an improved understanding of the research topic in literature and in practice (sections 6.2 and 6.3). With regard to the validity of the inferential results (section 5.4), the major capacity of MMR is its ability to address the following points simultaneously: i) ensure trustworthiness (internal validity) of the results, ii) ensure generalisability (external validity) of the results, and iii) perform both validity forms in an efficient manner (Kemper et al., 2003). The often heard truism, that while increasing internal validity, the external validity decreases, does not have to be valid for MMR studies (Kemper et al., 2003). It is this capacity of considering the issues of the external and internal validity of the results that makes MMR valuable for this research.

In addition to the rough classification of assessing quality in MMR with three different validity types (sections 4.6.1 and 4.6.2), Onwuegbuzie and Johnson (2006) propose the implementation of a continuous evaluation of applied procedures to ensure the consistency of research objectives and the outcomes of the INFs. Such feedback loops between the INF or interim results and the research objectives were frequently performed for the two defined points of integration in this research (sections 4.5.1 and 4.5.2), such as at the interpretation phase when combining the results of both primary phases as well as between the QUAN and QUAL phases to define the appropriate participants and questions for the subsequent QUAL phase. As such, the research objectives as well as the research hypotheses for the QUAN phase were kept consistent with the interim results and final resulting INFs and vice versa.

According to Greene (2007), while the challenge of interaction between different methods in integrated design is understudied and undertheorised, the degree of integration of various data and analyses in MMR studies also seems to be developable. At this point, appropriate computer software can facilitate this integration process (section 4.4.3.2), generally improving the rigor of coding and analysis and the overall quality (Bazeley, 2010).

4.6.5 Assuring the Quality in Relation to the Applied MMR Design

As an emerging third major MMR quality approach, to assure the quality in relation to the applied MMR design and to answer the research questions, it is crucial that the chosen selected design type, including the timing and stages of integration, matches the overall research purpose (Curry and Nunez-Smith, 2015, Plano Clark and Ivankova, 2016). This was ensured by the following: an elaborate discussion of the different design elements of MMR (section 4.1.1), a detailed argumentation regarding why the selected MMR typology and additional design features were chosen for this research (section 4.1.2), and then a rigorous implementation of the selected and defined MMR design elements (sections 4.2 and 4.5). The latter approach is key for any selected MMR typology; however, a particular challenge is encountered in sequential MMR designs, since the quality of the outcomes of the initial strand influences the quality of the subsequent strand (Teddlie and Tashakkori, 2009, Creswell and Plano Clark, 2011b, Ivankova, 2015) and ultimately the overall INF quality, which is affected by a cumulative effect of the quality of the previous phases (Plano Clark and Ivankova, 2016). Therefore, a thorough planning procedure was necessary after having critically reviewed the literature, as was the provision of justifications for the design choices and transparency regarding how to perform the research (section 4.1.1). To ensure such a ‘planning quality’ (O’Cathain, 2010:539), a detailed research design was developed (section 4.1.2.1) to perform rigorous data collection and analysis procedures (Creswell et al., 2003) and to define the stages of integration (section 4.5).

While performing these various steps, the design quality was ensured in line with the four indicators of Teddlie and Tashakkori (2009): i) the applied design is suitable to appropriately answer the research questions, ii) the study procedures are adequately performed to ensure design fidelity, iii) within-design consistency is consistently checked for all applied components and during all research phases, and iv) the analytical adequacy is ensured to perform the most appropriate data analysis to answer the study questions.

5 RESULTS AND FINDINGS

In this chapter, the analysis outcomes of all performed phases are presented. The term *results* is applied to the QUAN phase, and the term *findings* is used for both qualitative phases. In this sense, results refer to the processed raw data from the field, whereas findings come from new emerging patterns from a discussion of the results of a performed investigation or research.

5.1 Findings of Exploratory Qualitative (qual) Phase

The findings from the qual phase are presented as inputs for the two subsequent primary phases.

5.1.1 Inputs for QUAN Phase

The findings from the initial exploratory phase provided the following inputs regarding the design of the questionnaire:

- Since the APV approach (section 2.4.2.1) was not known to any of the qual phase participants, it was not provided as an answer option assessing the application of valuation techniques. This was supported by the results of the questionnaire pilot phase (section 4.3.2.1). For triangulation purposes and due to its advantages in valuation, the application of APV was evaluated in the QUAL phase, particularly to consultants who specialised in valuation (section 5.1.2).
- The outcome of this preliminary research demonstrated that the systematic risk component *force majeure*, (section 2.2.5) was not considered in RES-E valuation adjustment processes and therefore not asked for in the questionnaire (section 4.3.3.1). This risk seemed to be mitigated as much as possible with insurances.
- The findings indicated that the survey can be better answered if the assessment of risk is considered as a combined rating for likelihood and consequence.
- Exploring the developed RAPV concept (Appendix 3) demonstrated that it is a valuable concept that understands valuation processes as a combination of and interaction between different project valuation steps with appropriate risk/uncertainty management before the investment decision can be taken. This finding provided an optimal basis for developing the question to assess risk adjustment processes investigated in the QUAN phase (sections 4.3.3.5).

5.1.2 Inputs for QUAL Phase

The qual phase provided various general findings about valuation, expressed as the following preconditions and necessities, which were investigated in more detail in the QUAL phase:

- The suitability of the applied valuation methods with regard to the investor’s objectives and perspectives

- The suitability of the applied valuation method for market communication while still appropriately considering the main risk components
- The comprehensibility of the applied valuation methods for both transaction parties (sellers and buyers)
- The comprehensibility of the applied valuation methods for decision makers
- The consistency in method application to ensure comparison with historical projects

In addition, to observe whether responses would be translated into action, the discussion with the interview partner demonstrated that valuation decisions based on realistic investment scenarios could lead to valuable results. Therefore, a discussion of investment scenarios was integrated into the performed interviews, as a separate part, in the QUAL phase (section 4.4.1.2).

Based on all these results, the ICF (section 2.7.4) relevant for the coding process was updated and prepared to begin the QUAL analysis (Figure 41).

Figure 41: Updated ICF from literature review after qual phase (with knots in software nVivo10^{TM}; green marked knots were added by the qual phase).

5.2 Results of Quantitative (QUAN) Analysis

In this section, the survey results are presented.

5.2.1 Firm and Participant Statistics

The QUAN phase results begin with a summary of the firms' and participant's characteristics in the sample (Appendix 9 Figure 56 and Figure 57).

The survey participants worked mainly for organisations in Switzerland (68%), compared to organisations in Germany (42%), while the response rate in Switzerland was considerably higher (68.7% vs. 20.2%). With respect to the collected smaller number of German participants, compared to Swiss ones, the applied statistical tests in the approach analysed herein divided the data into subsamples by country, and the subsequent QUAL phase considered the effects of unequal sizes of the evaluated subsamples (sections 4.3.4 and 4.1.3.3).

Utility companies had the highest survey participant numbers (43%) with the financial advisors (8%) and banks (5%) registering the lowest survey participant numbers. The pool of survey participants consisted of more small organisations, defined as those organisations with fewer than 501 employees (58%), onshore wind is the main investment technology focus (41%), most companies have a low leverage (55%), defined as a debt ratio lower or equal than 40%, and are mostly not listed on any stock exchange (85%). About 95% of the participants had an academic degree while 21.4% have a MBA degree. Nearly half the participants were younger than 40 years (44%) while the majority of the participants were male (89%), and had performed more than ten transactions (58%).

Analysing the correlations of demographic variables (Appendix 9 Table 36), it is found that small organisations were significantly more likely not to be energy related companies. In contrast to the Swiss group, the German group in the sample included small sized and lower leveraged organisations. Interestingly, none of the German survey participants held a MBA degree in contrast to 32.3% of Swiss survey participants. MBA-educated participants were likely to work in organisation with lower leverage rates and in stock exchange listed companies. Unlike female participants, male participants were more likely to work in not listed companies. More mature participants tended to work in larger organisations. There is no significant nor strong relationship between size and leverage or stock exchange listing which is rather surprising but decreases corresponding biases from this perspective (section 5.2.3) as well as between the organisation type (energy related versus not energy related) and country.

5.2.2 Analysis Results

5.2.2.1 Risk Assessment

The results in Figure 42 show that three risk categories are considered as most risky: political/regulatory and market risk, both two systematic risks, and weather-related volume risk, as an unsystematic risk. The political/regulatory risk received the highest score, consistent with the findings of Watts (2011) and is probably based on the fact that most RES-E investments in newer electricity generation technologies, such as wind power, photovoltaics or concentrated solar power, are still dependent on state based subsidies (for example, FiT). The stated alphabetical letters in the first column of the following tables of results (Appendix 9 Table 37 to Table 47) indicate the original sequence of the provided answer options in the questionnaire.

The results are quite homogenous if examining the responses conditional on the firm's characteristics and domicile (Appendix 9 Table 37). Significant differences were found for tax risks in relation to organisation types for utility and institutional investors with higher rates, while political/regulatory risk is considered significantly more severe by the German subsample. Weather-related volume risk was viewed as significantly more severe by higher leveraged firms and firms that are not listed on the stock exchange. Furthermore, listed companies considered operational risk as significantly higher.

Focusing on the results in relation to project stages (Appendix 9 Table 38, Figure 43), significant differences were found in weather-related volume risk, where greenfield and brownfield[58] investments are rated as having significant lower risk, surprisingly (see below). Investments in RES-E power plants ranging from the initial ready-to-build stage through power plants which have been operating for five years were considered as significantly riskier. Interestingly, the analysis uncovers a significant higher environmental risk for power plants which are in operation longer than six years. Moreover, operational risk were associated with significant higher risk in some operating phases. All three previous results show that this unsystematic risk is essential in RES-E investment valuation, even if a certain risk reduction based on diversified RES-E portfolio was reached. The figures regarding financial risk for RES-E power plants between six and more than ten years in operation show a significant lower risk which could be explained by having reduced the financial exposure at this stage. Investors rated tax risk for RES-E investments in greenfield and brownfield stage as well as in the stage with focus on repowering/retrofitting as significantly less risky. However, those RES-E investments in the ready-to-build stage through to having been in operation for five years were deemed to be significantly riskier.

Puzzling are the results for certain risk components, for example, for weather-related volume risk, in the relation to some project stages. Objectively, it would be expected that this risk should remain equal before more information about this topic are available which is for this particular risk component before starting production. This was however not the case for this risk since it was constantly increasing from the greenfield until the stage of projects just starting operation. The QUAN phase does not provide more insights about this particular result. It will be investigated in more detail in the QUAL phase (sections 4.4.1.1, 5.2.5 and 5.3.6.6).

Figure 42: Survey responses to the question 'How would you rate the significance of each of the following types of risk to your company's RE projects?' in relation to systematic and unsystematic risk components presented in section 2.2.5.

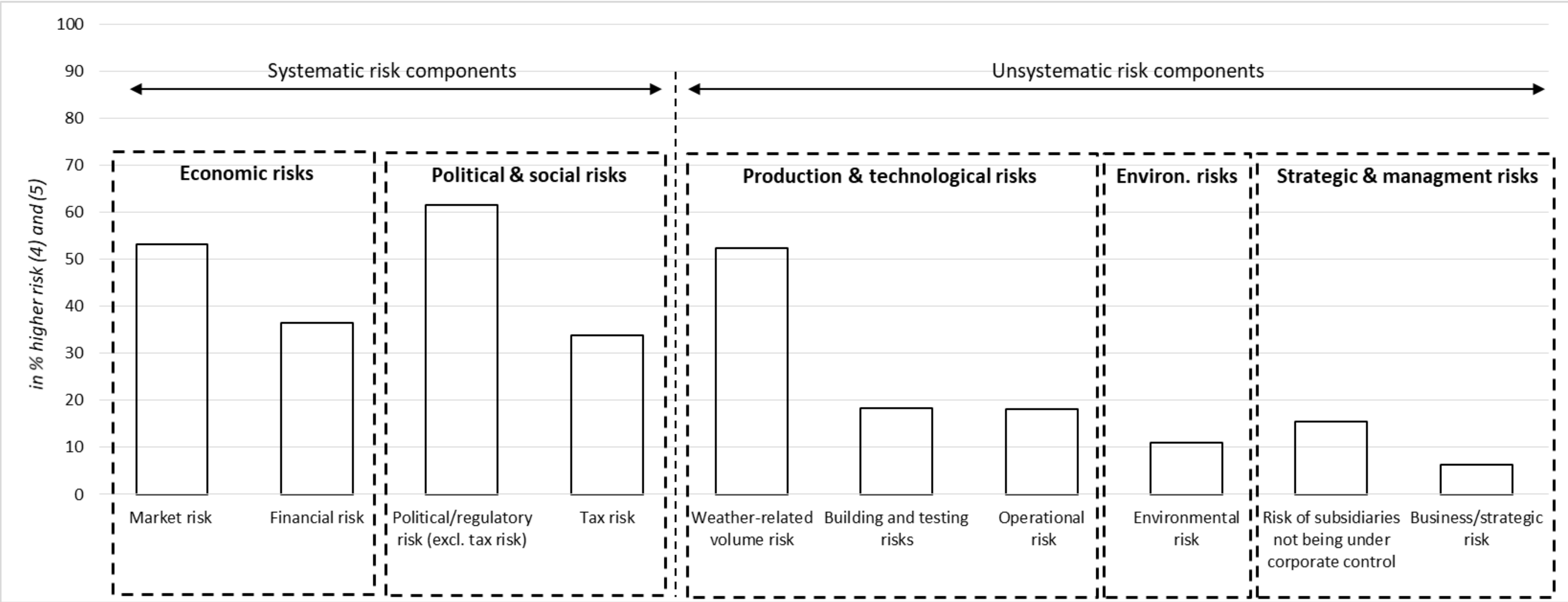


Figure 43: Significance of risk types (systematic and unsystematic risks) in relation to the different type of project stages of RES-E investments (1 = very low risk; 5= very high risk).

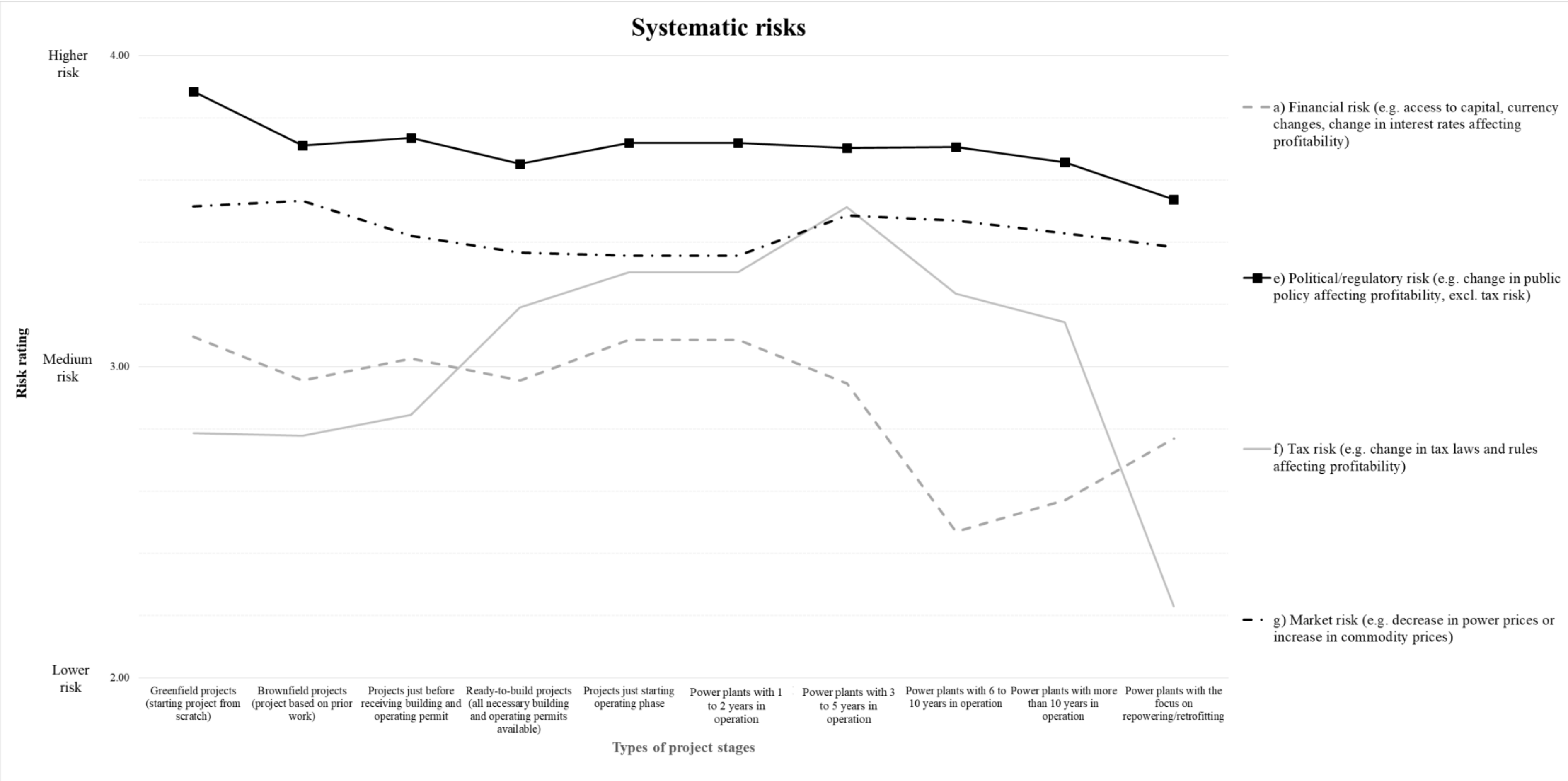
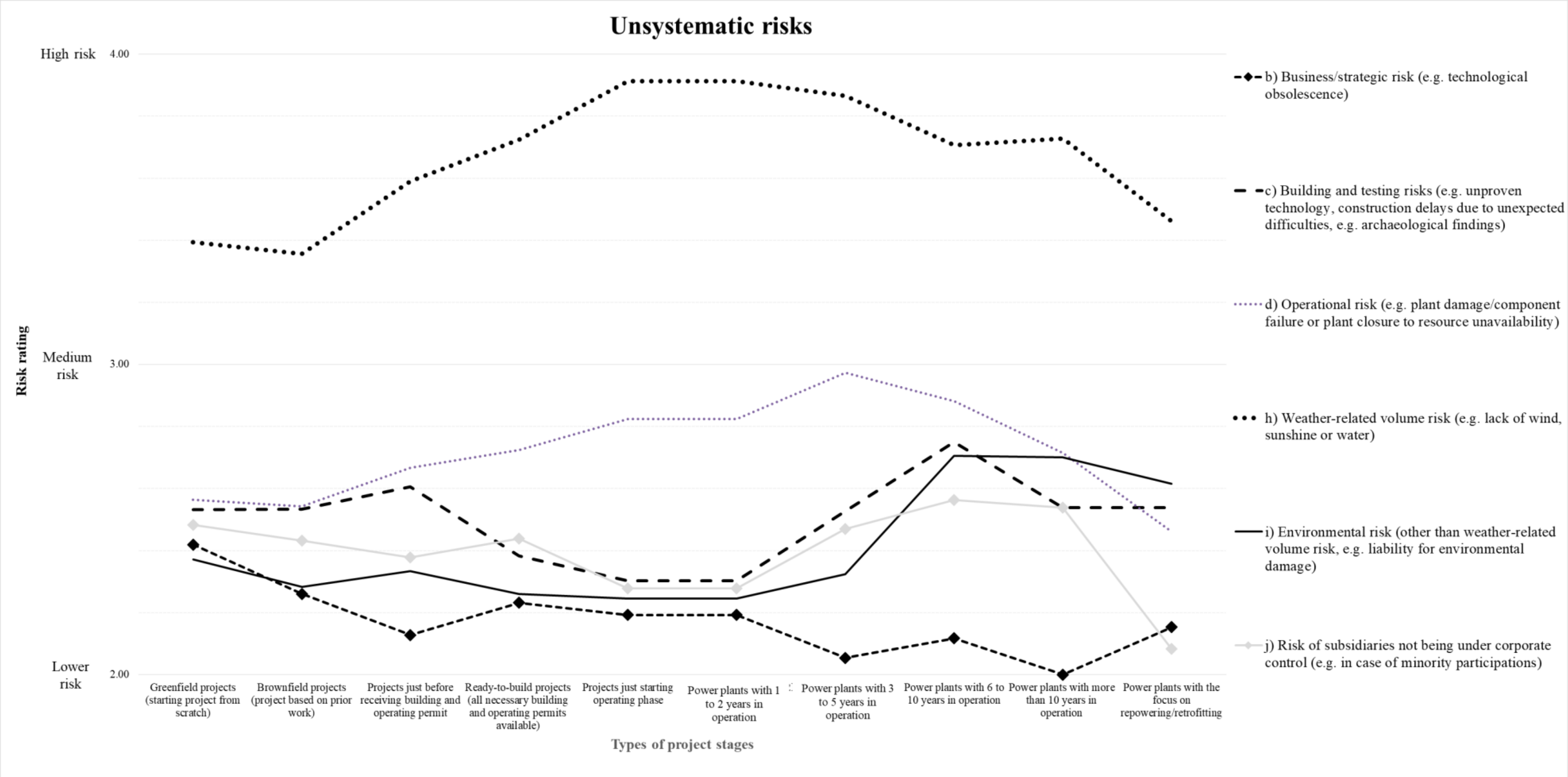


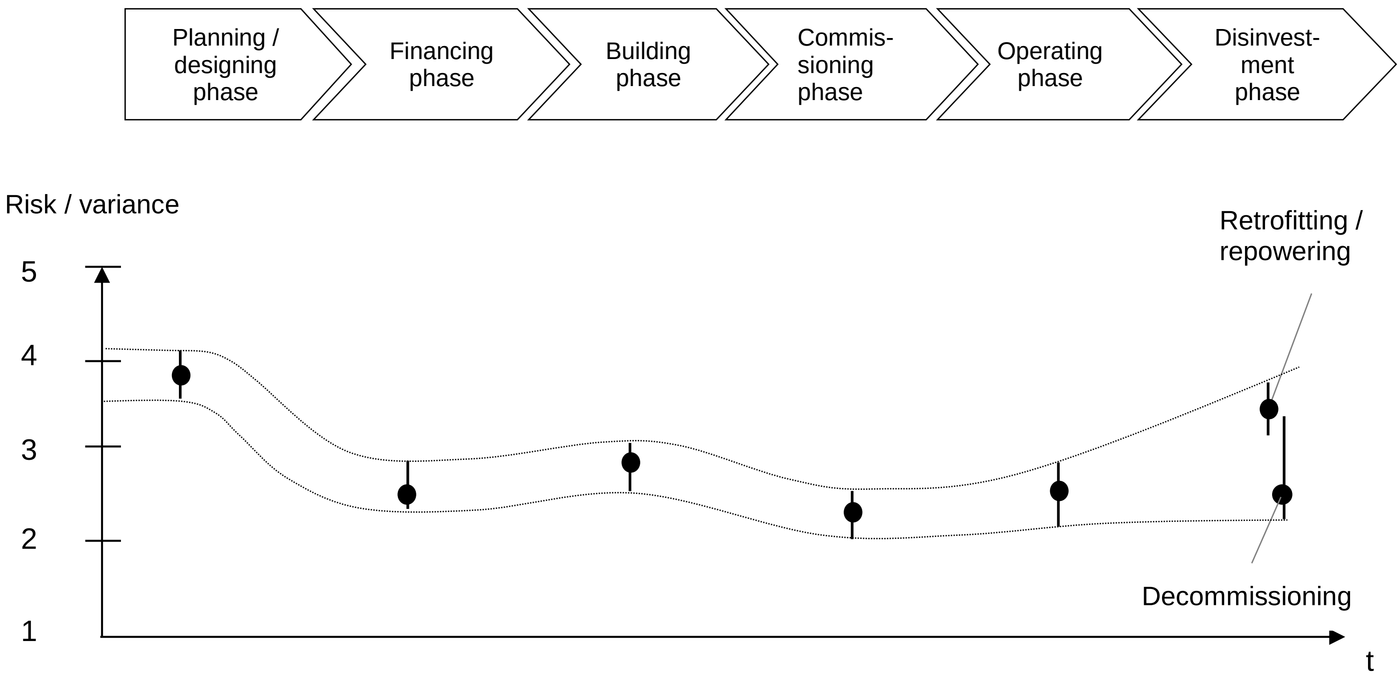
Figure 43: (continued).



In addition, the results show that in many cases the risk categories were scored as riskier—in most cases significantly—if the participants reported that the same risk had already materialised in their RES-E investments in the past five years (see bold letters in Appendix 9 Table 39). This shows that risk attitudes and/or individual risk preferences were clearly influenced by having experienced materialisation of the same risk. This indicates that 'optimism bias' (Sharot, 2011:R941) which leads to overestimation of revenues and underestimation of costs, probably caused by cognitive biases and organisational pressure (Davies et al., 2012), are decreased for analysts and manager with such experiences.

The results of the overall risk assessment for the different stages of planning, building and operating (Appendix 9 Table 40, Figure 44) have to be considered with caution due to the poor internal consistency, based on Cronbach's alpha (section 5.2.3). Planning/designing the power plant were considered by far as RES-E project's highest risk stage, confirmed by study of Watts (2011), followed by the project stage about retrofitting/repowering the power plant which also included components of planning and designing the project adjustments while still operating the power plant. Building, financing, operating, decommissioning and commissioning were projects stages associated with lower risk within RES-E investments. Moreover, as small companies have more restricted access to capital than bigger firms, they considered financing the power plant as significantly riskier than their large counterparts.

Figure 44: Illustration showing survey responses to the question 'In general, how would you assess the overall degree of risk associated with each of the following stages of planning, building and operating RE power plants? (1 = very low risk; 5= very high risk)'.



5.2.2.2 Risk Mitigation

The results (Appendix 9 Table 41) illustrate that the most popular risk mitigation measures included internal DD and DD with external consultants, reduction of operational risks, arranging insurances, reduction of market risks with FiTs and/or long-term PPAs and standardisation of procedures regarding, for example, processes and contracts.

With regard to firm's characteristics and domicile, statistically significant differences were found for standardisation of procedures between financial advisors with low mitigation requirements for this type of measure on one end of the spectrum, and institutional investors and utility companies with high requirements at the other end. Significant differences were also found for checking the type of suppliers between financial advisors with low and IPP and institutional investors with high rates. Making co-investment was a popular risk mitigation measurement of utility companies, while financial advisors and banks did not consider this measure within their risk mitigation strategy. Significant more approval rates were detected for applying weather protection insurances in case of financial advisors and institutional investors—however, on low basic application rate. Moreover, significant cultural differences were found in applying external DD which is applied by the majority of Swiss RES-E investors. Larger organisations relied more on external DD.

Evaluating the responses about applied risk mitigation measures conditional on materialised risk (Appendix 9 Table 42), the results show that 78.0% of the survey's participants had experienced materialised risk in their RES-E investments. Because of this, risk mitigation measures became more relevant. Statistical significant results were found for about one-fifth of all relations in the cross-tabulations, particularly in case of having experienced materialisation of financial risk and political/regulatory risk. These results show that there is a change of behaviour when considering, refusing, reacting to and mitigating potential risk if risk materialisation has been experienced.[59]

5.2.2.3 Capital Budgeting Techniques

The results (Appendix 9 Table 43) show that the majority of companies employed multiple capital budgeting techniques instead of relying on one single method. This is confirmed by other studies (Bierman, 1993, Ryan and Ryan, 2002, Truong et al., 2008). Most respondents selected IRR, NPV, scenario analysis and sensitivity analysis as the most frequently applied techniques for valuating RES-E investments. Compared to other studies (Graham and Harvey, 2001, Brounen et al., 2004), the frequency of usage of IRR was distinctively higher. The usage of NPV was similar to their US and UK samples but higher than their samples from the Netherlands, Germany and France. Non-DCF methods had a lower preference in the practice of RES-E investment valuations. Moreover, estimating cost of equity and total CoC, and the hurdle rate concept were also popular techniques. Complementary to the main valuation methods, simpler methods, such as PB, as shown in Petty et al. (1975), and MA were also widely applied, but the former less frequently than in previous studies (e.g. Moore and Reichert, 1983, Burns and Walker, 1997, Graham and Harvey, 2001).

Sensitivity and scenario analysis were established methods in many firms, supplementing IRR and NPV methods, while simulations, such as Monte Carlo simulations, were rarely applied in practice, as registered in other studies (Petty et al., 1975, Gitman and Vandenberg, 2000). Sensitivity analysis was generally a more established method in RES-E investments than in other sectors (Graham and Harvey, 2001, Brounen et al., 2004), while ROV were seldom applied in RES-E investments, less than in previous studies (Graham and Harvey, 2001, Brounen et al., 2004). Similarly low rates were found for PI and VaR. Moreover, only 24.0% of the participants included possible added value of opportunities and synergies in their RES-E investment valuation.

Examining the responses conditional on firm characteristics (Appendix 9 Table 43), the IRR approach and the total CoC of a project were applied more frequently by the Swiss sample. Significant higher rates were also found for applying IRR and NPV in lower leveraged firms. Moreover, the PB method showed significantly lower usage rates for financial advisors compared to banks and utility companies. The results demonstrate that in Germany there was a significantly higher application of simulations.

Putting the results in relation to project stage focus (Appendix 9 Table 44), the IRR approach was significantly more frequently applied for power plants in operation for one to two years. Sensitivity analysis were more often applied for brownfield projects and RES-E projects with one to 10 years in operation while simulations are significantly more often used in investments with a longer production history than six years. Organisations investing in ready-to-build projects, projects just starting the operating phase and power plants which have been in operation for three to five years were significantly more likely to use the hurdle rate concept. Estimating cost of equity capital of projects were significantly more employed by organisation which run power plants just starting operations or which have power plants in operation up to five years. Estimating equity capital cost of projects, estimating total CoC of projects and the MA were techniques significantly more often applied for projects starting operations and for those with a few to several years in operation. Valuating opportunities and synergies possibilities were significantly more likely to be employed by organisation which have RES-E power plants in operation between six to 10 years[60], but less likely by organisations with greenfield projects. The results for ROV indicate a significantly more frequent usage by power plants with six to 10 years in operation. Surprisingly, the results do not demonstrate that ROV is more frequently applied in the early stages of projects, as it would have been expected.

5.2.2.4 Cost of Capital

Table 45 in Appendix 9 summarises the results for the applied approaches to determine the cost of equity or discount rates in valuating RES-E investments, after having conducted a specific robustness check (Appendix 10 Table 51 and Table 52). The WACC of the whole company was the dominant CoC approach in RES-E project investments, as shown in other studies (Bruner et al., 1998, Payne et al., 1999). The second dominant approach was that discount rates are at least as high as defined hurdle rates. The found rate was similarly high as in the results based on US companies within Graham and Harvey (2001) and has gained considerable ground in Europe and Germany with regard to RES-E investments, compared to the results of Brounen et al. (2004). Formal risk analysis followed as the third dominant approach.

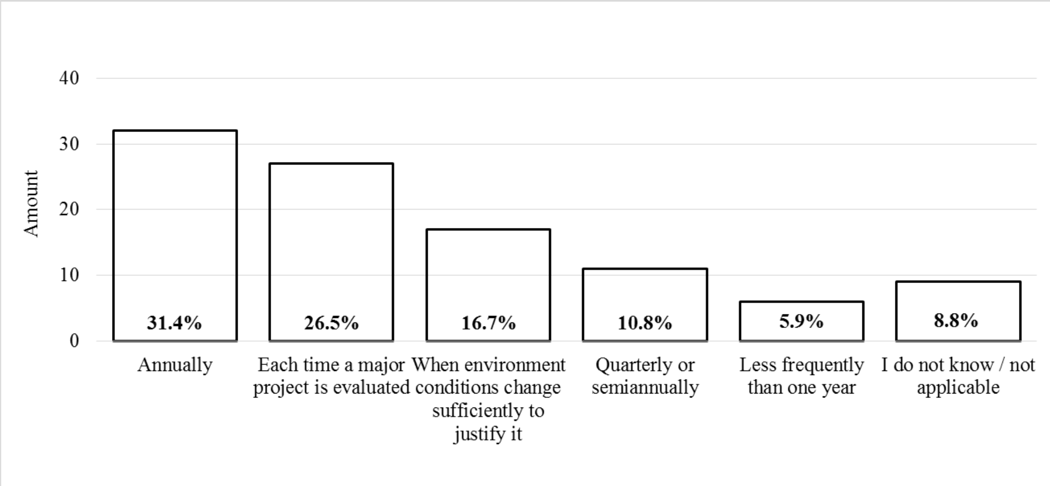
In addition to the dominance of WACC which was significantly more frequently applied by the Swiss subgroup, the hurdle rate approach was a popular, but not significant approach used by utility companies. The differences between the organisation types show, though also not significantly, that banks applied formal risk analysis as their dominant approach to valuate RES-E investments, indicating a considerable backlog for the other RES-E investor types. The CAPM, was only applied by 35.3%, but more frequently than the usage of the modified CAPM, including additional extra risk factors, which seems to be the more suitable alternative out of both for RES-E investments, as outlined in Hürlimann and Bengoa (2017a). Moreover, it was more commonly applied by low leveraged companies. A major gap between theory and practice was found for the propagated CE method. In the researched population, the CE method was a largely unknown concept (33.3% chose answer option ‘I don’t know/not applicable’) and rarely applied in RES-E investment valuations, confirming the low application rates within past surveys (Petty et al., 1975, Gitman and Mercurio, 1982, Gitman and Vandenberg, 2000).

In relation to project stages (Appendix 9 Table 46), significant higher application rates were found for formal risk analysis in case of ready-to-build projects, for discount rates set by regulatory decisions for RES-E power plants in operation for six to 10 years and cost of debt plus risk premium for RES-E power plants in operation for more than 10 years.

In applying discount rates, the results in Appendix 9 Table 47 show that a specific discount rate either for the considered country, technology/industry, and project stage were the most frequently applied approaches, and dominantly applied by stock exchange listed and low leverage companies. Having verified the results within an appropriate robustness check, it also revealed a medium to strong correlation between applying WACC as well as country-specific and technology-/industry-specific discount rates (Appendix 10 Table 54). This indicated that certain firms might define separate specific WACC for certain countries and technologies/industries, adjusting the WACC of the entire company for risk and certain other factors characterising the considered investment country or technology/industry. In addition, specific discount rates for the considered country enjoyed a higher application rate in Switzerland and in larger organisations. Consequently, a certain theory-practice backlog still exists for the RADR concept, proposed by finance theory (Hürlimann and Bengoa, 2017a), although having gained ground in RES-E investment practices, compared to previous studies (Petty et al., 1975, Brounen et al., 2004). There were, however, still a certain amount of organisations which use a single discount rate for the whole company. This is only feasible if project risks are similar to the investment firm’s risk and both have similar capital structures (Harris and Pringle, 1985, Brigham and Ehrhardt, 2008). Discount rates based on past experiences were applied by 31.5% of participants, mainly by small and low leveraged companies and not as the sole approach, but as a complementary method to some of the other more frequently applied methods (Appendix 10 Table 59).

The results in Figure 45 show that the majority of RES-E investors re-estimated return rate requirements annually and each time a major project is evaluated, more often than when the environmental conditions change sufficiently to justify return rate adjustments or than quarterly or semi-annually, or than less frequently than one year. The findings demonstrate that an annual frequency was the most popular policy which is consistent with previous studies (Bruner et al., 1998, McLaney et al., 2004), but in contrast to the results of Brigham (1975), Gitman and Mercurio (1982) and Gitman and Vandenberg (2000) with the highest approval rates for adjusting return rates when environmental conditions change sufficiently.

Figure 45: Survey responses to the question 'How frequently does your company re-estimate return rates requirements for investment projects?'.

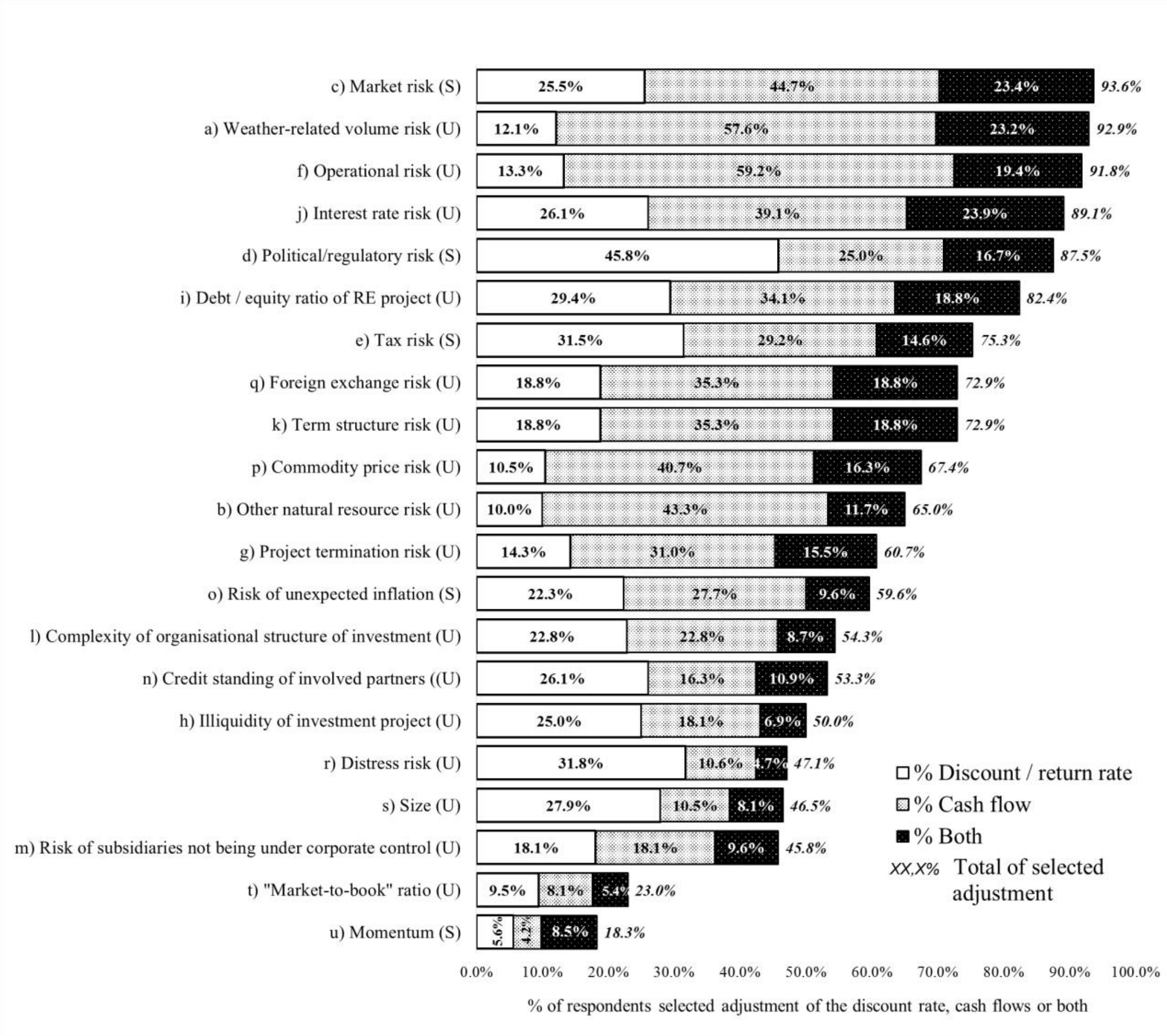


5.2.2.5 Valuation Adjustments for Specific Risk Components

Performing risk-adjustments in RES-E investment valuation, the most relevant risk components[61] were the three systematic risk (S) components market risk, political/regulatory risk and tax risk and the four unsystematic risk (U) components weather-related volume risk, operational risk, interest rate risk and debt/equity ratio of RES-E investments (Figure 46). Focusing solely on different risk-adjustment methods, cash flow adjustment was the most popular (44.6%), followed by discount rate adjustment (34.0%) and then by risk-adjustment of both cash flows and discount rates (21.4%).

In RES-E investment valuation, weather-related volume risk, operational risk, market risk, including the risk of power and heat price reduction, and interest rate risk were most frequently considered through cash flows adjustments[62] while political risk was mainly considered within discount rate adjustments[63]. The latter also applied for size and illiquidity of investment project, distress risk as well as credit standing of involved partners, but with high rates for no adjustments at all. Tax risk was adjusted either in discount rates or cash flows or neither of them (Figure 46, Appendix 9 Table 48).

Figure 46: Multibeta risk for adjusting discount rates and/or cash flows, including unsystematic risk (U) and systematic risk (S) components.



Cultural differences with statistically significant results were encountered for interest rate risk. In relation to leverage of organisations, significant differences were found for debt/equity ratio for RES-E projects (Appendix 9 Table 48). In case of materialised risks, cash flow adjustment was preferred compared to discount rate adjustments for interest rates, term structure and other natural resource[64] risks (Appendix 9 Table 49).

5.2.3 Results of Validity Check

This section presents the final results of the performed validity check in the QUAN phase while its details are given in the Appendix 10. Both performed non-response bias tests show that the sample is in total representative for the researched population although there was a slight misrepresentation of German utility companies due to their reluctance in taking part in the survey.

If the mean differences of non-size IVs were significantly influenced by the size, they were correspondingly marked in the tables for those data with mean differences at a 10% significance level and lower, and they were not reported in writing within the paper.

The robustness of the answers regarding capital budgeting techniques and CoC approaches in relation to the participants' understanding of the topic and professional experience were generally confirmed. All except a few methods (for example, PB, PI, and VaR) demonstrated a higher rate for participants with MBA degrees and higher experience. However, only a few of them were significant. The performed PCA demonstrates that the questions about assessing the risk in the stage of building the power plant and commissioning the plant are highly related (with a coefficient of around 0.6), and two distinct compounds could be found, which indicates that they measure similar concepts. In addition, after several iterations to find minimal correlations (i.e. with a determinant > 0.001) between the variables in the questions about valuation approaches and CoC, it could be confirmed that similar concepts are grouped together, such as the concept of hurdle rates and various corresponding discount rate determinations as well as the WACC and CAPM approaches. Furthermore, no additional latent structures could be detected. The reliability analysis with Cronbach's alpha indicated that the internal reliability of all questions was given, with the exception of the group of questions about the overall risk assessment for the different stages of planning, building, and operating (Appendix 9 Table 40, Figure 44).

5.2.4 Support and Rejection of Hypotheses

In this section, the hypotheses formulated for the QUAN phase and presented in section 4.3.1 are discussed. Some of the hypotheses were supported, whereas others were rejected or only partially supported by the QUAN results. These two latter cases are studied in more detail in the subsequent QUAL phase.

H1: Apart from systematic risk components, unsystematic risks are relevant components in RES-E project investments to be considered in valuation processes.

The results about risk assessment—either the standalone risk or the risk in relation to the project stages—demonstrated that unsystematic risk components are essential in analysing RES-E projects. The analysis of the adjustment for risk in valuation (see also H13) additionally supported this hypothesis, since valuation for RES-E projects were frequently adjusted for unsystematic risk components. *Hypothesis H1 is consequently supported* by both QUAN results.

H2: Volume-related risk components, such as wind resources, sun irradiation, and the amount of water, are considered to be the most important risk components and relevant unsystematic risk components for RES-E projects and corresponding valuations.

The QUAN results demonstrated that the volume-related risk is clearly considered to be the most relevant unsystematic risk components before operational risk in general as well as in all considered project stages. Therefore, *hypothesis H2 is supported* by the QUAN results.

H3: Political risk is regarded as the most crucial systematic risk component in RES-E projects, particularly due to the applied RES-E supporting regimes.

In assessing the risk of RES-E investments, political/regulatory risk was regarded as the most crucial component of all risk components, both systematic and unsystematic, and before market risk. Political/regulatory risk was also the most crucial component independent of the considered project stages (see also H4). Therefore, *hypothesis H3 is supported* by the QUAN results.

H4: The assessment of risk components in RES-E projects differs in relation to different project stages.

Focusing on the results in relation to project stages, significant differences were found for some risk components; for example, weather-related volume risk with lower risk for greenfield and brownfield investments and higher risk for RES-E power plants ranging from the initial ready-to-build stage through to power plants that have been operating for five years, tax risk with significantly higher risk in ready-to-built projects until projects that have been in operation for a few years, and operational risk with significantly higher risk in some operating phases. Therefore, *hypothesis H4 is supported* by the QUAN results.

H5: Experiences of particular risk materialisations influence risk assessment and the prioritising of risk components in RES-E project investments.

The results demonstrated that the risk categories were often scored as riskier—in most cases significantly—if the participants reported that the same risk had already materialised in their RES-E investments in the past five years. This means that risk attitudes and/or individual risk preferences are clearly influenced by having experienced materialisation of the same risk. *Hypothesis H7 is consequently supported* by the QUAN results.

H6: Having experienced the materialising of certain risk components, corresponding risk mitigation measures become more relevant.

The QUAN results indicated that certain risk mitigation measures became more relevant and that that there was a change in behaviour if the materialisation of corresponding risk components were experienced before in the past five years. *Hypothesis H6 is thus supported* by the QUAN results.

H7: Discount cash flow-based capital budgeting techniques are the predominantly applied valuation methods in RE transactions.

The QUAN results clearly demonstrated that DCF was still the dominant underlying investment-evaluation technique. It was the basic technique for the dominant IRR approach and the often-applied NPV approach. Therefore, *hypothesis H6 is supported* by the QUAN results.

H8: The RADR concept is regarded as the most appropriate capital budgeting technique.

The RADR concept was only applied by less than 50% of the participants, while both the hurdle rate (59%) and the WACC (67%, see also H9) concept were more predominantly applied. However, RADR has gained considerable ground in usage in RES-E investments, compared to previous European survey results. *Hypothesis H7 is consequently only partially* supported by the QUAN results.

H9: The investment company's WACC as the required return rate or as the basis for defining a required return rate is not regarded as an appropriate CoC approach in RES-E investments.

The WACC was the still the principle technique to determine CoC requirements, particularly by large organisations, although the single company-wide discount rate was not as frequently applied as it used to be in the past. The results indicated that the WACC was the basis for deriving the prevailing country and technology/industry discount rates. Therefore, *hypothesis H8 is rejected* by the QUAN results.

H10: The CE method is known to be an appropriate alternative approach in valuation, particularly focusing on value protection.

The QUAN results demonstrated that a considerable gap exists for a complete exploitation of the possibilities in computational valuation methods, which lack a more holistic valuation picture of the considered RES-E investments. The presented CE method was almost unknown to the participants. The valuation in RES-E investment projects focused clearly on traditional DCF-based methods without considering supplementary alternative approaches. *Hypothesis H10 is thus rejected* by the QUAN results.

H11: A company's risk management processes provide the basis for valuation processes.

The company's risk management processes were evaluated in this survey with the usage of scenario analyses, sensitivity analyses, simulations, the hurdle rate concept, the RADR concept, and the frequency of setting the CoC requirements. Most of the stated concepts were applied frequently, and only simulations were seldom applied. These results indicated that the general risk management processes of an investment company provide the basis for valuation processes. Therefore, *hypothesis H11 is supported* by the QUAN results.

H12: Apart from considering the downside potential (threat) of RES-E investments, possible positive deviations from the target value are also considered in valuations process.

The QUAN results show that the value of opportunities and synergy potential, as positive effects, are only seldom considered in valuation processes. Consequently, the *hypothesis H12 is rejected* by the QUAN results.

H13: The valuation of RES-E projects is adjusted for risk and either in the cash flows or discount rates, depending of the considered risk component.

Risk-adjustments in RES-E valuation were widely applied processes that considered systematic and many unsystematic risk components—in contrast to valuation models for PTCs, with the sole consideration of systematic risks, presenting a list of relevant risk components for RES-E investments, while demonstrating that the risk-adjustments are mainly performed within the projected cash flows. Therefore, the *hypothesis H13 is supported* by the QUAN results.

H14: There are cultural differences in valuation, and valuation is influenced by the type of investment company.

Some cultural differences existed between the Swiss and the German subsamples. In RES-E investments in Switzerland and Germany alike, market professionals tended to assess risk components and to adopt and neglect the same theoretical models and theories when managing their finances. However, the Germans assessed political/regulatory risk as more severe and applied simulations more frequently as part of their valuation processes. On the other hand, the Swiss more often used the total CoC of a project, even more frequently than its cost of equity, the WACC, and country, and they were likely to employ external DD as a mitigation measure in their valuation processes. Similarly, large organisations were relatively likely to apply not only the WACC, country discount rates, and external DD, but also the CAPM and a formal risk analysis within RES-E investment valuations, while small organisations relied rather on discount rates set by their investors or based on their past experiences. No evidence was found for differences in applying risk adjustments in valuation in relation to organisation size. High-leverage companies were more likely to use the NPV and PB methods within their RES-E investment valuations. *Hypothesis H14 is consequently partially supported* by the statistical analysis.

5.2.5 Interesting Phenomena to be Analysed in QUAL Phase

The following results from the QUAN analysis are regarded as interesting phenomena to be analysed in more detail in the subsequent QUAL phase.

- The found QUAN results about risk consideration in valuation provided some interesting phenomena to be investigated in more depth, such as valuation adjustment for risk in valuation processes, and the understanding about risk and risk preferences. In addition, the QUAN results demonstrated that the assessment of certain risk components does not remain equal between certain project stages, even if the risk, for instance, for the volume-related risk components, should objectively remain equal (section 5.2.2.1)—a puzzling QUAN result to be investigated in more depth.
- The QUAN results presented high frequency for the IRR and NPV approaches, but they did not provide additional information about the detailed applied DCF techniques, as illustrated in section 2.4.2.1.
- The QUAN results did not provide enough information regarding whether certain reflections and considerations about certain alternative capital budgeting techniques are performed. The survey results only indicated that a few participants applied, for instance, the CE method or simulations. However, perhaps there is more knowledge to be discovered in the QUAL phase.

Based on these three results from the QUAN phase to be analysed in the QUAL phase, the ICF from the qual phase (section 5.1.2) was updated (Figure 47). This builds the basis for performing the content analysis in the subsequent QUAL research phase.

Figure 47: Updated initial coding frame (ICF) from literature review and qual phase after the QUAN phase (with knots in software nVivo10^{TM}, blue marked knots were added by the QUAN phase).

5.3 Findings of Qualitative (QUAL) Analysis

In this section, the findings from the interviews of the QUAL phase are presented. It starts with findings from the investment scenario discussion, which provides a good general overview of the discussed topics, followed by general findings about valuation processes and then more specific findings about numerical and judgmental capital budgeting approaches and CoC approaches. Finally, the section concludes with findings about risk considerations and influence factors in valuation. All the findings are presented in text format for the key findings, accompanied by corresponding tables illustrating the complete results for all 16 participants.

5.3.1 Findings from Investment Scenario Discussions

The discussed investment scenarios in the second phase of the interviews provided key insights (Appendix 11 Table 60) while discussing real investment cases (section 4.4.1.2). This part was actively and even enthusiastically performed by all participants because, presumably, they felt highly confident in performing this task, similarly to performing valuations at work.

The stated missing or inadequate information in the investments scenarios provided valuable insights into the additional data and information that are crucial in performing a valuation of RES-E investments. Most participants required more details about the manufacturer and the exact type of engine to be able to assess the reliability of the engines and one of the main corresponding risks in operating the considered RES-E project. One participant stressed his additional focus on the type of sub-suppliers of the used technology's main components due to quality issues with some alternative, third-party suppliers (participant 16). In addition, the majority of participants requested additional details about operation, including detailed operational expenditures (OPEX), dependence between revenues and OPEX, and possible compensation measurements. About half the participants missed additional details about the service agreements, including the type of service suppliers, their credit rating, and the length of service contracts. For approximately a third of the participants, the name of the project developer or the seller and the involved counterpart risk were key within valuation in order to assess the transaction security and transaction efficiency. Besides additional information about the resource assessments and their data, an inquiry about the market value of the electricity production was key for one participant, in addition to the provided and related information about direct marketing[65]. Additional information about stakeholders, such as the local opponents of the RES-E project, and the situation about the grid, including the risk of curtailments due to load management in the grid, were mentioned as crucial points for some participants. Moreover, a few participants requested additional financing details, including the name of the bank and contracted credit covenants, details about the project structuring, the cash flow model itself, and a detailed description of the provided risk scenarios. Furthermore, some participants missed the exact purchase price in contrast to the calculated values or value range, details about existing portfolio and investment strategies, as well as details about DD processes.

For at least half of the participants, key information for performing the valuation of RES-E projects were the resources and their volatility, distribution and power, annual production, FiT or price based on PPA and FiT / PPA length, and the maintenance and management of service contracts. The hub heights of wind farms were additional key pieces of information, according to two participants, who stated that the higher the tower is, the less disturbed and more stable is the wind regime and correspondingly the production are. Only one participant evaluated the projects in relation to set minimum full load hours, which other participants considered to be irrelevant. The project's available stake to acquire was a key point for two participants, with the priority being to acquire 100% of the project. Additional key points for the valuation were the assumed power prices after FiT or PPA period termination and the project and valuation length; the above-mentioned site attractiveness with regard to the market value of the produced electricity, which becomes more relevant with more market integration of RES-E[66]; and the summary of the performed DD outcomes. Financial information, including the leverage (gearing) and covenant requirements, the installed capacity in relation to the set objectives for building the investment portfolio, as well as the transaction probability were additional crucial pieces of information.

For some participants, in contrast to the statements above about the hub heights, the above-mentioned full load hours, the average wind speed, and the rotor diameter were irrelevant or less relevant pieces of information for the valuation of the investment scenarios. As stated, they did not provide additional insights into the purpose of valuation, since their inherent characteristics were already included in other input data, such as the description of the resources, the expected annual production, and the wind assessments. In contrast to the statements of some participants, as mentioned above, the transaction probability was not relevant for two participants, nor was the WACC of the investing company, as explicitly mentioned by one participant.

Table 27: Categorised code matrix presenting the findings of the applied valuation methods, found in the discussion of the provided investment scenario (+ applied, - not applied; +/-: applied in some cases, sometimes not applied, 0 = interesting, but not applied).

No.	Themes/categories	Participant no.															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
01	IRR approach	+	+	+	+	+	+/-	+	+	+	+	+	+	+	+	+	+
02	NPV approach		-				+/-			-			-				+
03	Equity return rate	+	+	+	+	+	+	+	+	+	+	+/-	+	+	+	+	+
04	Project return rate (total CoC)	+	+	+	+	-	-	-	-			+	-		-	+	
05	Comparing expected return rate to set hurdle rate	+		+			-			+				+		+	
06	Payback period method		-	+	+	-	-			+	+				+	+	
07	Certainty equivalent method	0	-	-	0	0	0	-	-	0	-	-	-	-	-	-	-
08	Profitability index			0	0		-						-				
09	Multiples, specifically for RES-E projects		+	+		+/-						+		+/-	+	+	
10	Covenant profile	+	+	+	+				+		+						
11	Distribution profile to equity investors	+								+							
12	Risk assessment (sensitivity and scenario analysis)	+	+	+	+	+		+	+	+	+		+	-	+	+	+
13	Considering opportunities	+	+		+	+		-					+/-			-	
14	Considering synergy potential															+	

With regard to the applied quantitative methods in RES-E valuation, DCF-based methods and in particular the IRR approach were clearly the main capital budgeting methods, while the NPV approach was considered as less relevant (Table 27). From the CoC perspective, the expected equity return rate and the corresponding cash FTE approach, namely the simplified FTE approach (section 2.4.2.1), were the main foci of all participants, except for one, who put the focus on cash flows to firm and the total CoC. These findings about DCF-based methods and CoC approaches are discussed in more detail below (sections 5.3.3.2 and 5.3.5). The resulting equity IRR outcome was the basis for comparison with a set hurdle rate, as mentioned by some participants (section 5.3.5.5). Interestingly, approximately one third of the participants considered the simplistic and rather outdated PB approach (section 5.3.3.8). Having introduced and discussed the CE approach and its results, the findings demonstrated that this approach was known to five participant from theory; also, five participants considered it as an interesting and possibly relevant approach for RES-E project valuation. Few participants considered the PI approach method to be interesting, while almost half of the participants considered the MA, specifically the calculation for RES-E investment projects, but only for screening purposes and not as the main valuation method (section 5.3.3.6). The calculation of covenant profiles based on the leverage and credit agreement details and of distribution profiles to the equity investors were additional, specific, numerical approaches. The risk assessment, with a sensitivity and/or scenario analysis, was an integrated method in valuation approaches for most participants (section 5.3.6), while opportunities were only considered by a handful of participants. Considering the synergy potential in project valuation, for example, by considering the potential positive effects of the targeted project within the existing portfolio, was only reported by one participant (section 5.3.4.4).

5.3.2 General Findings about Valuation Processes

This section provides some general findings about the valuation (Appendix 11 Table 61).

As a first general finding about valuation, participant 5 pointed out the necessary suitability of the applied valuation methods with regard to the investor’s objectives and perspectives:

> *[…] valuation factors depend, of course, also on the point of view. [For example,] during assessments of financing structures, we often evaluate how the medium term of capital and duration is [...]. As far as project valuations are concerned for early [project] phases, one considers multiples too. […] The more accurately you know the projects, the more specifically you can perform them [i.e., the valuations] with DCF methods.*

Participant 1 noted the less standardisation of valuation methods in the early development stage of RES-E projects:

> *I think that for projects that are still at an earlier stage, especially in the development of the project, where it is not quite clear at which point in time it will be in operation, and what framework conditions prevail in order to predict exactly the cash flows, I think, other methods [than DCF] are applied. In my opinion, there is considerably a less clear standard. Subsequently, it is then more about: What is the value of the project rights in early development stages?*

The applied valuation of a method must be suitable for market communication and for negotiation between seller and acquirer, while still being able to appropriately consider the main risks, as participant 3 pointed out:

> *And I cannot name the developer, ‘Here, I have a super nice valuation method,’ and he says, ‘I really do not care because I want the price.’ That's one thing and the other thing is to what extent is it [i.e. a sophisticated method] really an added value […] for me. Can I really evaluate risks better, so is it [i.e., the project] really better valuated?*

Also, participant 8 added that the applied valuation method must be understood by both transaction parties, particularly if certain factors change during negotiation, and both parties must reach a common understanding about the new outcomes. So, according to participant 8, valuation methods that consider particular input parameters were problematic if

> *[…] one does not really know what comes out, and the seller, the [project] developer, does usually not have this view.*

Moreover, for successful transactions, it is key that the decision makers understand the applied valuation methods, as outlined by participant 10:

> *[…] certain, more sophisticated methodologies are simply not understood […]. You have to speak in the language of the decision makers that they can understand [the valuation outcomes] and take a decision [about submitted investment opportunity].*

In addition, participant 1 noted that there is a crucial difference between price and value, as also discussed above in section 5.3.1. The calculated price and the negotiated value do not have to be identical, particularly in the case of misbalances in the market (section 5.3.7.3):

> *And a price that is paid is not necessarily always 100% the value that has been determined within a valuation procedure. So, value is what you calculate; price is what you have to pay. […] Or vice versa: price is what you pay, and value is what you get. And […] there is certainly often the topic that one must find a common basis in negotiations to determine a value that then is accepted by both sides to finally derive a price from this.*

As participant 11 pointed out, many sophisticated methods developed in science are mostly too complicated to be applied in practice. The question regarding what is theoretically correct is not the relevant question within practical implementation—the relevant question is rather what practitioners consider as correct.

> *[…] what I come to realise is that it is not simply a question of what is theoretically correct in valuations; the only and decisive question is rather what the market participants consider as correct.*

Moreover, there is a risk of concentrating intensively on a technical and sophisticated valuation method and neglecting to focus on the essential negotiation process, as noted by participant 10:

> *I think a valuation […] must be done professionally […]. Of course, I have seen a lot of valuations, but there's a danger […] that when the assessment becomes so technical, the link between the overview and the negotiation within the transaction is lost.*

Other participants added that there is the risk of applying unnecessary and misleading, spurious accuracy when applying more complex methods, even those that are theoretically more consistent. Furthermore, participant 9 also emphasised the necessary focus on valuation methods accepted by the market, even if the drawbacks of the applied simplistic DCF-based methods are known:

> *If you want to be so exact, and you value an OPEX cash flow and a revenue cash flow separately, then I would also have to assess and value the political risk, the regulatory risk, the probability of technological [problems…]. So, these are things that all go, for me, into the realm of semblance of precision, and the more I look at it, the more I lose the understanding that my rating is anyway wrong. […] the more digits after the comma that one tries to calculate, the more you lose the [relevant] focus, and that is dangerous in my eyes; therefore, I rather prefer to stay with the typical methodology which I know […] is wrong. The others [who are*

not aware of this] live in a pseudo-world. This is also fine, but all of us apply the same [simplistic DCF-based methods] to generate the market prices.

A standardisation of the input data for project valuation (for example, *P* value[69], project lifetime, not fixed market prices, and indexations) was necessary to be able to compare different investment projects on the same basis and to make appropriate decisions while also being able compare valuation results with possible set hurdle rates (section 5.3.5.5).

5.3.3 Numerical Approaches in Capital Budgeting

The first part of this section discusses the application of numerical techniques within capital budgeting (Appendix 11 Table 62), while the subsequent section 5.3.4 elaborates on the use of judgmental approaches.

5.3.3.1 Discount Cash Flow-based Methods as Main Valuation Approaches

All participants agreed that DCF is the appropriate and state-of-the-art, basic capital budgeting technique (Table 62), based on the cash flow projection of the considered investment project. Most market participants regarded it as a simple, straight-forward method, the most accepted method, and the optimal approach to discuss project values between sellers and acquirers within transactions. Moreover, as participant 10 pointed out,

as soon as project-specific valuations are performed, DCF-based methods are applied. […] Furthermore, this established method is based on an agreement between the valuation and the accounting domain.

In practice, the application of DCF-based techniques in valuation is supported by finance theory (section 2.4.2.1), indicating that there is no gap between theory and practice in this perspective. The majority of participants were aware of some of the available varieties of DCF-based approaches. However, while performing in-depth discussions of some challenges and issues of DCF-based approaches, it became clear that the inherit assumptions, advantages, and disadvantages of the different DCF-based methods were not known to all participants[67].

With regard to the debate in theory about considering the time value of money and risk in one and the same parameter, namely the discount rate, and the necessity of decoupling those two parameters (section 2.4.4.3), only a small minority of the participants were aware of this issue, and those who were aware of it did not consider it to be that relevant. According to participant 7,

the issue about having one discount rate in the DCF method, which considers both the time value of money and risk, is not that problematic, since the most risk is anyway considered within the cash flow projections.

Even if this criticism about the discount rate is known, participant 9 did not see it as that relevant. He pointed out that *the question about setting the appropriate discount rate should rather be 'What could I alternatively earn with my money?' [while investing in an alternative, comparable project].*

Similarly, participant 3 argued that the focus should rather be on choosing the optimal valuation method to consider risk and the most relevant risk components (in cash flow projections) and not on applying the most sophisticated valuation method.

Some participants stressed the inherent issues of DCF-based methods that value early years higher than later years. Participants 3, 9, and 16 emphasised the problem that the uncertainty of the available resources stated in resource assessments are related to a long reference period, such as 20 or 30 years, but not to the uncertainty of the resources from year to year. This understanding was not completely understood by many decision makers (participants 3 and 16). Participant 3 outlined it as follows:

> *[…] the uncertainty calculation [within resource assessments…] is a fundamental problem. […] that means, the fluctuation [of resources and correspondingly revenues] from year to year; what I really get is what really comes every year. […] And I have got my big problems whether that [i.e., this risk] is covered [in my valuation].*

Having said that, DCF-based method do not appropriately consider the risk of encountering cash flow volatilities from year to year, which is particularly problematic when positive cash flows are postponed to later years, as reported by participants 9 and 15. Participant 15 outlined this issue as follows:

> *[…] the DCF method presents itself as problematic, particularly for renewables, having [typically] loss years at the beginning [of the project], which I can usually offset with enough liquidity. But if it then gets worse [with lower resources at the beginning], then I actually have a disproportionate weighting of the bad years compared to the good ones that come at the end [of the project], which are discounted so much that they do not save the project anymore.*

This problem of the DCF methods particularly emerges when performing ex-post[68] DCF-based valuation, by virtually going back to the point of investment and considering the occurred relevant circumstances, while comparing ex-post to the then-performed ex-anti valuation. Participant 1 pointed out the crucial point of defining a base case scenario for the ex-ante valuation as being vital and inevitable for all transactions, and he or she stressed the dilemma of the impossibility of finding the true and real business case:

> *[…] this static scenario is really just a help for the calculation, but [...] we will never give us the actual IRR or NPV value, which can be calculated retrospectively after we have accompanied the project for 20 years.*

To learn from the previous investments, some of the participants, for instance, participant 16, were implementing ex-post valuations. This means that the input data of the previous years are replaced by the actual cash flows to calculate an IRR or an NPV from the acquisition entry date based on a hybrid model, including actual and forecasting data. This ex-post valuation could lead to new insights, which are beneficial for the valuations of new acquisitions.

Those participants who adjusted the incoming cash flows (revenues) to a more certain value, such as to a *P* value of P75[69], as reported by participant 14, decreased the risk of the encountered volatility. They reached a more conservative value; however, they potentially jeopardised its competitiveness on the investment side.

5.3.3.2 The IRR and/or NPV

Many participants stated that the IRR and NPV are almost the same method, calculated from a different point of view—either from a defined enterprise value or from the required return rate. However, all the participants, except one, did not seem to be aware of the restrictions of the IRR method, compared to the NPV approach.

All participants regarded the IRR as the main DCF-based approach for transactions for RES-E projects (Appendix 11 Table 62) and as more adequate than the related NPV approach. The main stated reason for using the IRR method included the possibility of comparing the different return rates between different projects, which is also applicable to projects of different sizes. As participant 11 pointed out, the discount rate derived from the IRR method is the optimal figure to communicate between different market participants for comparison purposes:

> *With the IRR approach, one simply knows from the discussion of market participants where approximately the actual IRRs lie, and the market participants communicate about it.*

The IRR approach was often also applied because of existing corporate requirements in the form of minimal discount rates and hurdle rates (section 5.3.5.5). Participant 1 outlined these requirements as follows:

> *The IRR method is typically used in the sector in such a way that the IRR resulting from the project valuation model is compared to a hurdle rate that has been predefined […]*

In contrast, the NPV approach cannot be normalised to directly compare the attractiveness of projects of different sizes and to communicate between different market participants, as interviewees 11 and 12 explained. However, the NPV is able to provide answers regarding the possible contribution in terms of value and its potential financial impact on the investing company. As participant 16 correspondingly outlined, the NPV closely follows the accounting perspective and is more relevant for performing impairment tests. As such, the participants regarded the NPV method in RES-E investment transactions as less relevant and less useful or as clearly of minor importance, compared to the IRR approach.

Moreover, the findings demonstrated that the advantages of the NPV approach, in contrast to the disadvantages encountered for the IRR approach, such as the necessary reinvestment rate of the free cash flows at the IRR (section 2.4.2.2), were not known by the participants, or at least not reported.

In addition, the IRR approach was mainly applied by the acquirers and financial investors—either acquirers or sellers. However, project developers applied the IRR method only to optimally communicate with the acquirers to have the same basis. As participant 5 explained, contribution margins or the NPV approach were rather utilised as the main internally applied capital budgeting technique:

> *So, I think IRR is in any case the subject that is generally more applied by investors in the operating phase with large capital. The NPV is, I believe, much more useful for [project] developers because they, of course, have a lower amount of equity capital invested and can therefore compare more contribution margins of [different] projects and not the IRR on small amounts of equity capital.*

Moreover, within the current market situation in a seller's market, participant 6 explained that the IRR and the NPV approaches are not particularly relevant in the selling process for project developers, since they are able to concentrate this process on the highest bid(s) while comparing the offers:

> *In the run-up [to develop, build, and commission the RES-E project], we are likely to look at what we would expect from our existing knowledge of (a) the project and (b) the market, which prices we should achieve, conservatively. […] But afterwards [i.e., in the selling process], the offers are next to each other. […] And then we compare the offers, the hard numbers, so then we can say […] in the aftermath of the project […] the prices were suddenly so much higher, and that is not just in one project, but that has been the last three projects. […] Do we [now] have to adjust our assumptions on the subject of IRR or the required interest rate for an NPV consideration? This is then more a downstream process, but if we are in the direct sales process […] we then can [just] compare the prices with each other.*

5.3.3.3 Cash Flow Levels—Entity and/or Equity Approach

The findings demonstrated that the difference between the various cash flow levels in relation to performing a valuation, such as the entity approaches or equity approaches, is not trivial and is sometimes even confusing for professionals experienced in valuation, as recognised within some of the performed interviews. As already reported above (section 5.3.1), the valuation focus for RES-E investments in respect of the IRR approach is clearly set on the equity approach.

As participants 1 and 3 outlined, the WACC approach, which is an entity approach, is not appropriate for RES-E investments due to the static debt/equity ratio imbedded in the WACC, which is not applicable to RES-E investments because of the typical decrease in their senior loans over time.

Participant 1 justified the choice for the equity approach based on the FTE method (section 2.4.2.1) for RES-E investment projects as follows, and he or she again highlighted the predominately applied simplistic FTE approach with a constant discount rate in practice:

> *[…] I would say that an approach is chosen that is also used for real estate, for example, that you look at: 'What exactly has the project company contracted for financing?' And this financing is then exactly, periodically, specifically modelled into the business case with interests and repayments as a function of the corresponding redemption plan and credit agreement concluded with the bank, and then only the following are considered for the valuation: 'What remains in the end after deduction of interest, repayment, and possible savings in reserves? What then flows to equity investors?', and this is then discounted with an expected return rate on equity, and so the market value of the equity is determined. And that, I'd say, is a very common approach, so the IRR method and this equity cash flow valuation, which is what I believe is used standardly according to my experience.*

In contrast, as already mentioned above in section 5.3.1, participant 11 stressed the relevance of focusing on the cash flow levels to all capital providers, i.e., debt and equity. This is outlined in more detail in section 5.3.5.2 about the appropriate CoC approach.

Several participants considered both cash flow streams and cash flow to entity and equity; however, with different priorities. For example, participant 15 focused on the cash flows to equity investors, but considered the cash flows to firm as a means of cross-checking:

> *[Discounting cash flows to firm] is rather [applied] as a cross-check to simply evaluate whether that [i.e., discounting cash flows to equity) does somehow makes sense.*

On the other hand, participant 2 discounted both levels of cash flows for detecting effects from the leverage:

> *[I calculate] certainly the equity IRRs [based on discounting cash flows to equity], but also the project IRRs [based on discounting cash flows to entity], because one can derive from the delta or from the ratio of these two IRRs also the leverage effect. There are such situations where the project IRR is extremely depressed and the equity IRR is just accepted or acceptable because simply the debt financing is super good. […] if one can then compare [this] with a wind farm that has a slightly higher project IRR and is less leveraged, I would prefer the second one.*

Some interesting insights into how to discount cash flows to equity and cash flows to entity were found while discussing the investment scenarios with participant 4 in relation to the provided different resource scenarios, the *P* values[69]. He compared the P90 values for the equity IRR to those of the project IRR of the investment scenario 3 (Appendix 8):

> *Why is the P90 lower [of the equity IRR] than here [i.e., project IRR] the P90 value? That can hardly be. The IRR on equity must be higher than the total project IRR. […]*

After some thought, he arrived at the following conclusion:

[…] Now I understand it because here […] the bank gets [in case of P90 scenario] more because with an interest rate of 2.6 [i.e. for debt financing], this is above this rate [i.e. the equity return rate] of 2.16. That is the reason.

Choosing the appropriate CoC approach for the chosen cash flow level is discussed in a separate section 5.3.5.2.

5.3.3.4 Distribution Potential to Equity Investors

For cash flows to equity, the questions that arose related to the types of cash flows that are considered, namely either i) the cash flows after having paid all creditors, debt services, and cash flows to allocate to certain reserve accounts (project financing or decommissioning) or ii) the same cash flows that can then really be distributed to the equity investors considering all distribution restrictions.

The majority of the participants considered the distribution potential to be relevant in RES-E project valuations. For example, participant 9 outlined the distribution potential as a crucial point even if the calculated IRR based on cash flow projections seems to be superficially fine:

So, I can also reach an IRR extremely 'back-loaded'. […] it can also be that I cannot distribute dividends for 15 or 20 years, for example, because the bank financing comes first and I always have negative income, and only over the last 10 years, I can then pour out huge dividends. This gives me a 6% IRR. […]; however, I prefer to have stable cash flows from the beginning.

To consider the distribution potential, the quality of the cash flow projection must be increased by analysing and considering distribution barriers based on the appropriate financial statements (balance sheet or income statement), as reported by participant 11:

[…] we are fighting with quite different quality deficiencies […] I just think that we should have an integrated model that consists of profit and loss account, balance sheet, and cash flow calculation […], where the elements influence each other […] and the effects of changing working capital, distribution barriers, and so on are considered.

The resulting more realistic distribution stream to the equity investors was then the basis for calculating an *output* or a *distribution* IRR or NPV for applying the discounting approach. With the exception of participants 2 and 8, who already performed distribution stream valuation with an *output IRR* (see below), valuation approaches that discount distribution streams were seldom seriously considered by market participants, as reported by participants 2, 10, and 11.

One reason for neglecting the distribution potential lies in the possibility to optimally structure the SPVs with regard to corporate and project financing structures, as participant 6 pointed out. Since most SPVs in Germany are companies in the form of partnerships and accounting restrictions are thus typically not encountered, the mentioned distribution issue is less or not relevant. However, he acknowledged that this is different for companies in the form of corporations, which have to comply with more stringent accounting rules regarding the distribution of available cash flows on an SPV level. Moreover, project financing contracts must be optimally structured so that distribution restrictions do not occur due to overly strict bank covenants. Nevertheless, according to participant 6's experiences, the acquirers have always managed to deal with this challenge without having to calculate an output IRR:

> *[…] so, we have already noticed that, of course, the investors are asking themselves whether they always get the money out. […] there are then investors who are asking for such points, just like the structuring, are there certain minimum requirements [with regard to the distribution, or] are there any specific bank requirements […]?*
>
> *Investors who have a certain experience have always managed to get [their cash flows] distributed. […] there are investors who pay attention [specifically so] that there are no blocking elements, and this is also important with regard to the […] signing of a financing contract that could make it somehow impossible […] to make any distributions.*

Nevertheless, there were a few participants (13, 15, and 16) who were introducing additional valuation methods based on discounting the distribution streams, such as an output IRR or output NPV. Participant 13 stated that, in addition to the traditional IRR model calculation, his company was changing the valuation models to also compute an output IRR and to provide a distribution plan. This means the traditional IRR model was still used for the valuation while communicating with the market, whereas the output IRR and distribution plan were applied for internal purposes, in particular, such as for the treasury department:

> *We are […] currently in the process of […] adjusting the valuation models of the group I order to valuate the projects in the sense of what distribution do we actually have annually? So real pay-outs, real cash. […] So, what results matter more because this [i.e., the real distribution] is more helpful for our Treasury and for our planning than to consider only the pure return of the project.*

Participants 2 and 8 reported that they always computed both figures: the traditional IRR and an output IRR. However, in the case of participant 2, his clients have never applied the output IRR results in practice, for example, in valuation processes to state a price. He noted that the equity return rate calculated on potential distributions and not only on generated cash flows on the SPV level would be more relevant and better reflect the reality. However, there are restrictions, other constraints, or differing interests for why this is not always considered:

> *The [valuation] model that I use, in addition to the project IRR, the equity IRR, and the distribution IRR. […] but the distribution IRR is usually not a discussion. […] Depending on the constellation, this can be significantly lower than the equity IRR, but it is somehow only noted. […] but I will also not explicitly point out the distributing IRR when I am mandated—with my incentive system. […] So, I am somehow pragmatic and say, 'Okay, let us take this IRR, so that we can compare and so on,' but strictly one would have to clearly consider the distribution IRR and compare.*

On the other hand, for participant 8, both results were relevant: the traditional IRR results for pricing purposes and the output IRR for checking whether there are any distribution problems with the investment project:

> *And if this delta is too big, we see the project has a problem with distributions and that is of course very important because we ultimately promise our investors a certain return.*

Moreover, participant 12 pointed out that a calculation of an output IRR is a relevant consideration; however, it depends both on the individual project structure and on tax regulations, which often change and do not enjoy any protection from possibly being changed in the future by the law makers:

> *[…] it is a very interesting and also very complex topic, which is very strongly dependent on how the individual project is structured […]. And of course, […] if the tax regulations now change in retrospect, then I can be with my detailed calculation […] completely wrong [...]. This is […] the difficulty. We do not have any provision to safeguard the existing standard [i.e., an existing tax regulation].*

5.3.3.5 Certainty Equivalent Approach

The CE method was known to 5 of the 16 participants, although none of them applied it or saw it being applied in praxis. Moreover, some of the participants, and not only those who knew the method before, found the CE method to be an interesting concept with the potential to provide additional insights into the valuation of RES-E investments. It seemed to directly cause a change in the participants' views and opinions during the interview procedure (section 4.1.2.1).

As participant 9 noted,

> *if I have a CE value that equals the equity value of the base case scenario, I would have a perfect risk-adjusted return.*

Although, as he stressed, in this case

> *[…] the upside potential of the project is not considered at all.*

Similarly, while comparing different investments, participant 7 pointed out that

> *the smaller the difference between the CE and the equity value is, the better the project is […].*

This leads to the question of whether the difference between the encountered equity value and the CE is any amount of non-considered upside potentials in the CE method; for example, the option for repowering or renegotiating the maintenance contracts.

Participant 5 applied a similar approach in terms of a percentage of the results of the CE method in relation to the equity value as a base case:

> *I have looked at it [i.e., the CE method result] again as a percentage of the investment volume, so I have the amount of 14.1 [MEUR] […] as equity value. […] And then the first has 89% of it, the other two only 70%.*

Participant 4 added that this method can be used to define the lower limit of the value range, a specific worst-case scenario, while focusing particularly on risk measures and applying a lower return rate.

In addition, participant 6 explained that the CE method has the charm of not having to use the CAPM and beta factors to define an optimal return rate and a potential iterative process between the calculation of the project value based on the CAPM result and changes in the project characteristics (for example, operating and financial risk), which influence the CAPM calculation and subsequently the project value again, thereby reaching an equilibrium between the optimal return rate and project value, as explained in section 2.3.2.1. The CE method instead reaches this

> *equilibrium quickly [and] not iteratively […], finding a solution solely analytical— because the covariances, not the return covariances, among the cash flows with the return rates of the corresponding market are defined.*

Participant 7 spontaneously added to the discussion about applying the CE method that it seems to be related to fixed return concepts applied by banks.

However, there were several participants who viewed the usage of the CE method in practice as critical. For example, participant 10 pointed out the critical relation between applied valuation methods and either the negotiation process or the own decision makers and their understanding of the applied method:

> *I have also seen a lot of reviews, but there is a danger, and I have already mentioned that when the assessment becomes so technical, the link between the overall view and the transaction is lost. […]*
>
> *But often new methodologies, especially if they are too complicated or seem too complicated, are not taken into account by the decision-making body and are not taken into account in the negotiation.*

Although participant 7 found the concept interesting (see above), he questioned the consistency of the applied risk-free rates, which are also changing over time—sometimes even quite rapidly:

> *And [there] is just at this risk-free rate, which is also very deterministic, one specifies it and says that is it for the next 20/25 years so that it will be so, but certainly it will not be so.*

Furthermore, according to participant 12, this method involves a substantial amount of rather subjective assumptions to define the certainty level for the relevant input parameters, since the (basic) theory of the CE method does not provide suggestions for how to reach the certainty levels[70]. For him, theory and practice are quite apart from each other in this topic today.

5.3.3.6 Profitability Index

The PI, another alternative DCF-based method, was only known by two participants (Appendix 11 Table 62). For the other 14 participants, the PI method was completely new and had never been encountered in RES-E investment transactions. Nevertheless, while discussing the investment scenarios, two participants regarded the PI as an interesting concept, as outlined by participant 3 as follows:

> *What I found […] interesting, I must say, although I have not done it yet, is the profitability index. Makes sense for me; I think this is a good thing. Present value of future cash flows divided by initial investment, as I understand it, is for me a similarly revealing figure, also easier to understand, [compared to other more sophisticated methods].*

In addition, the majority of the participants had not applied the results of the PI method while comparing the investment scenarios.

5.3.3.7 RES-E-specific Multiples

Multiples are typically non-DCF based methods. The considered multiples in RES-E investments are different, compared to other sectors, which often compute multiples based on earnings, book value, and/or EBITDA.

Multiples were known to all participants, who typically performed them as complementary methods, and not as the sole method, and who mainly applied them for screening and plausibility purposes (Appendix 11 Table 62). Participant 10's answer represented the answers of many other participants well:

> *It is applied for rough comparisons between different renewable energy investments […] for first and fast screening purposes [and] not applied for project-specific valuations [for which better DCF methods based on its cash flow projection are applied].*

Participant 5 added,

> *the better the project is known, the more specifically the DCF-based approach can be applied. [However], the more unspecific the cash flows are, the better multiples can be applied for comparison purposes[,]*

corresponding to the statement made by the participant 7.

In addition, multiples are also applied in the early project stages, mainly by project developers, as outlined by participants 1 and 5. This approach has also proved its validity for valuating portfolios of projects in the developing stage (participant 1).

In addition to the stated criteria about similarity or equality (section 2.4.2.3) in order to be able to apply multiples, the affiliation to a peer group in RES-E investments is also defined by the applied technology, as pointed out by participant 12. In addition to the usually applied multiples found in valuation, RES-E project-specific multiples are applied (Table 28), as explicitly reported by participant 15.

Table 28: Different multiples applied in screening/benchmarking RES-E investment projects in valuation processes.

Enterprise value multiple	Paid price for equity multiple	Cost (OPEX) multiple	Earnings multiple
Enterprise value per capacity	Paid price for equity per capacity	Costs per capacity	Earnings per capacity
Enterprise value per annual production	Paid price for equity per annual production		
Enterprise value per annual earnings	Paid price for equity per annual earnings		
	Paid price for equity per EBIT		
	Paid price for equity per annual cash FTE		

5.3.3.8 Payback Period Approach

In the case of the PB, which some participants also called the repayment period, almost half of the participants applied either the non-discounted (PB) or a discounted version (DPB) in the investment scenarios, while the latter DPB method was only applied by participant 5, who preferred the DPB to the PB. Moreover, the PB was specifically used by some participants (3, 4, and 10) within riskier environments, such as for countries considered as riskier. As participant 3 noted,

> *[applying] the payback period is then interesting when entering in real riskier countries […].*

Some funds for retail clients apply the PB to minimise the risk as much as possible, as observed by participant 12. In addition, participant 7 noted that the PB is also applied for comparison reasons with the FiT period, determining a higher project risk if the PB is longer than the FiT period—a measure also applied by some banks. Moreover, participant 9 viewed the PB method as a particular measure to evaluate the downside risk and subsequently to focus on the downside protection of RES-E investments.

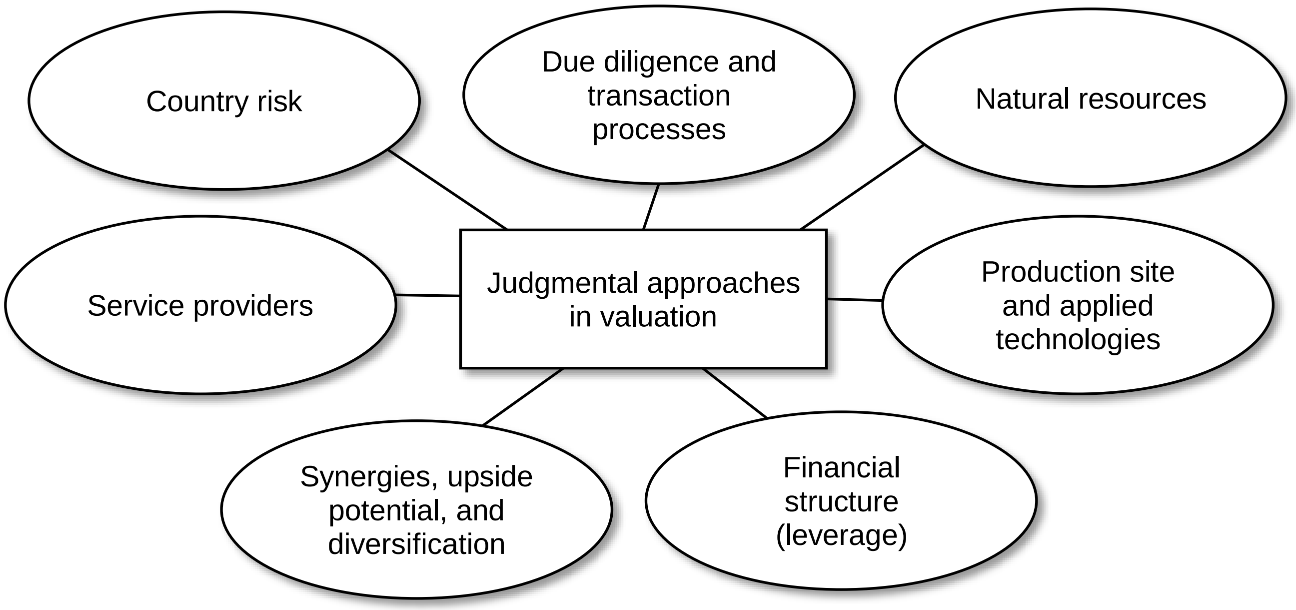
These findings supported the advantages of the PB method, as propagated within the literature (section 2.4.2.3), such as its simplicity and focus for the minimum time possible to recover its initial investment and subsequently its concentration on risk in the period until the investment recovery.

5.3.4 Judgmental Approaches in Capital Budgeting

In addition to the numerical valuation approaches described in the previous sections, a wide variety of specific judgmental valuation approaches and considerations were considered (Appendix 11 Table 63). They were applied complementary to the numerical approaches and never as sole approaches, as demonstrated by comparing the findings about applying judgement assessments (Appendix 11 Table 63, no. 01.1) and the applied numerical methods above in section 5.3.3

(Appendix 11 Table 62, no. 01.1) by the same participants. These judgemental approaches consider the assessment of specific factors that are difficult to assess using numerical methods. The section begins with two areas with a broader view of the topic (sections 5.3.4.1 and 5.3.4.2), before diving deeper into the field by focusing on the reported relevant factors for the valuation of RES-E investments (sections 5.3.4.3 and 5.3.4.4), as summarised in a concept map (Figure 48). In addition to covering these topics, a subsequent section below (section 5.3.7) discusses additional external and internal influencing factors that affect both numerical and judgmental valuation approaches. They are not directly and explicitly considered in valuation; however, they rather implicitly impact valuation approaches.

Figure 48: Concept map about applied judgmental approaches in valuation processes.



5.3.4.1 Evidence for Judgmental Assessments in RES-E Valuation

Almost all participants explicitly reported that they apply a judgmental assessment in the valuation of RES-E investments. Participant 12 outlined its necessity and the apparent appearance of the gap between theory and practice:

> *I would say, at the end, it is always the same subject within valuation that you have to weigh simply between the scientific theory and the daily common practice. This is a bit of the trade-off you have to find there, I say, because the theory is true in theory and in practice; however, you often have constraints that cannot be expressed in a formula, as one would like.*
>
> *[…] for example, in the case of uncertainty calculations, I say, especially in the case of wind reports, for example, one is […] very much in the hands of the experts and it would perhaps not be wrong to incorporate some personal experiences in the assessment of results of the resource assessment experts.*

[…] In particular, if I have now already one or more projects in one region and know the operating data, then I would orient myself, for example, there to evaluate whether the results from the reports seem plausible for a neighbouring project or not.

Participant 7 highlighted the importance of considering both numerical as well as judgmental valuation results:

[…] there are soft facts, but I believe […] many hide behind the numbers, which are also easy to present and communicate; but actually these soft facts or these things you know of the market [for example], this is a good project developer, this one always takes the old machines, this one has a problem with the performance, or this one is bad in operation and maintenance… [all] these [mentioned points] are difficult to quantify, but these are actually—I believe—the points that must be observed.

However, most of the participants did not apply any specific methodological approach for the judgmental assessment of certain components within the valuation of RES-E investments, as specifically outlined by participants 9 and 10. One participant (participant 8) applied a specific risk screening/scoring model that also includes the assessment of qualitative factors, specifically designed with the support of academic risk experts (section 5.3.6.4). Participant 6 applied a scoring method with a range from 1 (best in class) to 3 (worst in class) to evaluate the provided investment scenarios, including judgmental considerations. Another method for qualitatively assessing factors was reported by participant 2 below (section 5.3.4.2) with regard to the DD processes.

All other participants discussed internally specific key features and risk components in rather informal evaluation processes, such as discussions with internal experienced professionals, external advisors and with senior managers (see also participant 9's explanations in section 5.3.4.3), in which gut feelings and emotional experiences also come into consideration, as noted with the example of participant 9:

[…] then there are qualitative elements that we look at, for example […] counterparties, […] the location, maybe even regulatory political risk, simply less quantitative elements rather than credit risk analysis […]

or participant 15:

[…] the project has to fit very well and we also have to come to the conclusion […] intuitively that we think that there could be an upside. (see also section 5.3.5.5)

5.3.4.2 Due Diligence and Transaction Processes

Valuation processes cannot be separated from DD and transaction processes, which are based on valuation results. As the QUAN results demonstrated (section 5.2.2.2), all participants perform DDs to evaluate the project in detail for key components. Such DDs frequently reveal findings that must be evaluated judgmentally.

Participant 11 made it clear that for a final valuation and comprehensive assessment of a targeted investment project, the results of the performed and project-specific DD must be available, and apart from the financial numerical assessment, one must be able to qualitatively grasp the challenges of the investment.

> *Apart from the financial summary, I would like to receive a summarised legal, fiscal, operational, and financial DD report in order to simply get a qualitative feel for what are actually the challenges of these wind parks.*

For discussing findings from a DD process, participant 2 mentioned the so-called ‘what-if discussion’ techniques, which provide an interesting concept to approach findings with rather qualitative characteristic, and which cannot be incorporated and assessed numerically in traditional valuation models. As such, many issues found in a DD process can be approached with

> *[…] the question: ‘What if ...?’ […] So, what happens if we have a technical problem in the facility? Okay, then we have a two-year warranty period within an EPC contract with a provisional acceptance […]. So then, ‘Okay, what would happen if we had a systematic problem or systemic problem after that?’ Okay, then that would happen then, then, and then. Okay, in an insurance case, it would pass as follows. So, these are really things that are discussed, at least qualitatively.*

In addition, the amount of past experience of sellers or acquirers in RES-E investment transactions in general (participants 4 and 13) and between sellers and acquirers from previous mutual transactions, and their grade of satisfaction (participant 6) were considered to be crucial for new transactions, being evaluated from a qualitative point of view. Participant 13 outlined the importance of past experience of the transaction parties as follows:

> *[…] who is […] the seller, what kind of transactions has he done so far? Of course, we listen to the market regarding whether he has broken up any transactions […] because something does not fit him or whether he sets up a term sheet and then he pulls that through. These are also within the scope of investment and of course also considerations in order to estimate the cost of an investment […]. It does not help me if I start an idea 15 times and I do not get there 14 times. That makes no sense. This means, of course, we are looking at who is, so to speak, the one who offers us the project. Or the other way around, who buys the project from us […].*

In addition, participant 9 confirmed the importance of profound transaction experience of the parties involved in transactions to keep the transactions and the ensuing structuring costs low by noting that

> *Others are very inexperienced and try to sell projects, which first of all one has to be optimised […] in order to be able to acquire them at all. […] Or needs a lot of efforts in post-transaction optimisation.*

> *[…] so, one [topic] is the structuring, the other one is the counterparty and its professionalism in the sense of transaction experience. There are utilities that are now beginning to divest*

> *their large portfolios. They have developed a lot, but they have hardly sold anything, and since you realise that much […] more effort is required to get through a transaction from the DD, i.e., documentation security, documentation standardisation, and then the required experience in transaction, the knowledge of structures, and so on.*

As already mentioned above in section 5.3.1, several participants considered the probability of investment success to be an essential piece of qualitative information in performing transactions, also with regard to the spent transaction costs, which run the risk of being laid out in vain in the case of lost selling and/or acquisition negotiations. Participant 8, however, considered the differences between the provided probabilities of investment success for each of three investment scenarios as too small (around 10%) to be considered relevant for taking them into the judgmental assessment; larger differences would be relevant. In addition, participant 11 pointed out that the relevance of having the information about

> *[…] the probability of the investment success […] depends a bit on how many transactions I make in parallel […] If I have the capacity to work and say I want to build a portfolio, and I have enough human resources, I would put my colleagues on all the processes, regardless of their success, because I would say if they were not on the processes, then the colleagues would sit around and learn nothing. And even if they pay the project by paying the personnel costs anyway, yes, even if the project does not turn out to be successful, I have learned something from the mere participation and working with the project for myself as a team in the future. […] I say, […] the question is ultimately […] how good or bad I am internally placed with my resources.*

5.3.4.3 Key Characteristics of RES-E Projects

This section discusses, in detail, the additional key features of the RES-E projects that were evaluated in the above-mentioned DD processes.

A key feature in RES-E projects is the quality of the available resource at the site of the planned or operating power plant, which is also frequently assessed with judgmental approaches, apart from the applied statistical resource analysis. This involves the assessment of the involved external experts—who, for example, assess the available resources—based on the investor's personal past experience with the specific expert (and not only the involved company) and the expert's reputation to provide top-quality work (participant 12 and 9).

In addition to the provided resource assessment, the attractiveness of the production site itself and the applied technology is evaluated in terms of grid access, hub heights, full load hours, and suitable technology. Having said that, participant 8 pointed out the significance of performing an attractiveness rating—in addition to the above-mentioned risk screening/scoring model—for the location of an RES-E power plant, for the example considering the hub heights for onshore wind farms:

And in addition […], of course, we […] look at our assumptions about profitability, apart from the expert opinion [of the wind assessor], and we are fairly convinced that we have the higher yield security and probability, the higher the turbines [i.e., the hub heights] are. That is why, from today's point of view, and this is still very common in France, for example, we would always put a minus point [in the rating] for a hub height of 98 meters. […] Because we see that the closer to the ground, the more questionable is the actual amount of production. So, the higher I can go, whether 137 or 141 meters is not so the difference, but the higher, the better actually.

Participant 9 added that certain types of technologies from various suppliers are better in certain areas than others, as technical experts pointed out based on their past experience:

We have already analysed this by wind experts and […] from technical experts: certain turbine technologies are very reliable in certain areas, in others not. So, at high temperatures and low temperatures, for example, there are differences.

Furthermore, the evaluation of the production site attractiveness was key to defining its potential to secure the site for future projects, i.e., its repowering potential (participant 4).

Experience at the site of production has a major influence on valuation due to significantly decreasing the project uncertainty, as participant 13 outlined:

If we have the experience [from the production site], especially from the wind data […], we buy less the pig in the poke as if I have a completely new location—maybe even with new machines.

This could eventually either decrease the required return rate (lower risk) or reduce the considered production amount.

The quality of the service providers, particularly the maintenance service providers (operation and maintenance, O&M) and technical manager, including the quality of the involved persons, for example, the involved technical service team at the production site, is key for the success of RES-E projects. As such, an appropriate evaluation of the counterpart risk of the involved service providers (participant 5), the experiences of the service providers (participant 12), and specifically of the technology providers (participant 9) is crucial. Participant 10 described the necessary judgmental assessment in valuation with regard to full O&M contracts as follows:

There is a qualitative point [of discussion] for the entire full maintenance contracts. The question is: Who provides these full maintenance contracts? Is that someone who is reliable? […. For example,] a 15-year long, full maintenance contract by someone who is almost bankrupt is not beneficial for me.

Participant 11 added, in the same sense, *What might be interesting […] if I analyse the contracts is the performance of a few market benchmarks [about the provided] O&M contract, whether it is now really expensive or cheap. […] And then, again, this coincides with a question: What do I get for my money at all? [In answering this question,] I would say that there is always a qualitative assessment involved […]*

After evaluating the provided investment scenarios (section 5.3.1), participant 5 outlined his additional focus on qualitative points in addition to the provided quantitative results:

So, if I would buy, I would probably show quite an interest in qualitative matters, in the sense of […] how well are the engines, how well are the contracting parties […] But with regard to the numbers, I think there is actually everything provided [in the investment scenarios].

When taking investment decisions about RES-E investments and trying to consider judgmental assessments in addition to quantitative results, participants 11 pointed out his dilemma:

[…] I do not have the qualitative information to tell me about the quality of the contracts and above all about the quality of the people who are to carry out these contracts.

and

[…] I mean, the real difficult question is: Would that be a deal breaker for me? […]

Many offered investments in the RES-E sector are turn-key-transactions with no possibility anymore to change the provided service contracts (participant 11). So, an issue found in the DD process in such a project stage with regard to the service providers results either in a deal breaking or in disregard of the issue, since adjustments within the conditions of the signed contracts are almost impossible.

In addition to the more quantitative characteristics of countries' credit risk ratings (participant 9), the country and regulatory risk are often assessed using qualitative approaches for valuation purposes, as explicitly reported by three participants. Such judgmental assessments are often performed based on internal discussions within the investment team, including a subsequent, final discussion with a senior manager and/or a senior investment board to reach a final estimate, as explained by participant 9:

So, for example, Turkey would be a classic example where one must immediately speak of an increased political risk, regulatory risk. […] This is then analysed qualitatively, on the one hand, internally in the team, and on the other hand with the CIO, […] and if one is already well advanced, also with the investment committee.

For confidentiality reasons, no additional detailed insights into such processes could be collected.

The discussion of the financial structure could only be analysed by discussing the investment scenarios. Participant 3 revealed that a high project return rate and low leverage are more attractive due to lower financial risk by making the whole project safer:

> *In principle, I find it good if the investment has a high project return, meaning a project IRR, and a low leverage, because these alone make the investment safer.*

5.3.4.4 Synergies, Upside Potential, Existing Portfolio, and Diversification

In addition to quantitatively assessing synergy effects within possible investment scenarios (section 5.3.1), there are often other synergy effects that cannot be directly assessed numerically.

The findings of the qualitative analysis demonstrated that many participants considered *synergies* in valuation from a qualitative perspective rather than a numerical calculation.

The focus on judgmental approaches in valuation processes in the case of analysing synergies was outlined by participant 2, starting already during the object scouting process, when evaluating possible investment targets. In particular, he mentioned synergy possibilities regarding regional proximity and access to the investment, as well as existing experience with the counterparty in the transaction, the manufacturer of the engine, and the engine type in order to utilise economies of scale to receive better conditions of suppliers:

> *[Considering possible synergies] is, however, always considered only qualitatively. […] I say, 'Look, dear investor, you have an investment here […], we can open the door to a possible investment very close [to your existing investment], this is the same seller or that is the same O&M provider or that is the same turbine.' […]*
>
> *Having a critical mass of investments in a certain country also means I can play with a certain volume effect, even if it is only regarding administration. So, if you manage seven SPVs in Germany, you usually get better conditions with an accountant and tax consultant than if you only have one.*

Participant 7 confirmed this approach of considering synergies in terms of operating regional clusters of RES-E projects. He particularly mentioned this judgmental assessment within object scouting or screening processes for possible investment targets:

> *However, there are also synergy effects of clustering if one has several projects […] in one place […]. I believe that this is taken into account and analysed in the screening process, but I would say, we are not on the level that we have now already formally standardised [this approach].*

In contrast to these judgmental approaches, participant 9 noted that he includes synergies in his valuation only if they are concrete and can be quantified for numerical valuation approaches:

> *So, for example, when I see I'm in the middle of a transaction and […] I see yet another project in the same country [and] that I could make with the same transaction team much cheaper.*

[…] I agree. […] Or when […] I can just close the insurance over both [projects] or make a grid access for both projects, then I can imagine that. [It is, however,] very project specific.

Using the synergy effect by concentrating volumes, clustering and economies of scale effects, and risk reduction by diversification, should not be ignored, as several participants mentioned. In saying that, participant 1 pointed out the trade-off between i) a high diversification from a technology point of view in a portfolio with advantages of decreasing technological risk and ii) focusing on one or a small number of technology providers to use synergies, for example, to be able to improve the conditions with operation and maintenance service providers due to a larger portfolio:

And so that spread in the portfolio could already have some advantages. […] And perhaps also purely technology-specific, that all engines from different manufacturers have at the same time a problem and have to be repaired is less likely than if you only have a single engine type in the portfolio. […] On the other hand, you also have to consider the scaling effects [within this perspective]. If we have, for example, […] all wind turbines from the same manufacturer and we also have the same service provider, we can possibly achieve better conditions over a larger portfolio. So, there are pro and contra arguments for something like that.

An existing portfolio has various influences within valuation, including how risk is considered for an additional risky project, how the corresponding mitigation of such a risk is performed, and how risk is consequently valued (participant 14), and including the possibility of lowering return requirement rates for an additional project particularly suited for the portfolio (participant 15, section 5.3.5.5), for instance, with the potential to optimise diversification, as participant 16 outlined:

We have an asset [in our portfolio] that has offsetting effects [and which is] actually very interesting for hedging [purposes…]

Almost half of the participants considered the upside potentials or future opportunities in valuation, but in different contexts and to varying extents. The findings demonstrated that they are all based on judgmental assessments and not on profound numerical analysis. The topics around opportunities are, for instance, about handling dismantling costs after the end of the RES-E projects and corresponding reserves in valuation approaches, repowering potential, partnerships, and future renegotiations of operating and maintenance contracts.

The consideration of future opportunities with local partners within valuation approaches were key for participant 14, who did not provide additional details about how the valuation process is affected:

So, the subject of partnerships is extremely important to us. As a municipal utility, cooperation with municipalities, with municipal partners, is essential, and the opportunities that can arise from this cooperation over the next 20, 30, 40 years are, of course, decisive for today's decisions. [It is really about] a bond, a long-term partnership.

Participant 15 stated that certain upside potentials, such as decreasing operating costs due to renegotiation of maintenance contracts, should not be considered in the cash flows. He made it clear that each project should be valued based on the same assumptions to ensure the comparability of previous and future as well as alternative or mutually exclusive investments. However, such opportunities could be considered by decreasing the applied discount rate, if necessary, since the risk of, for example, increased costs is lower in the future.

> *This is […] a risk to say, […] we simply assume that we will negotiate the [maintenance costs] 30% deeper in five years […] So, I think it would be a dishonest view. So, I think it's more honest to say we're changing something at the discount rate, we're going down here because we actually have less risk in the years to come […] than saying somehow […] in five years 30% less maintenance costs or [alternatively] any high market prices [for the electricity sale]. […] So, this would somehow be a hidden approach, to say, we optimise the system. This can be done, but I do not really approve that […]. So, it would be better to always apply the same assumptions, as standard, do not assume something which we cannot know today, and then be honest and say this project interests us, fits well into the portfolio […], the numbers are more or less fine, and then decide that we decrease the discount rate. […] this [approach] is really applied as such.*

Taking a cautious approach in doing business (in German, ‘im Sinne des vorsichtigen Kaufmanns’), participant 12 took into account certain future opportunities in valuation approaches only when comparing different projects that have quantitatively the same or similar valuation results in the base case. Such considerations are only done from a qualitative point of view:

> *[Opportunities are considered] rather on the qualitative side than on the quantitative side, that is, as a cautious merchant, as one says so beautifully in the German law, would always rather consider a worst case or [at least] an average [base] case. […]*
>
> *And then use potential upside only for comparison [reasons], and if I now say, I have two projects that are quantitatively the same or more or less the same, then I would just consider a potential upside on the so-called investment decision level. However, I would not say now, if I have two projects […] I would not prefer the project where I see an upside potential but which is worse in the base case than the other project.*

Most participants considered the valuation of projects from a stand-alone perspective (Appendix 11 Table 63). While this is a riskless approach, potential valuable investments can be missed (section 2.3.3.2). However, some participants began to think about what influence the new investment target could have on the existing portfolio, as participant 15 outlined (sections 5.3.5.5 and 5.3.1).

5.3.5 Cost of Capital Approaches

Since CoC approaches are some of the main input parameters of DCF-based methods, the findings those approaches and setting discount rates are presented in this section (Appendix 11 Table 64).

5.3.5.1 Discount rates

The discount rates represent the required returns on investments or CoC requirements, or in the words of participant 9:

> *[…] the discount rate is supposed to say: 'What else could I earn with the money now?'.*

In more detail, according to participant 5, discount rates are indicators of the anticipated risk—and at least in theory, as participant 6 pointed out. However, they are compromised by the current market conditions and missing attractive, alternative risk-return-balanced investments. In reply to the question of whether discount rates are indicators of the anticipated risk, participant 6 answered,

> *This is supposed to be the case in theory. […] In my opinion, however, it is not because the risks involved differ in no way, i.e., not significantly between the individual projects, but I believe that the return on equity is driven by more liquidity, […] investment pressure, and [missing…] alternative investments in the market. They know that through the feed-in tariffs and all the long-term contracts, the project is actually made very, very rigid—the wind is almost the only risk of what is going on in this business or with this project when they buy it turn-key.*

Furthermore, discount rates are, at the same time, indicators of the current market prices for specific project classes regarding the technology, project stage, and investing country, among other things, as outlined by participant 2:

> *So, we see that the discount rates actually correspond to the market prices. Yes, projects for an IRR of X percent in France, wind, operating project, new project, et cetera. […] So, it is a market price indicator, which is subject to a momentum and to which the investors actually have to adjust accordingly each year.*

As already stated above in section 5.3.3.3, an absolutely essential point in valuation is that the discount rate matches the considered cash flow stream levels. However, this is not always consistently applied, according to participant 11:

> *[…] I mean the most essential point [...] is actually the link between the risk of cash flow and the risk of choosing risk premium in discounting. And in my opinion, in practice, apples and pears are often compared […].*

Participant 6 explained that the dynamic between the uncertainty level of the cash flows in terms of *P* value and return rate is currently presented well when looking at the prevailing investment pressure, while both parts are under pressure, as is again discussed in section 5.3.7.3:

[…] in the past years, I had taken P65 or P75 as the banking case and P65 rather the investor case. And now it seems to be not just in terms of the [lowering] equity requirements, but also in terms of the so-to-speak 'What security does my cash flow take into account?' [i.e., also lower security] be shown how much pressure the investors have.

5.3.5.2 Equity and/or Total CoC (Project Return Rate)

The theoretical foundation for this section is mainly provided in sections 2.3.2 (leverage as risk component), 2.4.1.3 (project financing as typical financing policy of RES-E projects), and 2.4.2.2 (the distinction between the equity return and project return rates).

The *equity return rate* was more or less considered by all participants. However, there were various differences in how they apply it and how its relevance is considered. Within this context, the discussion about the investment scenarios becomes relevant because certain considerations were revealed only when comparing and discussing the provided projects and their valuation key figures (marked with an asterisk * in Appendix 11, Table 64).

For the project developers, the equity return rate was clearly the most important CoC approach. As discussed before in section 5.3.3.2, they applied it particularly for transaction purposes. Project return rates do not provide them additional benefits, since they do not compare the projects or the provided offers based on project return rates. This focus of project developers on equity return rates was clearly illustrated with the statement of participant 6: that based on the potential acquirers' offered prices, an implicit equity return rate is calculated by always normalising the valuation to a 20-year valuation period—even if the valuation period has been increased. This enables a long-term comparison for all projects sold or to be sold, ensuring consistency and precluding systematic valuation failures.

We do this in such a way that we precisely cut our investment horizons on these 20 years and then calculate our implicit return on equity from the prices that the investor gives us, so to speak. This is what we will do, but this will not be the return on equity that the investor himself logically requires. […] Because he [normally] applies a much longer investment horizon, at least five years or more [...], but we do not need it this way because we valuate our [current] projects [as well as] the future projects we assess always on the investment horizon 20 years, […] so that we systematically do not make a mistake, but of course we receive a different value with this way […]

Also, other participants (7 and 12) considered project return rates to be irrelevant when project financing is already established at the transaction date, since it is just as it is. As expressed by participant 7, the focus regarding CoC lies

[…] just [on the] equity return rate. […] One wind farm […] could have a bad or a worse financing. [… and the project return rate] is just a result of it […]; but in the end, it is just about the equity, and we just roll over the subject of the refinancing: either we take it [i.e., financing] over ourselves, but then we make it before [implementing a project financing structure], or it

> *comes financed and then that is something that is given and then […] this is just being implemented in the valuation.*

Although the equity return rate is the essential focus of equity investors (participants 1 to 10 and 12 to 16) and the standard approach for levered RES-E projects (participant 1), there were several participants who outlined the importance of valuating the whole project and not only the cost of equity, which is only the result of financial structuring. Two different approaches were encountered for how the *total CoC* (debt and equity)—sometimes also referred to as project return rate for RES-E projects—is considered in valuation: the calculation of a project return rate or an implicit equity-only return rate.

To consider the effects of the implemented financial structure (financial leverage) and financial risks, the calculation of the project return rate is an established method for the valuation of RES-E investments (participants 2, 3 10, and 11). Participant 11, who puts the primary focus on the project return rate, before considering the equity return rate, provided an explanation for this while evaluating the three investment scenarios:

> *What is my project IRR? Because the equity return does not interest me in the first step because this is only a question of financial structuring. But the financial structuring is actually not a question that is relevant to the investment decision in general but which has to be considered downstream […] If I have a satisfactory [project] IRR, that is, one that is higher than my debt interest, then I can optimise my project in the future and achieve everything that is there.*

An alternative approach to consider the total capital in RES-E investments is given by computing an implicit *equity-only* or *all-equity return rate* (or unleveraged equity return rate), which either does not consider any project financing at all or artificially eliminates the implemented financial structure (participants 8 and 12). This approach to reach a standardisation enables a comparison of RES-E projects without the influence of any financing structures that have currently dramatically affected the attractiveness of RES-E projects (in relation to equity return rates), due to the low interest rates, and therefore the market prices for RES-E projects. This approach replaces the need to use the project return rate at all. This equity-only approach was outlined by participant 8:

> *And we always standardise the IRR in the analysis on an equity-only [perspective …] to sort out any distortions of high leverage in the consideration.*

In support of this argument, participant 12 added,

> *There are [market participants] who just artificially remove the entire debt financing in their valuation process to compute an all-equity-approach in order to evaluate how the project alone presents itself.*

The project return rate should not be mistaken with the *WACC* of the investing company. These are different with regard to CoC perspectives and follow diverging goals in handling riskiness within capital budgeting decisions. However, there are certain players in the RES-E investment market who talk about the applied WACC in valuation, which normally means the applied IRR in valuation or a set hurdle rate (section 5.3.5.5). In this study, the term WACC is solely used for the CoC of the investing company. Moreover, as outlined in section 5.3.3.3, the WACC approach for RES-E projects is not reasonable, since the applied return rate, the WACC, changes with each redemption (typically quarterly) of the senior loan.

Having made the definitions of the terminology clear, the WACC of the investing company was regarded as irrelevant in the valuation of specific RES-E projects (participants 1 and 3), as particularly illustrated when discussing the investment scenarios with participants 1, 9, and 10. That means that the investor's WACC does not provide a basis for deducing the project return rate (participant 10), as participant 9 pointed out in his clear statement:

> *[…] certainly the company WACC—my own WACC—I do not care at all.*

However, the WACC of the investing company might be the basis for setting appropriate hurdle rates to provide a minimum requirement for discount or return rates to compensate for adopting riskier projects (sections 2.4.3.2 and 2.4.3.3). This connection between the WACC of the investing company and setting the hurdle rate (section 5.3.5.5) was not directly found in the interviews; it was only indirectly indicated within the conversations about WACC, IRR, and hurdle rates, for instance, with participant 10.

5.3.5.3 Setting Return Rates with Theoretical Concepts

The most widely known and applied theoretical concept is the CAPM (section 2.5.1). It is the only theoretical CoC concept that the participants discussed in this QUAN phase. That is, more than half of the participants knew about and discussed the possibilities of setting return rates with the CAPM in RES-E investments.

Having applied the CAPM in practice, participant 11 explained that the involved beta factors are always based on a margin of discretion and more or less a judgemental decision, and they are difficult to deduce from the financial market due to a limited number of pure-play wind energy projects for instance (section 2.5.2.2). The same can be stated for other type of RES-E technologies.

> *[…] depending on where the discretion is then ultimately, is the question: How do I determine the beta factor?*

> *[…] if you look at the research of beta factors, it is simply that there are actually very few pure-play wind energy projects [that are publicly traded], and those that [are traded publicly] often have low market liquidity, so the beta factor, which is actually determined there, has relatively limited meaningfulness.*

There are market participants who set beta factors based on traded securities with similar risk profiles, known also as an indirect approach (section 2.5.2.1), such as real estate portfolio, as participant 11 pointed out:

> *In this respect, one tries to get close to the topic, I say times, comparable risk profile, by saying, for example, […] then I take for the sake of comparison similar kinds that belong to this industry. There are also approaches that say I compare them with real estate portfolios […], since there are also stable cash flows involved […].*

However, according participant 11's experience, the CAPM and estimating beta factors were seldom applied to RES-E investments, in contrast to their main application purpose in performing impairment tests for developed and acquired RES-E projects:

> *[Setting discount rates with the CAPM and beta factor] is only applied for impairment tests, but not encountered for transactions […]*

As an alternative approach, participant 11 stated that information can directly be collected from the market to estimate the appropriate discount rate

> *[…] on current information. So, you always hear something what is happening something in the market.*

Also, project developers have a profound knowledge of the CAPM concept as well as its possibilities and restrictions. However, for RES-E investments, they (participants 1, 5, 6, and 12) did not consider it as relevant for the reasons mentioned next. Participant 1 explained that project developers do not apply the CAPM due to its reference to the financial market and the project developers' restricted grade of access to the capital market. The CAPM is rather applied by financial investors and utilities.

> *[…] a classic CAPM approach [is not applied by project developers]. […] this is partly due to the fact that the project developers themselves have limited access to the capital market. […] and therefore, must take what the investors/buyers are willing to pay. […]*
>
> *And as a result, they [i.e., investors/buyers] naturally have a return expectation, which consists of their funding or an internal investment guideline. I think that there is also a difference in financial investors and energy utilities […] having a treasury and a financial system that are able to procure capital on the market and then define internally an appropriate hurdle rate.*

The CAPM is a rather theoretical concept, and it has not proved its worth in RES-E investment practices, as noted by participant 12. This was supported by participant 5, who noted that, in general, the CAPM is not a useful concept for RES-E investments, since in the case of RES-E projects with no correlation to markets (i.e., with only FiT), the involved beta factor cannot be applied.

> *So we are not now using a CAPM […] let's take the simple case of a project, having to consider only a FiT in the project's valuation—for example—without any market prices and hence no market correlation, then we would have to say at the CAPM: 'Yes, my beta is then probably zero, and then it becomes a fairly risk-free interest rate.' Even if we encounter declining yield claims at the moment, no one would accept the approach of uncorrelated economic risk and therefore set a zero. That would theoretically have to be done according to [the] CAPM.*

In comparison, participant 6 arrived at the same conclusion and also refrained from applying the CAPM in setting discount rates within RES-E project investments, since the CAPM ignores unsystematic risks to which the main risk within RES-E project investments belongs, namely the volume-related weather risk (for example, wind, sun, and hydro). According to participant 6, there is the necessity to think about an alternative model that considers relevant unsystematic risk, which is normally ignored in the CAPM (section 2.5.1):

> *[the wind risk, an unsystematic risk,] will not be remunerated […], which should lead to the fact that you should actually discount with a risk-free interest rate, but we know that it does not happen. […] Actually, it needs [an] alternative, let's say, approach, if not models, to somehow, let's say, deduce adequate risk rates.*

This also means that the CAPM concept becomes more relevant again only for RES-E projects with more market correlation. For example, for RES-E projects at a later operating stage, with the end of the FiT period and more mergent risk as well as lower uncertainties of wind resources due to a many-year-long production experience (section 5.3.5.7).

Therefore, participants 5 and 6 focused more on approaches with market sounding for projects with FiT (section 5.3.5.4).

5.3.5.4 Setting Return Rates with Market Sounding

According to the majority of the participants, setting return rates cannot be done solely internally within companies and in absolute isolation. It is a process based on a clear understanding of the market and its dynamics, driven by market competition and in close exchange with many different market participants on the seller and acquisition sides. However, the participants reported different approaches and nuances regarding how market information is deployed to set required and optimal return rates.

Project developers set required return rates based on performing specific market sounding to collect the required return rates of potential investors (participants 5 and 6) or to collect data from previous, periodical project divestment tenders (participant 6). Participants 1 and 12, who now work as consultants but have many years of experience as employees of project developers, also apply the *survey-based market sounding approach,* as participant 1 summarised as follows:

They ask the market what they would be willing to pay and at what prices they would be prepared to make an investment, and after several surveys, they would have a kind of market consensus or market sentiment to know what is the rough cost of equity […].

In addition, participant 6, who is employed at a project developer, provided insights into the *transaction-based market sounding approach*:

By selling projects on a regular basis, we can, so to speak, calculate [discount rates] implicitly from the investors' feedback on prices. […] we compare the offers, the hard numbers, so then we can say, okay, […] the prices were suddenly so much higher and that is not only with the one project, but that has been found in the last three projects.

As such, project developers do not base their required return rates on theoretical concepts, as participant 1 explained. In addition, project developers do not set return rates and apply IRRs as capital budgeting techniques for their own internal purpose, as participant 5 elaborated. They are only applied for transaction purposes to have the same communication bases as the acquirers (see section 5.3.3.2).

On the acquisition side, institutional investors also set the required return rates in relation to the market conditions. This process starts by evaluating past transactions, particularly those where offers have been submitted and combined—where necessary—with an interactive process between investors and market conditions to align return rate expectations, if possible (participant 8). Similarly, other market participants apply a benchmarking analysis based on the many, previously screened projects with similar characteristics to those of the new project (participant 9).

Funds often seem to apply the *exit strategy approach in setting return rates*. This approach is also based on a thorough understanding of this specific market, as participant 3 clearly explained:

Important is that a project can be resold from my point of view, and it does not matter whether I am the final operator or not, but I must valuate the project so that I could sell it if I wanted to. And therefore, I need to know what the market offers and then adjust the discount rate again. […] I do not want to make it specific to the company now, but in principle [..] I'd just use a rating or an IRR where I know if I wanted I could sell it again. […] It is important […] to know: 'What does the market offer? At what discount rate can I resell it or at what price can I resell it?'

Such an exit strategy approach in setting return rates can be found in similar variations within many funds that either have a fixed life span or have to be flexible enough if some of their investors withdraw their money. These considerations were encountered in utilities or in investor types.

Another market sounding approach in order to define an RADR was explained by participant 12, as outlined below in section 5.3.5.6.

5.3.5.5 Hurdle Rates

A hurdle rate is stated to be either a minimum discount rate for future acquisitions or a benchmarking or reference value for the applied discount rate (Appendix 11, Table 64). Following an IRR approach, this calculated IRR is compared to the set hurdle rate, whereas in the case of an NPV approach, for example, for impairment tests, the hurdle rate is applied as a discount rate. As a foundation, valuation input data must be standardised to enable a consistent comparison (section 5.3.2). There were various companies that set hurdle rates for different company divisions (participants 1, 3, 9, and 11) and only one company that did not define hurdle rates, but defined the RADR, which considers project-specific risk components (participant 9) (section 5.3.5.6). Moreover, some participants reported the application of both (participants 7 and 12).

The IRR-hurdle-rate comparison approach is also useful for computing different valuation scenarios, as participant 9 pointed out:

> *I have a hurdle rate, and I'm looking for an IRR that is higher than the hurdle rate—and then I also evaluate how IRR behaves in different scenarios [in relation to the hurdle rate].*

In any case, setting specific hurdle rates and adhering to them is a topic almost solely considered by investors (participants 1, 3, 8, 9, 11, 12, 15, and 16), and rather not for those who only sell RES-E projects. Having said that, in general, setting hurdle rates is irrelevant for project developers, since the use of return rates is only a tool to communicate with potential acquirers, as outlined by participants 5 and 6. That is, the majority of the participants involved in acquisitions reported the application of hurdle rates.

One participant (no. 8) did not use the term ‘hurdle rate’. However, similarly, the fund manager talked about specific return rate requirements set in relation to specific technologies and markets that are defined by the fund’s investors. This can also be regarded as a sort of hurdle rate in the wider sense, since the set return rates are applied to a group of investment objects and not only to one specific project.

However, hurdle rates must not be understood as a hard cut-off line that is absolutely set in stone, as outlined by several participants. Participant 9 pointed out that there are circumstance in which to go lower than the set hurdle rate if specific arguments for having considerable low project risks can be presented:

> *[..] if you want to go below this, you must be able to justify it well. It can be that there is a great and nice project with an extremely stable developer, super technology, and so on in a market that one typically classifies as rather risky. […] And then you can argue that […] the risk [involved in the project] is closer to a market that we typically classify as less risky.*

This approach was also explained by participant 15, who stressed the application of professional experiences and judgmental consideration within the valuation, in addition to quantifiable facts, as an advantage to the existing portfolio (section 5.3.4.4), such as less risk in the future and possible opportunities:

> *The project has to fit very well and we also have to come to the conclusion […] intuitively we think that there might be an upside. So maybe not only from the point of feelings, but we also really consider that […] from [a] regional point of view, for example, from the perspective of market value factors.*

As already elaborated as advantages for the IRR method, compared to the NPV approach in section 5.3.3.2, the applied discount rate, the equity IRR, is the optimal parameter to be used for comparison with the set hurdle rate, as several participants reported. Comparing the expected equity return to the set hurdle rate was also applied by participant 11, even if he focused the valuation primarily on the project return rate.

Having said that, participant 3 outlined the applied approach for making a positive investment decision as follows:

> *For me [it] is in principle the crucial point: the comparison […] of the hurdle rate, which we have talked about at the beginning, to [the] equity IRR or equity return rate. So, I check if the equity IRR is bigger than my hurdle rate.*

There was consensus within the group of participants who reported on how to apply hurdle rates in that they set the benchmark or the minimum rate to be compared with the equity return rate or equity IRR, and not the project return rate. However, the application of investment scenarios revealed that the project return rates are also sometimes compared to the set hurdle rates, in addition to the equity return rates, as participant 3 demonstrated.

Moreover, it can occur that hurdle rates are undercut due to the current competitive market conditions, i.e., some investors, particularly newcomers in the RES-E market, consider hurdle rates less and/or do not comply with them, in order to be able to acquire projects, as participant 11 outlined:

> *So I feel as tight as the goods are, yes, that people are very flexible with their hurdle rates […] Just as for the first investments, many people—let me say it like that—are willing to pay entrance fees, […] in order to be able to acquire a wind farm in the first place because they are, of course, not taken seriously as bidders within a transaction if they do not have wind farms at all, […] therefore specifically young bidders, young funds are ready at the beginning to very much concessions.*

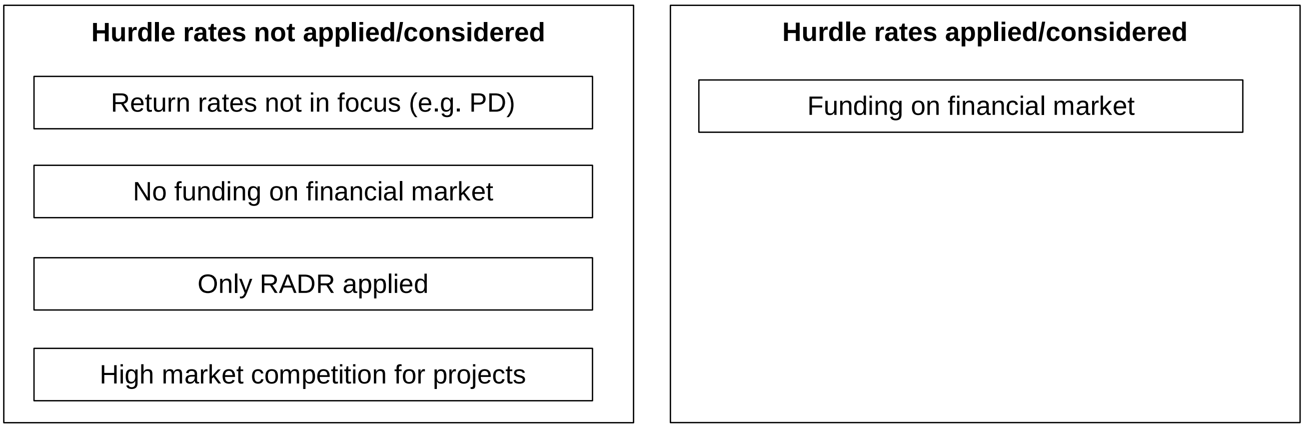
Sellers certainly take advantage of these behaviours and dynamics in the current sellers' market condition, making the prospect of acquiring decent, risk-return-balanced projects difficult, particularly in the current situation of having a sellers' market (see section 5.3.7.6).

However, there are market participants who do not seem to apply hurdle rates. Apart from the above-mentioned project developers who consider hurdle rates to be irrelevant, another possible explanation was found in funding capital. Participant 1 noted the relation between companies funding themselves on the financial market and setting hurdle rates:

If you are in a company that funds itself on the financial market, then you would define a hurdle rate internally for different business units, also for renewables, and would then have a requirement that would somehow be justified on the basis of market input data.

The presented reasons for applying or considering hurdle rates or not are summarised in Figure 49.

Figure 49: Reasons for and against applying/considering hurdle rates (PD: project developers).



Several participants reported having different hurdle rates, one for each country, technology, and some even by project stages. Additionally, two participants stated that they apply only one hurdle rate, while one of them said he was just working on distinguishing them in separate hurdle rates.

Setting the hurdle rates is based on the discussion about setting discount rates, either with the help of theoretical concepts or by performing a market sounding (sections 5.3.5.3 and 5.3.5.4). Another approach was added by participant 13, who stated that his applied single hurdle rate is based on the issued corporate bond.

5.3.5.6 Risk-Adjusted Discount Rate

The RADR was widely discussed in the literature (section 2.4.4.1). In accordance with the results of the QUAN phase, it is less often applied in RES-E investment valuation than the hurdle rate concept. However, the findings of the QUAL phase only presented three participants who applied and suggested the RADR: two of them apply it as a supplement to the set hurdle rates (participants 7 and 12), and one applied it solely (participant 9) and stated:

We look at regulatory risk in the sense of a credit risk analysis. So, we have a financial model that looks at a VaR, based on the country rating. […]

In order to include it in the pricing […]: What is so to speak the risk-adjusted IRR on this project? […] We apply this for country risks, but it also goes for corporate counterparty risks […], where we work with corporate PPAs [instead of lower risk FiT].

Participant 10 explained the application of the RADR in his own words:

> *There are […] experienced financial investors who come predominantly from […] the financial world and who define, I would say, regardless of their own group WACC, an individual discount rate […] for the particular project.*

As elaborated in section 5.3.5.3, unsystematic risk should be considered in valuation modelling, as suggested by participants 5 and 6, of whom the latter went a step further and suggested considering adjusting valuation models to consider specific unsystematic risk components to reach an adequate RADR. An alternative possibility to consider specific risk components is to adjust the cash flows to more conservative values, as suggested by several participants (2, 4, 5, 7, 8, and 15).

Furthermore, participant 12 explained his RADR approach, based on a market sounding and then adjusting the value with a specific project risk premium, which ensures both a risk-adjusted valuation and a market-adequate price for the project by being in close consultation with the market:

> *I guess I would orientate myself to the market, which is so 'base rate'. […] And then just add some extra surcharges if I see special risks or have a certain need somewhere in a particular project. I believe that would be the approach I would choose as a buyer, on the one hand, to come to projects at all and, on the other hand, also to take into account the specifics that I consider necessary.*

The reasons practitioners apply hurdle rates more often than the RADR were not answered in this phase. However, it can be speculated that hurdle rates are much simpler to define and therefore more suitable for practical applications, also in communicating the valuation results to the decision makers, and they are aligned in complying with financial market requirements. Defining solely project-specific discount rates for each valuated investment would be labour intensive and would not necessarily bring better investment success. However, applying hurdle rates in general and combining them with project-specific risk-adjusted return rates could be valuable.

5.3.5.7 Static to Dynamic Discount Rates

As elaborated above, the static discount rate is the predominately applied method within the simplistic DCF-based approach (see section 5.3.3.3). However, there were indications from practitioners that different discount rates are applied for specific distinct periods. Participant 2 saw the application of different discount rates for FiT periods and the subsequent periods with only market prices by one of its advised investors. Similarly, participant 5 applied different discount rates several times for the leverage period and unleveraged period as a specific scenario analysis. This scenario analysis convincingly demonstrates the possibility of attracting different types of investors for different periods, depending on the corresponding risk involved, as the following interview conversation indicated:

> Participant: *So, we have also looked at such an approach, but we do not use as a standard. This is just for playing around: 'How does it affect the valuation?' And then dropped it again because it is not that tangible.*

> Interviewer: *Okay. […] then it is more likely that there is [a] higher discount rate in the first phase, and a lower one at the end of the project. […]*
>
> Participant: *Exactly. […], in most approaches it blurs or does not matter. But […] it is perhaps quite interesting to look at […] a project after x years in operation. If one believes that the wind can be confirmed, it could then even be sold to, for example, an all-equity investor. […] And when comparing the all-equity investor [to other investor types] in the very first year, he still has to compete with an equity investor who takes 80% of the most favourable debt and invests 20% equity. […] In the last 10 years, however, he is competing with someone who may have only 60 or 50% leverage in relation to the investment budget, and something like that is better if you apply the levered beta […]*

Having said that, the CAPM with a levered beta is appropriate for application to projects with wind or other natural resources with many-year-long production experience and hence low resource uncertainties.

In addition to considering different periods within those long-term horizon projects, the relevance of ‘duration’ as specific risk component is outlined in section 5.3.6.3.

However, when choosing the most appropriate discount rates in relation to the involved financing policy, the findings demonstrated that no participant suggested using the propagated dynamic discount rates for different valuation periods instead of constant discount rates for the complete valuation period. This is contradictory to financial theory, which suggests applying a dynamic discount rate in the case of valuations of autonomous financed projects—in contrast to projects with value-oriented financing policies—to receive consistent results (section 2.4.2.1). This indicates a clear gap between theory and practice. This finding consequently demonstrated that the simplistic DCF-based approaches with a constant discount rate are clearly predominantly applied in practice. Moreover, none of the participants reported this point as a particular issue or discussed the application of constant or dynamic discount rates.

5.3.6 Risk Considerations in Valuation

Considerations about how risk is handled and managed in valuation processes is discussed in this section (Appendix 11 Table 65).

5.3.6.1 Risk Mitigation

Project standardisation influences the way in which risk is mitigated. This is also influenced by implementing project financing and necessary structures, as required by banks and as participant 15 pointed out for the example of wind onshore projects, which leads to standardisation of risk mitigation measures:

[…] for wind [onshore projects], it is actually relatively clear because in the normal case the bank already requires a lot, for example, a full maintenance contract. […] In the normal case, this must exist and […] then we do not have to make more strict rules.

As such, certain risks are then already included in valuation, particularly in the cash flows, and do not have to be considered separately, qualitatively, or within the discount rates (section 5.3.6.2).

All participants implemented risk mitigation measures, mentioning various risk mitigation approaches, such as full-maintenance contracts, insurances, implemented managements contracts and surveillance and monitoring of the operation, longer periods of fixed interest rates, and debt reserve accounts to bridge lower liquidity periods. They also implemented a DD process, FiT in contrast to volatile market prices, most contracts and their costs are fixed over the whole period, representation and warranties in share purchase agreements (SPAs), earn-out models in SPAs to offset lower natural resources and subsequently purchase prices, for example, based on real yield assessments with production data.

The implementation of risk mitigation measures is a particular task when negotiating the SPAs, including clauses about representations and warranties and specific earn-out models, in order to shift as much risk as possible to the counterparty in transactions, as participant 7 explained:

Mitigating [risk in valuation and transactions] is about trying to distribute as many risks as possible to the seller or the counterparty, […] based on guarantees [or] earn-outs. There is a whole range of different possibilities which one can install in the contract. […] we place a great value on the design of [share purchasing] contracts, [including] reps and warrants [and] earn-out. This is usually a relative time-intensive topic for us.

Risk mitigation is regarded as beneficial within projects for valuation purposes because it enables better planning, and it helps to decrease the complexity within valuation by providing long-term cost reliability for certain components, which participant 5 outlined:

[Risk mitigation] measures, such as full maintenance contracts, have advantages and disadvantages for the valuation, so they make it clearly easier for the person who evaluates because he does not have to make an assumption, but can [just] assume a price over the entire term […].

However, risk mitigation also decreases the chance to benefit from available opportunities.

Participant 10 pointed out that there is no scientific approach for how risk mitigation measures are considered in valuation approaches and risk assessments. It is probably again, to a large extent, a judgmental approach when considering risk mitigation and performing valuation.

Many of the cost factors […] are anyway insured by the full maintenance contract or insurance […] but [can] it [be] scientifically calculated in a DCF or in a sensitivity [analysis]? […] rather not.

And not all applied risk mitigation measures with valuations and transactions are unproblematic, even if they can be integrated into the DCF-based methods. Participant 8 experienced issues with implemented earn-out models, originally regarded as beneficial as risk mitigation measures and the DCF-compatible method while ensuring a successful close of a transaction, which later turned out to be the root cause of intensive discussions between sellers and acquirers:

> *Yield assessments based on real production data [in German, 'Realertragsgutachten'] are not necessarily easy [within transactions] because we have made, for example, the experience that the perspective on certain valuation methods [i.e., an earn-out[71] model], which are defined in the contract at the time of signature [and] which the wind resource assessment expert [in German, 'Windgutachter'] has to execute in one and a half or two years to come […], are themselves subject to changes. In other words, we have today a lot more and very different indicators for such a valuation than two, three, four, five years ago, and we have experienced cases where we were in discussion with the seller [while executing the SPA] about a [defined] yield assessment based on real production data because the resource assessment expert suddenly himself writes [that] he comes to a certain result according to the established criteria, but he considers this [result] from today's point of view of science as wrong. […] And then it gets difficult.*

5.3.6.2 Valuation Adjustments for Risk

With regard to the mainly applied DCF-based methods, risk can be considered to be discounted either in the cash flow projection or in the discount rate itself (section 2.4.1).

Many participants clearly demonstrated that the focus on the quality of cash flow projections is crucial for the valuation, since these present the fundament of the DCF-based methods, as participant 2 explained:

> *As with any DCF-based analysis [and with regard to literature] in corporate finance […], one can spend a lot of time [researching] how to set a discount rate. […] there is the capital asset pricing method, and you can be extremely concentrated on intellectually studying this. But in the end, the quality of the cash flows is actually decisive. This means that the fundamentals of the [considered] investment have to be right, that is […] that all aspects that influence the cash flow are solid […]. And that is often forgotten, […] maybe not necessarily forgotten, but it is made a bit sloppy in certain cases […].*

Participant 7 added that after considering all risk mitigation measures, all remaining, individual risks that the business needed to be taken into account are considered as much as possible within the cash flows and not within the discount rates:

> *If there are now specific or individual risks, then we try to simulate them actually within the business case […]*
>
> *[…] if we now have a project with extremely high risks, we are then adding some cost premiums for this risk [to the cash flows] during the valuation of the project. [As such,] we*

refer to the individual cash flows, [and] we cannot use […] a higher WACC [i.e., hurdle rate] or directly consider the risks in the WACC [i.e., hurdle rate] […]

[or even] pass on the risk [to the counterparties] via the contracts; then, depending on that, I do not have to consider anything in the cash flows.

All other participants did not display any specific preference for either one of the two main adjustment possibilities for risk, in general, in DCF-based methods. It probably depends on the considered risk component.

5.3.6.3 Risk Components

As demonstrated within the discussion of the investment scenarios (section 5.3.1), the natural resources, such as wind, sun, and water, and the corresponding energy conversion into production output are both considered as key input data for RES-E project valuation. As input data under considerable risk, i.e., both threats and opportunities, natural resources are some of the main value drivers in all RES-E projects (section 5.5.1). Therefore, they are always taken into account when discussing risk considerations in the valuation and diversification of unsystematic risk.

The relevance of natural resources as major value drivers was also made clear with the following episode, reported by participant 7:

A small episode: The external auditors came [to us] when the Euro-Swiss France linkage was offset [on January 15, 2015 by the national bank of Switzerland]. And I said, 'Hey, what does it matter in our case? What is at risk in our business?' In the end, the wind, a year wind like today is much more than cancelling the linkage of the euro exchange rate to the Swiss franc.

As outlined by the literature in finance theory (section 2.2.5), the participants differentiated between *systematic risk*, i.e., the project-independent, market-specific risk, and its counterpart, un*systematic risk*Table 65). Unsystematic risk can be diversified, and therein lies the potential and the attractiveness of RES-E project investments, as participant 9 outlined:

The unsystematic […] risks are an advantage because we can diversify them nicely. One cannot diversify anywhere as well as with random risk profiles […]. And wind or sun are randomly distributed. […] For the most part. And then one can achieve geographic diversification and […] technology diversification, so to speak portfolio diversifications, which greatly reduce the risk. And that's what we do.

Even if the unsystematic risk can be diversified, the volatility of natural resources is still regarded as relevant within the valuation of RES-E projects, since it is the key equity driver. It cannot be ignored, as participant 3 pointed out:

[…] there are always investors who say, 'I do not consider such unsystematic risk factors because I have invested enough', but I think with such investments it is [still] very decisive.

More on risk diversification is presented below in section 5.3.7.1.

This unsystematic risk can also not be ignored due to potential errors done by resource assessment experts, as participant 5 pointed out:

> *Namely, that he [the resource assessment expert] has failed in the methodology, [for example,] that the expert has applied the wrong long-term prognosis […].*

As reported in the resource assessment, considering natural resource risks based on standard deviation in cash flow projection is already a challenging venture. However, this information does not tell us anything about the variability of natural resources from one year to another. This circumstance is usually ignored, particularly when considering the forecasted average production output (the so-called P50 value)[69] in the base case valuation scenario without any deductions for risk. This variability can however have a major influence on valuation, as participant 7 highlighted:

> *So, we have modelled this [i.e., variability of natural resources from year to year]. This 10% [deviation] plus and minus, which one [usually] assumes simply on the whole period. […] If you now say […] the first half [of the project period] is minus 10% and the second half is plus 10%, that makes up more than 1% less of the return.*

Participant 5 also described this phenomenon when separating risk about natural resources in time-variant and time-invariant parts:

> *[…] we say time-invariant risks and time-variant risks, and the time-variant risks are the ones that also diversify over time. Considering my risk in one single year, the volatility of the wind is not so small. This can, as you can see also in the wind index, be plus 10% or minus 10% […] Over 10 years [however], this is diversified and has an amount of perhaps 2 or 3%, not more. That is, the wind risk, what you have in the wind assessment […] is indeed a mixture of the systematic [and unsystematic] risk in the wind.*

Furthermore, there were no findings regarding whether the participants distinguished between risk and uncertainty and hence about the awareness of latent uncertainties in practice, as the literature suggests (section 2.2.1). Most participants used uncertainty and risk as interchangeable terms. However, one participant (no. 10) mentioned risks that are not known at all or that cannot be quantified, even though he did not distinguish them with separate terms.

> *But at the same time, there are […] other risks that you do not know yet, right?*

Participant 1 mentions the aspect of ‘duration’ in risk assessments, as a major influence factor on setting discount rates. He states that in valuation of RES-E projects,

> *[…] it is assumed that the risks remain constant over the entire term [of such long-term horizon projects] which is de facto not the case […].*

although that many risk components are deliberately fixed for much of the whole duration of the project. In case of operating RES-E projects, this long-term hedging particularly includes systematic risk components with regard to the variability of the cash flows, such as with fixed electricity selling prices with FiTs and PPAs and with fixed interest rates. Only one participant (no. 8) discusses the issue of changing risk-free rate as basis for future variations of the discount rate which is however ignored by the market.

5.3.6.4 Risk Assessments

All participants apply risk assessments within RES-E investment project valuations with scenario and/or sensitivity analyses, while some apply formal risk assessments, including numerical and judgmental input factors (section 5.3.4.1). Discussing the investment scenario, participants 5 and 10 revealed the disadvantages of these risk assessment methods regarding an objective approach to defining scenario cases and assigning the corresponding probability to these cases to provide both risk dimensions, as the literature suggests (section 2.3.1) and as noted by participant 10:

> *But how to get the best case [or] worst case? I find that difficult, and I hardly see […] a [objective] methodology for this. […]*
>
> *This scenario analysis, how likely is any scenario case, right? […] How likely is this case, you cannot see it here.*

Moreover, only a few participants applied simulations to assess the involved risk. Participant 10 pointed out the unsuitability of presenting simulation outcomes, such as from Monte-Carlo simulations, to many decision makers due to their lack of understanding;

> *Imagine [that] you are going to the board of directors and say we have done a Monte-Carlo simulation, I mean, a Mr. XXX [a specific member of the board of directors] would not want to discuss it. I would not like to present that [i.e., outcomes of the Monte-Carlo simulations].*

Another assessment about risk concerns the strength of the distribution to the equity holders of the considered company and project. While the above mentioned PB (section 5.3.3.8) and output IRR or output NPV (section 5.3.3.4) are numerical approaches that consider this perspective, participant 1 proposed additionally a corresponding, more qualitative approach with a graphic representation of the results. It is a plotted distribution profile or a cash waterfall, deduced from a diagram illustrating each type of cash flow stream in each period, as generated free cash flow in the project and/or as cash flow to be distributed to debt and equity providers:

> *What could be shown [within this perspective] are the parameters from the banking perspective […]. So, the bank is mainly interested in the fact that the debt service coverage ratios [DSCR] are complied with, and perhaps one could use a diagram, which I also like to apply […], to evaluate the cash flows over the project lifetime, graphically […]. And then you can see, 'How much of this is operating costs, and how does it develop over time? How much are taxes to be paid? How much of it is interest, repayments, and what is the actual resulting equity cash flow?' […] these are considerations that are also seen often in banking models […]: 'How is the cash flow actually used in percentage with regard to [the cash] waterfall concept for the individual positions to be served?' […] [if] the DSCRs are always tight, it of*

course leads to the fact that the distributions become uncertain. The more leverage is contracted and the more reserves are required [by the bank for a higher leverage], the riskier is, of course, the annual distribution [to the equity holder] if there is a bad wind year.

5.3.6.5 Understanding Risk and Risk Preferences

Participant 8 explained why his investment vehicle only considers downside risks for his investors, which influences their risk attitude and their grade of risk aversion (section 5.3.7.1):

[…] we are also using DCF for the valuation, and in addition, we also look at the risk structure; since we are investing for a very conservative, risk-averse audience, we focus only on the downside risks for the given return rates. The upside potential is of less interest to us, but we try to make the downside risk as visible as possible in the form of risk bands. And when we see surprises there, then we decide against the investment.

Similarly, participant 13 explained the applied risk attitude in valuation, a clear risk-aversion, in relation to possible opportunities:

[…] we would rather forego a chance, but have less risk.

Different perspectives on risk and different risk preferences are also encountered between sellers and acquirers, and they can influence the valuation of RES-E investment projects significantly, as participant 5 experienced:

[…] there are circumstances when we think that some investors value some project risks somehow too negatively or vice versa, so that we naturally have a preference to keep the project where we see it more positively than the investor. However, this rarely occurs. Most of the time, it is more a strategic consideration of which projects are valuated and sold.

This different risk preferences are also the basis for defining different risk-return profiles (section 5.3.7.1).

The risk appetite (section 5.3.7.1) is defined by the board of directors and its executive management, as participants 14 and 16 stated. Participant 16 explained the internal process of defining the investment focus based on the investor's risk appetite:

We did not want to go into the development risk at the beginning […] we have done [our earliest] signing with the presentation of the building permit, but have finally acquired the project with commissioning. [Later,] we have thought of entering into the development phase, but we have not made this step.

With regard to the topic of the discount rate compensating for taking a risk, participant 5 pointed out that this is only correct for the still available risks at the time of view and not for those investors who have already participated before:

In our view, [the discount rate does not compensate for taking risk] because the discount factor that we use for the project valuation is […] the one that is on the market […] and we

> *can have started the project five years ago at a time when it was not clear whether the new government was still promoting renewables or not. […] The risk was [at that time] super high. […] And now we have, five years later, a great law and the returns, and all have money and therefore the returns are good, or it can be exactly the opposite. […] But it has nothing to do with what has developed during this period. The discount factor at the time of sale is the discount factor of all the risks that still exist. […] Our investment, our risk of what we did [as project developers] was in the phase up to the date of sale. […] That is, the discount factor from our valuation scenarios, which is mostly the one […] for investors, […] the discount factor is a charge for the remaining wind risks or risk of revenue, interest rate risks, unstated cost risks, or even opportunities through changes, of course, both directions, but everything that can still happen in the operating phase, which from our point of view is honestly not that great, compared to the previous risks, namely resource risk and tariff mechanism, as main parameters. […] We normally take all risks ourselves until commissioning. […] That is, our remuneration is then the contribution margin. But there are so many external factors that influence that [i.e., the contribution margin] that one cannot always say that this corresponds to the risk, but there can also be bad luck.*

5.3.6.6 Explanations for Puzzling QUAN Result

A particular focus was placed on trying to identify explanations for the puzzling QUAN result regarding the assessed level of risk components in relation to project stages (section 5.2.2.1). Several participants provided similar explanations, and the quote of participant 5 represented the answers of the others:

> *Yes, I can explain that. If I have three risks, say, wind risk, inflation risk, and cost risk, at commissioning date, then the wind risk is the biggest. If I have in the developmental phase the risk of having local opposition against my permit, I do not know if the government is stable and the law will maybe change in two years, […] And that means, I do not believe that the absolute wind component is much more important or unimportant in the sense, just the comparisons, what other risks do you have at what time. […] but you just have the other risks that still exist.*

Therefore, the QUAN results of the risk component assessment in relation to the different project stages must be understood as a comparison of the considered risk component to other relevant risk components in the concerned project stage. In other words, the relevance of a considered risk component (for example, natural resources) can change due to eliminations of other risk components from one stage of the project lifecycle to another (for example, from a greenfield to a ready-to-build phase), even if the relevance of the considered risk component should stay equal.

5.3.7 Influencing Factors in Valuation

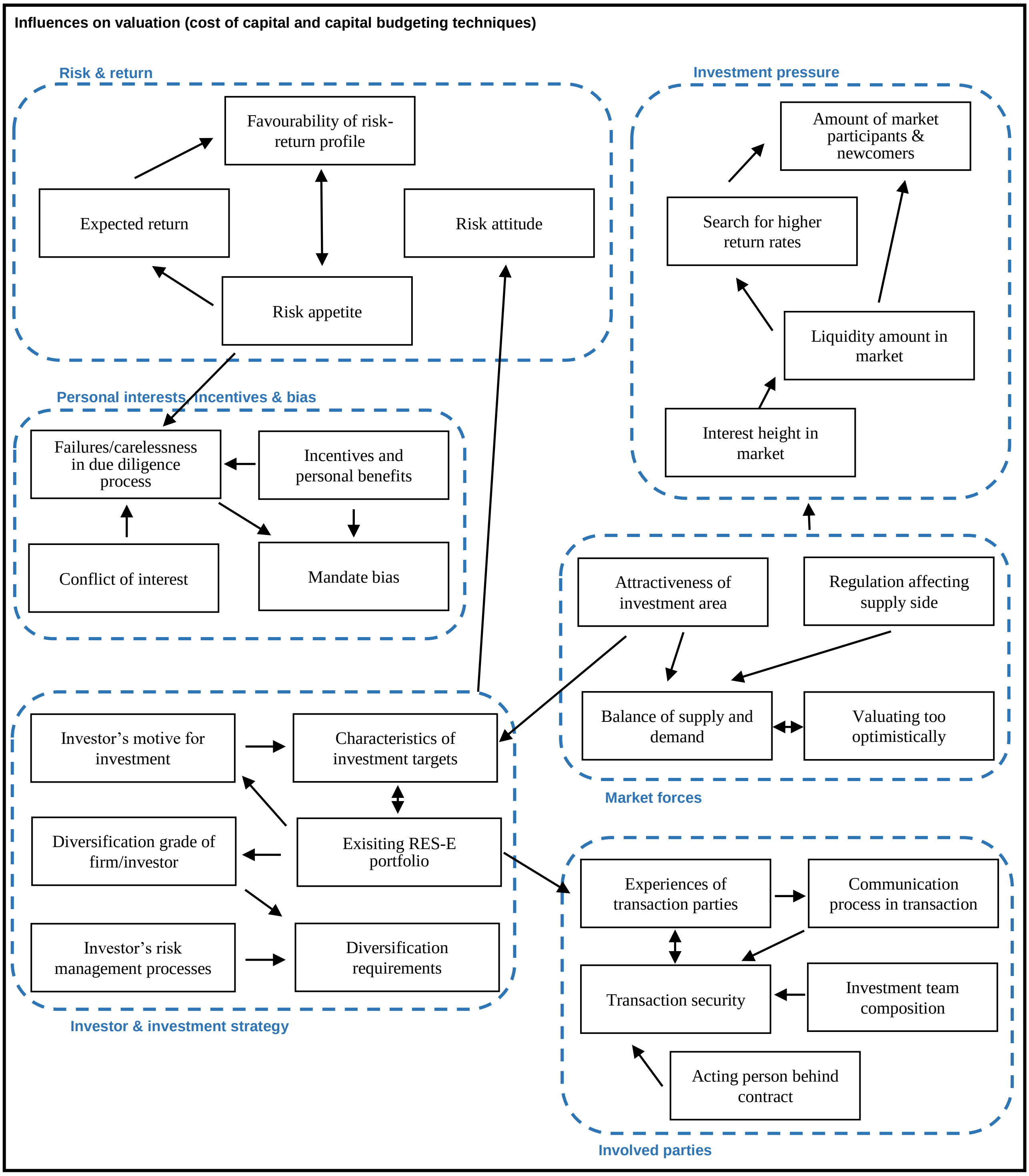
Based on the performed interviews, a wide variety of influencing factors on valuation and on investment decision-making processed in general were explicitly discussed and/or emerged from the analysed patterns (Appendix 11, Table 66). The found general factors influencing valuation processes in the QUAL phase are then presented in a concept map (Figure 50). Thereafter, the subsequent subsections provide corresponding details and a discussion about the findings.

5.3.7.1 Risk and Return

As elaborated in section 5.3.5.4, risk and return and therefore risk of the cash flows and corresponding required return rates corresponding to these risky cash flows must match each other; in other words, they must be traded off against one another. However, there are certain additional factors that influence the pair or one of the two and consequently the valuation:

- Risk attitude—the risk attitude, particularly the typical found risk aversion and the magnitude of such a risk aversion of the investment team and investing company, is an essential influencing factor for valuating investments (participants 6, 8, and 13). This found risk attitude was also supported by the literature (section 2.2.3), demonstrating that most investors are risk averse and not risk neutral. High risk aversion can influence the risk perspective, such as to focus mainly or solely on downside risk, (participant 13), and no upside potential is considered at all (participant 8) (section 5.3.6.5).

Figure 50: General influence factors on valuation processes (capital budgeting processes and CoC approaches), illustrated in a concept map.



- Risk appetite—another concept about handling and managing risk is given with the risk appetite (section 2.2.3). It defines the investor's focus on specific investment targets with risk-return characteristics that match the set return rate requirements, as reported in section 5.3.6.5.
- Risk-return profiles—the risk appetite is also the basis for selecting and defining the preferred risk-return profiles for possible investments. This favourability of certain risk-return profiles has a considerable influence on the valuation, attracting new investors (section 5.3.7.3) and allowing the valuators to focus on specific (unsystematic) risk components that can be optimally diversified (participant 9, section 5.3.6.3 and below). The interest of the risk-return profiles lies also in the (still) possible higher return rates and on the low correlation with financial markets, as reported by participant 6, based on a conversation with a fund manager of fixed-income assets:

  > *[…] he said: 'Wow, […], that [i.e., renewable energy] is actually a super asset class that I really need' because he fights just as the 1% [other markets and] he is happy about the return […]. [Within RES-E projects,] the only risk he would have is [….] actually in the end the risks within the projects [which are] very low, and not with project developers. […] consequently, also the 4% [for renewable energy projects] in the current market environment is still great [, particularly] compared to other investment opportunities that are likely to have a very, very different risk profile.*

  On the other hand, risk-return profiles are not always understood the same way between different investors and between sellers and buyers. Participant 5 encountered a situation in which investors considered the risk of a certain RES-E project higher than the seller (section 5.3.6.5). The consequence was that the seller kept the investment, since it could only be sold under value in his perspective.
- Risk diversification—this was applied by almost all participants to a greater or lesser extent. As reported above by participant 9, volume-related weather risk, which is considered to be both the main risk component of RES-E projects and unsystematic risk, can be optimally diversified. This forms the basis for building a diversified portfolio with low correlation to market risks. This perspective and strategy can have a profound influence on the required CoC. Such a diversification strategy also depends on the type of investors and the amount of capital invested or to be invested, as participant 15 pointed out:

  > *So they [i.e., investors with large amount of invested capital in the RES-E sector] diversify the diversifiable risks [i.e., unsystematic risks] to make them practically zero. […] They have only the market risks [of the invested country]. The rest gets erased. […]*

  Furthermore, he agreed that other, less solvent investors cannot diversify as much as those investors with large investment tickets in this area can reach.

5.3.7.2 Investment Pressure

The investment pressure of the individual investors is one of the main factors impacting valuation within the current situation of the financial market (see section 5.3.7.3) and the current RES-E investment market.

- This is caused by the high liquidity in the market (participants 2 and 6) due to the low general interest rates. It is also caused by many investors searching for higher return rates with acceptable risk-return profiles due to the lack of attractive investment opportunities in the financial market in the current situation with low interest rates and hence low overall return rates (participants 6 and 11). Many investors have found the RES-E project market to be an alternative, attractive investment market with its generally low correlation with the financial markets and favourable risk-return profiles (section 5.3.7.1), particularly those with countries with FiT.
- A second reason is given by the market entrance of the young investment vehicles, which have collected much liquidity and are now forced to invest, as also elaborated in section 5.3.5.5. In the experience of sellers (participant 6) and consultants (participants 2, 10, and 11), such newcomers often disregard some risk components and/or accept lower return rates just to be able to invest liquidity and present their success story. Therefore, they were named *juvenile investors* herein. Participant 11 outlined this:

  > *Just as for the first investments, many people are willing to pay, I call this for the moment, entrance fee […] to be able to acquire a wind farm because they are, of course, not taken seriously as bidders on a transaction if they do not have any wind farms at all. […] Therefore, particularly young bidders, young funds, are at the beginning ready to very much make concessions.*

This currently encountered high investment pressure in the RES-E investment market also has a direct influence on the general market forces, as discussed in the following section.

5.3.7.3 Market Forces

The interaction with the market provides a major challenging influence factor on calculating a value and negotiating a price (section 5.3.1) due to the market forces, which are influenced by the balance of demand and supply in the market, as participant 1 pointed out:

> *[…] I think that this is one of the biggest challenges, since it [i.e., valuation and pricing] is ultimately […] always about bringing supply and demand together.*

A misbalance in the market can result in either a seller's or a buyer's market. The specifically encountered market forces are co-influenced by many of the previously mentioned points about the attractiveness of the RES-E investment area and the high liquidity in the market (section 5.3.7.2). There are also some additional, specific factors that were revealed in the interviews:

- The current supply and demand balance in the researched market is impacted by a misbalance between both sides. On the one hand, there is a particularly high demand for RES-E projects due to the entrance of new participants attracted by the favourable risk-return profile, and the search of many investors for attractive fixed-income investments (sections 5.3.7.1 and 5.3.7.2) and of many utilities to secure favourable RES-E production sites (participant 16). On the other hand, there are not enough attractive RES-E projects on the supply side, particularly due to introduced auction processes for FIT in many countries with fixed quotas for the total amount of capacity to be built, which is overdrawn by the larger amount of projects (participant 14). In some cases, this results in the overvaluation of certain investments, since an investor who is willing to pay more to win the contract for the project can often be found, particularly in this situation with excessive liquidity to invest. Participant 6 expressed the opinion that, in the current market situation, the return rate is not an indicator of the involved risk in RES-E investment projects:

  > *In my opinion, however, this [i.e., relationship between return and risk] is not the case […], but I believe that the requirements for the return on equity are driven by the high liquidity [in the market]—in other words, this encountered investment pressure and missing alternative [attractive] investments in the market.*

  Apart from the adjustment of the return rate requirement, the market forces also seem to influence the considered certainty level within the cash flows, as participant 6 also encountered for the assumption of the wind resources:

  > *In the past years, I had taken […] P75 as the banking case and P65 as the investor case. And now it seems to be encountered not only in the equity return requirements, but also in terms of the so-to-speak 'What security does my cash flow take into account?' how much pressure the investors have.*

- Moreover, in certain cases, valuation processes are 'pimped' by considering highly optimistic input data, such as high-power market curves. For this reason, there always seems to be an investor who is prepared to pay higher prices, as participant 16 noted:

  > *So we know that certain people after 20 years […] somehow consider 120 euros per MWh [as the market power price]. And we just do not see this as adequate. But […] you also find someone who does this. […] And especially in France with only a 15-year [-long feed-in tariff], this has quite an impact on the valuation.*

- Those market forces are checked with specific market communication by submitting periodically non-binding offers to win the bid or, if not, then to check the market and receive information about the final acquisition prices (participants 6 and 15).

- The market forces lead investors to rethink the current valuation processes, for example, by reducing return rate requirements while more intensely scrutinising certain input parameters, as participant 15 outlined:

The basic problem is that projects cannot be acquired with the classic IRR models [anymore]. So you have to somehow look at the whole system differently and go to other benchmarks. So, two years ago, the values that we used […] with which, today, you do not win a single project, so at least in the countries with FiT. In those [countries] with market prices, it looks different, since it [i.e., the classic IRR model] still works a bit. [In the FiT countries], the targeted return rates […] are to be revised, and if you define new target return rates that are much deeper, then you have to somehow differently support it [i.e. the project valuation] in order to justify it. Hence, this [calculated] value alone is not sufficient anymore. A deeper analysis is necessary. […] So, we try to listen to certain parameters even more precisely. […] So, an example is cash flow. So far […] we have looked at if it is true, but we could also focus much more on that matter: […] Do I really have cash flows or even distributable profits? And do not only look at the return rates [from fee cash flows within the project], but what is really distributed in the next, I say now, five years or 10. […] If I earn something in the first 10 years, then it can already be good […] As such, I may accept less return on investment—that's a little bit about our reflection, that's not standard yet. But we are really now diving fully into this discussion on how we should adjust [the valuation processes].

This explanation is also the basis of this study to collect and provide additional possibilities on how to improve valuation, as outlined in more detail in section 5.4.5.

- New regulations also have a profound influence on market forces, as currently experienced in several countries, by introducing more market schemes for installing RES-E projects (for example, in Germany with bidding processes) (participant 14).

5.3.7.4 Involved Parties—Experiences and Communication Process in Transactions

The following influence factors on valuation were found in relation to the involved parties in a transaction:

- The experiences of the parties in transactions are key factors in valuation to reach better, more profound, and faster results, which can also lead to lower costs:

  One must be able to estimate how reliable the numbers are. And especially in [the] case of wind studies, this is a decisive factor. […] On the other hand, it is also a pure cost factor. If I can analyse more quickly, the company has less expenditure, […] these are simple, essential experiences, I believe.

  The learning curve is essential in RES-E project valuation, as participant 2 outlined with regard to newcomers in the market:

  Then another effect I see is […] learning-curve-based. Newcomers who buy a wind farm in France for the first time are perhaps a little too positive in the valuation at the beginning, because they are just a bit in the transaction rush. […] : And then they learn *from their second investment and adapt their criteria. This can be seen actually everywhere, those beginner errors, which are made in various respects and then corrected logically afterwards.*

- Transaction security and the smoothness of transactions are essential points for both sides—sellers and acquirers—to ensure efficient and effective transactions. Therefore, both sides usually prefer standardised recurring transactions between the same involved parties, since many points are known from previous transactions and do not have to be performed again. This reduces the involved resources and the usage of the DD results of previous projects, and it involves generally lower risk and correspondingly lower return rates, and therefore leads in the end to lower costs. These findings were outlined by participant 5:

  It is partially also a standardisation of businesses possible […] as such, with each single project, we […] try not to start from the beginning, but we try to build on existing structures. We have experienced this both with banks and investors: how much differences in transactions exist, if you know each other from past transactions or not.

  and participant 15:

  [Knowing each other from previous transactions], the risk assessment is actually given by the projects we know, in which we work together with partners [whom] we believe basically suggest fundamentally good projects. […] So, because we know the partners because they are also well-known developers, we assume that the [suggested] project is actually coming along with generally few risks, and the rest is checked in the DD process. […]

- The acting persons behind contracts, particularly for operating services, are also essential influence factors for valuation. They make up a qualitative input factor, which is assessed judgementally. However, it is sometimes less well considered in valuation processes, as participant 11 outlined:

  And the most favourable contract […] with the best IRR […] will not help you if the results from the DD process show that their operating managers are not good from a commercial point of view, do not understand your questions, the answers they deliver are bad, and you realise that the persons are simply unqualified.

  In addition, participant 16 highlighted the difference in the quality of maintenance teams in various countries and areas, even from the same maintenance and manufacturing company and based on the same contract:

  Full maintenance contracts: […]. Which provider is it? How good is he? There are, for example, very large differences among manufacturers between countries. So, if the one manufacturer in country A has a very good maintenance, it does not mean that he has the best in country B or vice versa. And that is why you have to look at how much you are willing to pay for it.

- In terms of communication processes in transactions, information asymmetry between the seller and acquirer influences the valuation process profoundly, since the quality of the input parameters, which are typically checked by the DD team, is crucial for the valuation model. Participant 12 stated the dilemma regarding the optimal valuation method and available information as follows:

  [The optimal valuation method] is more likely a function of how exactly I calculate the whole. That means, how well I choose […] or also how well I know the input parameters for the calculation. But, always the same challenge is involved: you always encounter information asymmetries in the market.

5.3.7.5 Personal Interest, Incentives, and Biases

Since individuals themselves are a major source of influence in valuation, they are separately discussed, even though they are also related to the previously discussed topics about the involved parties (section 5.3.7.4) and risk attitudes (section 5.3.7.1):

- The individual interest of the involved persons or teams in acquisitions has a definite influence on the valuation due to, for example, a positive or negative attitude about the investment country, the project developer, the seller, or other involved parties, as participant 2 explained:

  […] in the end, [an investment] decision is not only made on the basis of the proposal and the fundamental analysis, but it is somehow also a mixture of people who follow a process and all have their own individual interests somehow […]. This is an aspect that one should not underestimate. […] It may well be that someone finds: 'Oh, a wind farm in France? Super', while being somehow already biased, having a positive attitude and then [subsequently] classifying certain things—which are, in general, classified as more critical at a different wind farm or opportunity […]—[in this particular case] as less critically, simply because someone likes the idea of a wind farm in France from a qualitative point of view. […] And these are aspects that I see almost everywhere.

  He also added that the set target brings along an adjusted, more positivistic perspective in order to better reach the set target:

  […] we are back with […] these biases, if one has to deal with a financial fund, which has collected 150 million [of certain currency] and is under pressure to invest in one to two years. Due to this fact, he will then automatically put on a pair of positive glasses and may not want to look so closely at the things and prefers to keep ratings somewhere a little out of focus. [However,] the more light you get into the dark, the more transparent [is the process and] the less you can be blurred […].

- In addition, differences in individual interests are also encountered between teams involved in the acquisitions of RES-E projects within the same investing company due to a divergence in the set objectives, adopted perspectives, and provided incentives. Participant 16 outlined this dilemma about conflicting interests, which profoundly influence valuations, by illustrating that acquisition teams are interested in fast and reliable transactions and are vulnerable to making concessions concerning the operating phase (or they are careless or even fail in certain areas with lower focus)—in contrast to the interest of the asset management teams, which concentrate on improving the asset after acquisitions:

> *So in principle […] most of the acquisition teams are incentivised, whether it is financially or even personally, about how quickly they have fulfilled the order. And this is mostly about gigawatt or megawatt as power or production. There are also financial incentives in some cases that the budget is not fully utilised. […] you may be willing to decrease the purchase price while accepting long-term management contracts with service providers at non-market prices. Hence, the asset management will suffer then. […] instead of a three-year or five-year contract, a 10- or 15-year or 20-year contract was concluded at inflated prices just to make the acquisition price deeper.*

As demonstrated, this conflict of interest is also fuelled by diverging incentives and in the end obtained benefits, both influencing valuation in one way or another to be individually beneficial.

- Moreover, individual benefits are also the root causes of mandate bias, as participants 2 and 7 confirmed. Participant 7 explained it as follows:

> *I also have to point out that I have a certain bias depending on the mandate. So this is also always discussed in every mandate. […] So, if I am mandated by the buyer and the mandate relationship involves a success fee, then I have, whether I like it or not, I have somewhere inside of me a bias which sees things rather optimistically […] to a certain extent, because there is [always] a short-term and a long-term way of looking [at things],*

while participant 7 classified this issue within the realm of the typical principle-agent problem:

> *We do this with external consultants, and the external consultant […] wants to come as far as possible in the process, and this is then a principle-agent problem […].*

5.3.7.6 Investor and Investment Strategy

The investment strategy of the investors can have quite a distinct influence on valuation. The qualitative analysis revealed the following topics in relation to investment strategies:

- An investor's motive for investment—The *buy and hold* investment strategy, particularly characteristics for utilities that invest in attractive production sites for future production supply, provides value to projects with a low levelised cost of electricity (LCOE) affected by a lower FiT or prices in PPA (participants 1 and 14) and projects with sites to be used longer than the valuation period (participants 1, 10, and 4). Participant 3 explained that at the other end of the scale is the *buy and resell* strategy, which focuses on acquiring projects to be resold for a premium after a period of time and after having added particular value to the project, such as either developing, financing, and/or building the project or operating the project for a certain time period. In the latter scenario, the focus is on reselling the project for a higher value, primarily after having lowered project risks and therefore being able to resell the project with lower expected return rates (participant 3) or, in the case of operating projects, after having reduced the operating costs to receive higher free cash flows (participant 9). Both scenario approaches follow the above described exit strategy approach in setting return rates (section 5.3.5.4). There are many investment strategies between those two extremes that apply a combination of the reported elements to increase the value of the projects. These stated influence factors involve many qualitative considerations within valuation, and they are mainly based on experience and professional judgement.

- All participants described the characteristics of the target investments (for example, technology, types of suppliers, size of project, age of projects, and country) as key factors, which were highly apparent in the discussion of the investment scenarios (section 5.3.1) as well as in the DD processes (section 5.3.4.2).
- Diversification requirement and current diversification grade—The risk diversification of one of the main risks, namely the volume-related weather risk, has been discussed above in section 5.3.7.1. The majority of participants indicated a diversification requirement in performing investments and building an investment portfolio. However, this requirement does not seem to be directly considered in the valuation process itself. As discussed in section 2.3.3.2, financial theory proposes that the valuation of individual project should not be performed in isolation, but rather in the context of its current investment portfolio in order to define the risk influence of the new project to the firm or the investor. However, this understanding was not found to be applied in practical applications.
- With regard to the influence of the existing portfolio of new projects, and in relation to diversification, hurdle rates can be undercut if a new project is advantageous to the existing portfolio (participant 15).
- General findings about investors' risk management processes were reported in the general findings about valuation processes (section 5.3.1), such as the suitability of a method with regard to the investor's objectives and perspectives and the standardisation of input data for valuation processes.

5.4 Findings from INF Analysis

This section presents the findings from the INF analysis. They were drawn by combing and integrating the two applied primary research phases based on the three different outcomes of INFs, such as the convergence and divergence of findings, and complementary findings, as outlined in section 4.5.3. The complete INF analysis table from nVivo™ is presented in Appendix 12, Figure 58. This section is concluded with making inferences about the answer behaviour of the participants in the QUAN and QUAL phases (section 5.4.5).

5.4.1 Inferences within Capital Budgeting Approaches

The convergent result confirming DCF as the main applied method in RES-E investment acquisitions (pt. 01.01, Table 29) was complemented with the finding from the QUAL phase that, more specifically, the simplified FTE approach (section 2.4.2.1, pt. 01.02) is the main accepted method within the transaction market. It can be regarded as the current *business standard*—a simplification and/or compromise within business—that has been implicitly agreed between the sellers and acquirers. Other converging results include that the FTE and the IRR are the preferred methods applied, while new insights emerged regarding the application of a virtual, all-equity case for testing the investment attractiveness (pt. 01.04) and the APV (pt. 01.08) as an optimal and complementary method for impairment tests. As demonstrated in the QUAN phase, the IRR method is more frequently applied than the theoretically more consistent NPV method (pt. 01.05), while both equity IRR and project IRR are relevant, as presented in the QUAN phase, but at different priority levels, as demonstrated in the QUAL phase (pt. 01.06).

Table 29: Inference findings for numerical capital budgeting techniques in RES-E investment valuations.

No.	Inference findings	Applied INF rule	Additional explanation by QUAL phase
01.01	Discounted cash flow is the main method applied for RES-E investments, since it is the accepted method in transactions by sellers and acquirers	Convergence	-
01.02	More specifically, the simplified FTE approach is the main DCF method applied for RES-E investments accepted by the transaction market	Complementary	Additional explanation
01.03	The FTE method is the preferred DCF method for RES-E investments	Convergence	-
01.04	A virtual all-equity case is applied for testing project attractiveness	Complementary	-
01.05	Within the FTE method, the IRR is more frequently applied compared to the NPV	Convergence	-
01.06	Both equity IRR and project IRR are relevant, but at different priority levels	Convergence and complementary	-
01.07	Distribution potential to be considered in DCF-based valuation	Complementary	-
01.08	The APV approach is suggested as an optimal and complementary method for impairment tests	Complementary	-
01.09	Multiples are applied for initial investment screening and/or second opinions	Complementary	-
01.10	The PB method is only relevant for investment in risky countries	Complementary	-
01.11	The CE method is almost unknown / not used	Convergence	-
01.12	The CE method might be a complementary, valuable concept in valuation	Complementary	Additional explanation
01.13	Increasing the know-how of investors by performing ex-post valuations of previous investments	Complementary	-

Other complementary results from the QUAL phase indicated that the distribution potential to equity holders should be considered in DCF-based valuation (pt. 01.07), that MAs are applied for initial investment screening and/or second opinion (pt. 01.09), and that the PB method is particularly relevant for investments in risky countries (pt. 01.10). The QUAL phase proved to be the optimal research approach to investigate the application possibility of the promising CE method in more depth (pts. 01.11 and 01.12), providing additional explanations about how to apply it. The QUAL results indicated that investors increase their know-how by performing ex-post valuations of previous investments (pt. 01.13).

In case of judgemental considerations in capital budgeting approaches, the QUAL phase provides particularly valuable insights in the form of complementary findings (section 5.3.4), which would be almost impossible to collect in the QUAN phase.

5.4.2 Inferences within CoC Approaches

Although the findings between the QUAN and QUAL phases regarding the application of the CAPM in CoC approaches in RES-E investment valuations are, in general, considered as convergent findings (pt. 02.01 in Table 30), a more in-depth analysis in the QUAL phase demonstrated that the participants in the QUAL phase were mostly not involved in applying the CAPM approach to set the required return rates. Some of them were not even well-versed in applying the CAPM and in understanding its features and restrictions. However, some participants reflected on the application of the CAPM, for instance, by deriving a pure-play beta factor based on corresponding traded securities on stock exchanges (pt. 02.02). Convergent findings were detected for the relevance of unsystematic risk components in setting discount rates in RES-E investment valuations (pt. 02.04). In the QUAN and QUAL phases, it was found that hurdle rates are widely applied in CoC processes (pt. 02.05), and a complementary finding in the QUAL phase was that setting required return or hurdle rates is predefined by a central organisational department (pt. 02.10). Both equity return and project return rates are applied, while cultural differences were found in their application rates (pt. 01.11). Additional convergent results were found for the application of the RADR with inputs for explanations of how it is applied (pt. 01.12).

Moreover, the application of the WACC approach in RES-E investments provided a differentiated picture (pt. 02.03). On the one hand, various corporates on the buying side consider the WACC approach to be a principle technique, not to set a company-wide required return rate or hurdle rate, but rather as the basis for deriving return rate requirements or hurdle rates that are distinguished between countries, technologies/industries, and sometimes also project stages (pt. 02.07). On the other hand, some participants, in particular many sellers, rejected the WACC concept for setting required return rates, hurdle rates, or risk-adjusted return rates (divergent finding). Instead, they propagated the applications without referring to the acquirer's WACC, as proposed by finance literature (section 2.4.3.3), such as results from previous transactions and market sounding (pt. 02.08) and/or exit strategies (pt. 02.09).

Table 30: Reference findings of CoC approaches in RES-E investment valuations.

No.	Inference findings	Applied INF rule	Additional explanation by QUAL phase
02.01	The CAPM is applied as a basic concept for defining the expected return rates	Convergence	-
02.02	Using the CAPM with a pure-play beta factor might become interesting in the future as soon as more RES-E portfolios (preferably differentiated by technology) are traded on stock exchanges	Complementary	Additional explanation
02.03	The WACC is still a principle technique to determine CoC requirements	Divergence	Additional explanation
02.04	Unsystematic risk is relevant in setting required return rates	Convergence	-
02.05	Hurdle rates are widely applied in CoC processes	Convergence	-
02.06	Required return rates are compared to the market	Convergence	-
02.07	Return rate requirements / hurdle rates are often distinguished between countries, technologies/industries, and sometimes also project stages	Convergence	-
02.08	Sellers often set discount rates depending previous transactions and/or information from a market sounding to maximise profit	Convergence	-
02.09	Required discount rates are set in relation to exit strategies in case of investors with a defined investment period	Complementary	Additional explanation
02.10	Setting required return rates / hurdle rates is predefined by a central organisational department	Complementary	Additional explanation
02.11	Both equity return rates and project return rates are applied, but in different frequencies in Germany and Switzerland	Convergence	-
02.12	Application of project-specific RADR	Convergence	Additional explanation

5.4.3 Inferences within Risk Assessment, Risk Mitigation, and Adjustments for Risk

Convergent findings between the QUAN and QUAL phases were found for the relevant risk components in RES-E investment valuations (pt. 03.01 in Table 31). The QUAN results demonstrated that, for instance, the German participants regarded political/regulatory risk and the wide application of risk mitigation measures as more severe (pt. 03.03), while in the case of adjustments for risk (pt. 03.04), scenario and sensitivity analyses, and simulations (pt. 03.06), no contradictions to the QUAN outcomes were encountered during the QUAL phase. Moreover, the QUAL phase provided complementary, explanatory results (pt. 03.02) for the puzzling QUAN results regarding the risk assessment results for the different risk components in relation to project stages (section 5.3.6.6). While the QUAN phase demonstrated that risk attitudes and/or individual risk preferences are clearly influenced by having experienced materialisation of the same risk, the QUAL phase complemented this result and provided a possible explanation: the prevailing risk aversion of the investors with their main focus on securing downside risk (pt. 03.05). Both QUAN and QUAL phases suggested that scenario and sensitivity analyses are more often applied than simulations, since decision makers understand the former better than the latter (pt. 03.06).

Table 31: Reference findings of risk assessment, risk mitigation, and adjustments for risk in RES-E investment valuations.

No.	Inference findings	Applied INF rule	Additional explanation by QUAL phase
03.01	Political/regulatory, market, and weather-related risks are the key risk components in RES-E investments	Convergence	-
03.02	Risk assessment of different risk components in relation to project stages	Complementary	Additional explanation
03.03	Risk mitigation measures are widely applied and have to be considered in valuation	Convergence	-
03.04	Adjustment for risk in valuation processes is widely applied, considering systematic and unsystematic risk components	Convergence	-
03.05	Risk attitudes and/or individual risk preferences are clearly influenced by having experienced materialisation of the same risk, being influenced by the prevailing risk aversion of the investors with their main focus on securing downside risk	Complementary	Additional explanation
03.06	Scenario and sensitivity analyses are mostly applied—simulations less frequently, but more often by Germans	Convergence	-

5.4.4 Inferences about Influencing Factors in Valuation

As complementary results to the QUAN findings, the QUAL results demonstrated that portfolio effects are not necessarily considered in RES-E investment valuations (pt. 04.01 in Table 32). Divergent findings were encountered for the application of opportunities and synergy effects (pt. 04.02 and 04.03) in RES-E investment valuations. In the QUAL phase, it was identified that while those features are interesting to know, they are not directly considered within the RES-E investment valuations. The QUAN phase could not detect certain influence factors on RES-E investment valuations, such as the market forces, internal investment pressure, and certain incentives and biases (pts. 04.04 to 04.06). In contrast, the QUAL phase did not examine the statistically analysed influences of company characteristics and domicile with the QUAN phase (pt. 04.07), and no additional insights could subsequently be collected on this matter. Moreover, the QUAL findings particularly stressed the necessity to differentiate between calculating a value or value range and setting the price (pt. 04.08 in Table 32), which was not clearly stressed in the QUAN phase.

Table 32: Inference results about influencing factors in RES-E investment valuations.

No.	Inference findings	Applied INF rule	Additional explanation by QUAL phase
04.01	Portfolio effects are not necessarily considered in valuation	Complementary	-
04.02	Possible opportunities of investment projects are interesting to know, but they are not directly considered in valuation within transactions	Divergence	Additional explanation
04.03	Possible synergies of investment projects are interesting to know, but they are not directly considered in valuation within transactions	Divergence	Additional explanation
04.04	Market forces are key influencing factors in the transactions and correspondingly in valuation	Complementary	-
04.05	Internal investment pressures are key influencing factors in the transactions and correspondingly in valuation	Complementary	-
04.06	Incentives and biases influence valuation processes	Complementary	-
04.07	Company characteristics, e.g. size, leverage, and domicile	Not examined in QUAL	-
04.08	Necessity to distinguish between value or value range and setting the price	Complementary	-

5.4.5 Inferences about Answer Behaviour

While investigating how participants behaved in answering the questions with regard to the reported, applied professional practices and the flexible responses to the nature of investments and whether they act as agents of their employers, differences could be found between the QUAN and QUAL phases.

The QUAN phase asks for professional practices applied at the respondents' employers. As such, the behaviour in answering was deliberately restricted to professional practices without allowing enough room to provide thoughts other than only the answers to the questions. Likewise, it is not possible to verify whether the participants really act as agents of their companies (section 6.4), nor whether the participants' backgrounds and in-depth details about the way in which they were professionalised influenced their behaviour in answering the questions.

The QUAL phase, however, also seeks more flexible and critically reflected answers. In doing so, not only are the respondents' professional practices in their current positions and the companies' procedures sought, but answers are also adapted to the nature of investments and influenced by the participants' educational backgrounds and professional development as elements of their behaviour. The former has been investigated with the discussion of the presented realistic investment scenarios (section 4.4.1.2), providing more flexible and in-depth responses. These are considered to be highly valuable due to their triangulation potential with the general answers of the first interview part, their potential to draw from the experience and knowledge of the participants, and their potential to also reveal some rather tacit knowledge. This means that they could report not only practices applied at work, but also interesting approaches that they have come across during their academic education and/or careers as well as during their professional development. Flexibility in the interview process, including critical reflections about the proposed approach, was particularly searched for in the discussion of the investment scenarios. Due to the sought-after, flexible, and critically reflected responses with regard to the nature of the investment, the participants' responses in the discussion of the investment scenarios did not strictly have to match the responses to the questions about the professional practices of the their respective companies (QUAN phase). This was specifically the case for those methods proposed in the investment scenarios that are not regularly applied. Moreover, the investment scenario discussion revealed whether not only thoughts and reflections are provided, but also views and opinions that are or at least can realistically be translated into action (section 6.4). In addition, it was possible to receive some indications about the ways in which the participants were professionalised influenced their behaviour in answering the questions. In general, it can be stated that the better the respondent's education in the research topic has been, the more companies they have worked for, and the higher the degree of variations of those employers has been, the more profound and differentiated their answers were.

Having access to the different types of answers due to varying elements of behaviour in answering the questions, as outlined above, resulted in the presented comprehensive findings of this research.

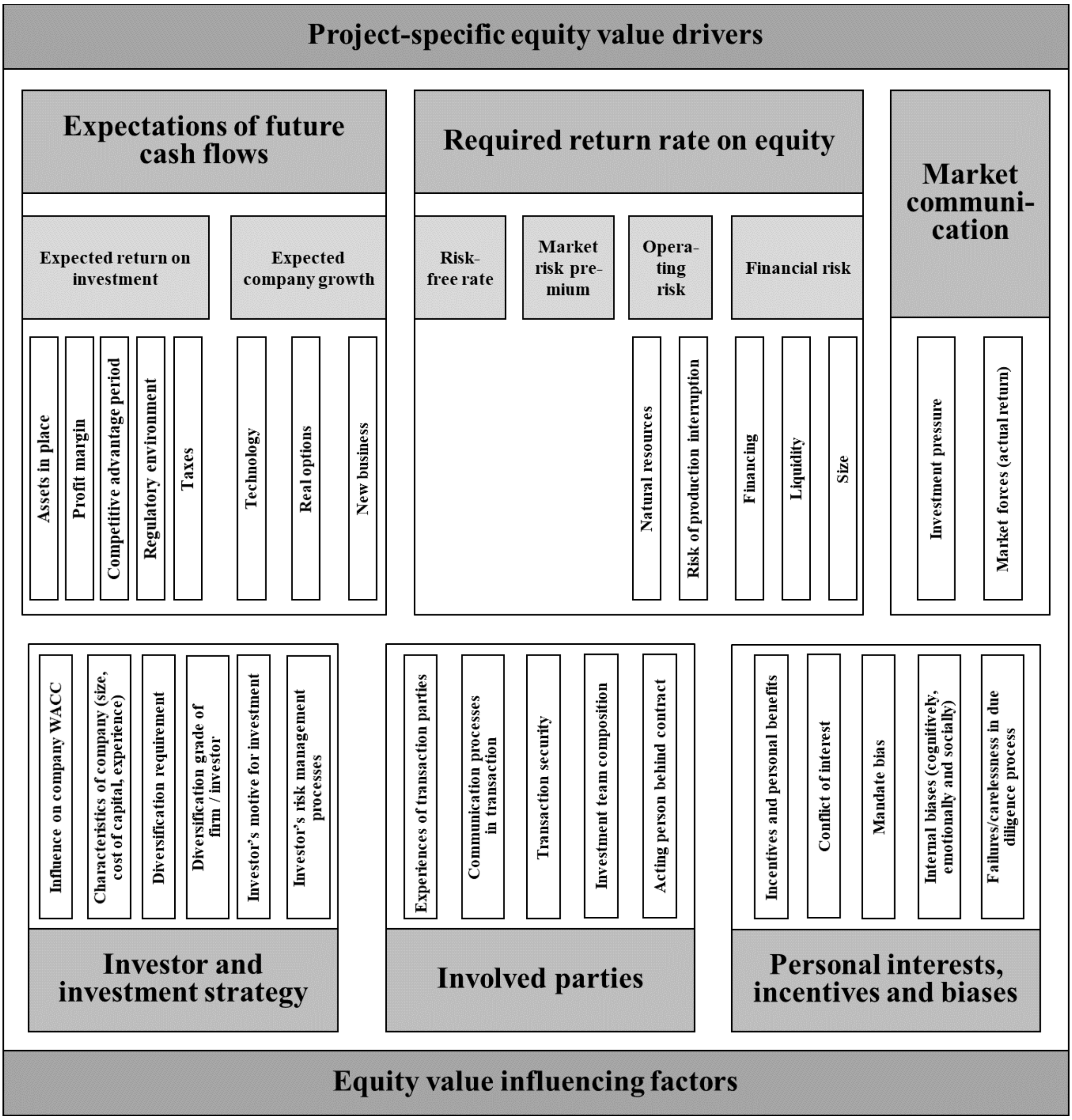
5.5 Final Concepts

Based on the conceptual framework (section 2.7.3), the research was performed. The results are three separate models that are particularly suited for RES-E investment valuation. The presented models in this section combine the best of both worlds—the theoretical and practical worlds, derived from the literature review, and the QUAN, QUAL, and INF results. First, even if the CAPM, as a sole concept, is not particularly suitable for RES-E investment projects due to its ignorance of unsystematic risk, it provides a powerful basic structure to build an equity value driver and influencing factor (EVDIF) model for RES-E investments. Second, an uncertainty consideration model for RES-E investment valuation is presented. Then, a feasibility measure is suggested with an updated coherent valuation model, which evaluates investment targets in two dimensions, namely in financial performance and in risk performance, and which is particularly suited for practitioners, while considering numerical and judgmental considerations.

5.5.1 Equity Value Driver and Influencing Factor Model

Figure 51 presents a project-specific equity value driver and influencing factor (EVDIF) model, as an enhanced model based on the concepts of Arnold (2013) and Fernandez (2016), specifically for RES-E investments with key value drivers and factors influencing valuation. The EVDIF model focuses on factors that can be opportunities and risks alike as the basis for value creation (section 2.2.1). It was deliberately chosen as one of the final concepts of this thesis, as opposed to a framework that solely considers risk factors and managing risk, such as the developed RAPV concept (Appendix 3) for performing the survey (section 5.1.1). The EVDIF model allows for the understanding of the investment project, which is a typical first step to be able to reduce project risks (Liebreich, 2005) and to subsequently perform valuations.

Figure 51: Project-specific EVDIF model for RES-E investments—an enhanced model based on the concepts of Arnold (2013) and Fernandez (2016).



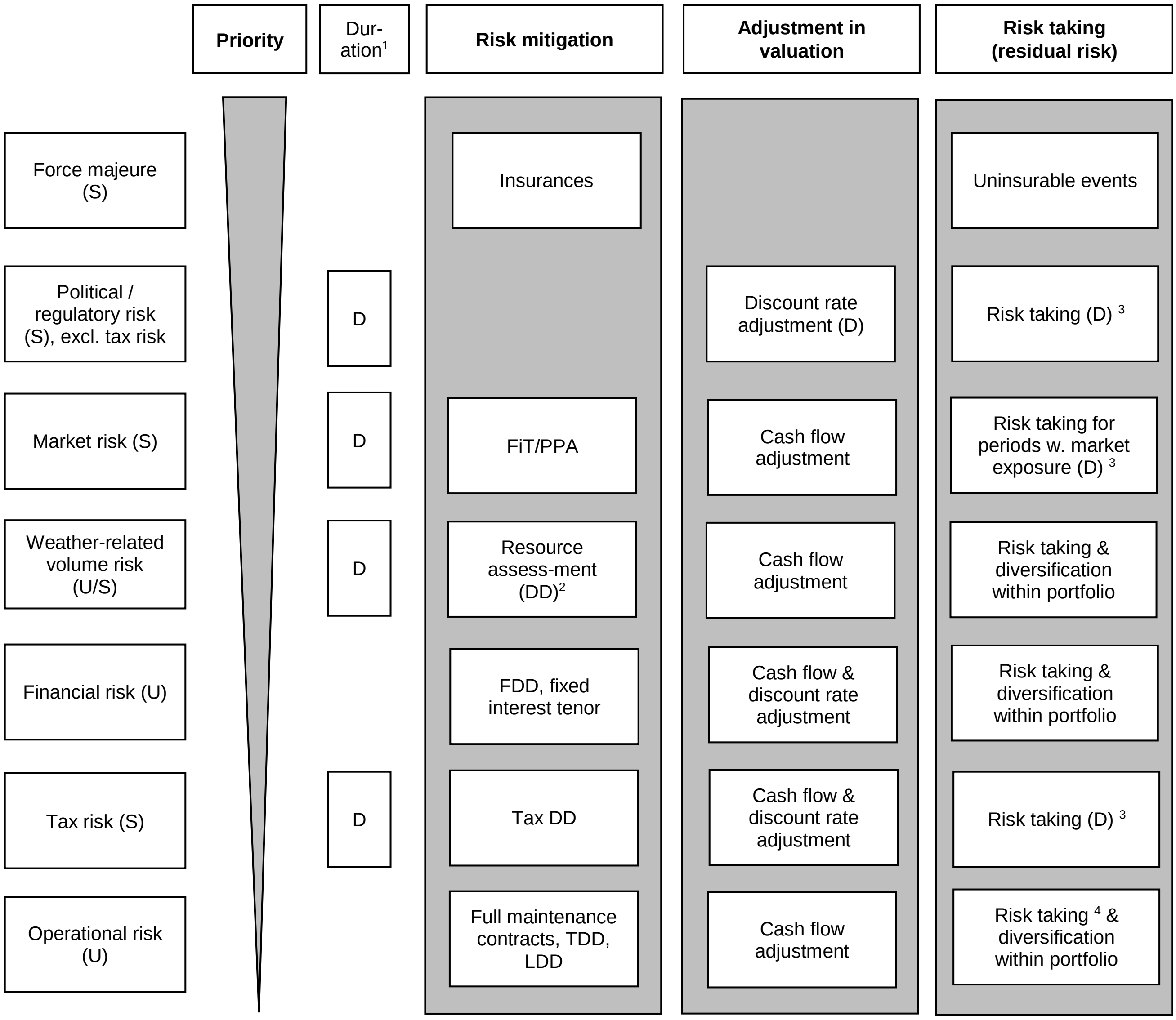
The equity value of an investment project primarily depends on the expectations in future cash flows on an equity level, the required return rate on equity, and the communication directly with the market. In turn, expectations of future cash flows can be subdivided into secondary equity drivers, such as expected return on investment and expected company growth. As the required rate on equity follows for its secondary equity drivers, the CAPM formula, with a risk-free rate and market risk premium, is an optimal starting point to consider risk in valuation (Arnold, 2013), as outlined in section 2.5.1, while adding unsystematic risk components that are relevant for NTA valuations, such as operating risk and financial risk. Furthermore, the equity value is influenced by various factors, including the investor, the investment strategy, and certain characteristics of the involved parties as well as personal interests, incentives, and biases. Each of those components is again subdivided into different tertiary single key drivers, and each is influenced by several factors belonging to the groups of investors and investment strategy, involved parties, personal interests, incentives, and biases, as examined in this empirical research. The main component and a major influence factor in valuation is the market itself, consisting of potential counterparties and competitors—either sellers or acquirers. While communicating to the market, expected prices are exchanged during price negotiation, and they are typically within the previously calculated value range.

The presented drivers and factors could still be general in some cases. As such, investors must analyse each targeted investment to identify its fundamental parameters that drive value and influence the valuation. However, the presented model provides an optimal foundation for performing valuation processes for RES-E investments in line with VBM, based on DCF-based methods for both value creation and value protection, as outlined further in section 5.5.3.

5.5.2 Uncertainty/Risk Consideration Model in Valuation

Uncertainty and risk consideration is a fundamental process step within the valuation of all investments. Figure 52 illustrates an uncertainty/risk consideration model within the valuation of RES-E investments. This model is described with a matrix of relevant and prioritised risk components and possible uncertainty and risk considerations. The illustration is mainly derived from the QUAN results, complemented with QUAL results, representing the current uncertainty consideration situation in RES-E valuation. The key factor, namely weather-related volume risk, is treated by all three types of uncertainty/risk considerations, while exposure to the residual risk after risk mitigation and adjustment in valuation can be reduced within an appropriately diversified portfolio.

Figure 52: Uncertainty/risk consideration model within valuation for RES-E investments: Risk component and risk consideration matrix (TDD: Technical DD, LDD: Legal DD, author's own illustration, (S): systematic risk, (U): unsystematic risk, (D): effect of duration on systematic risk).

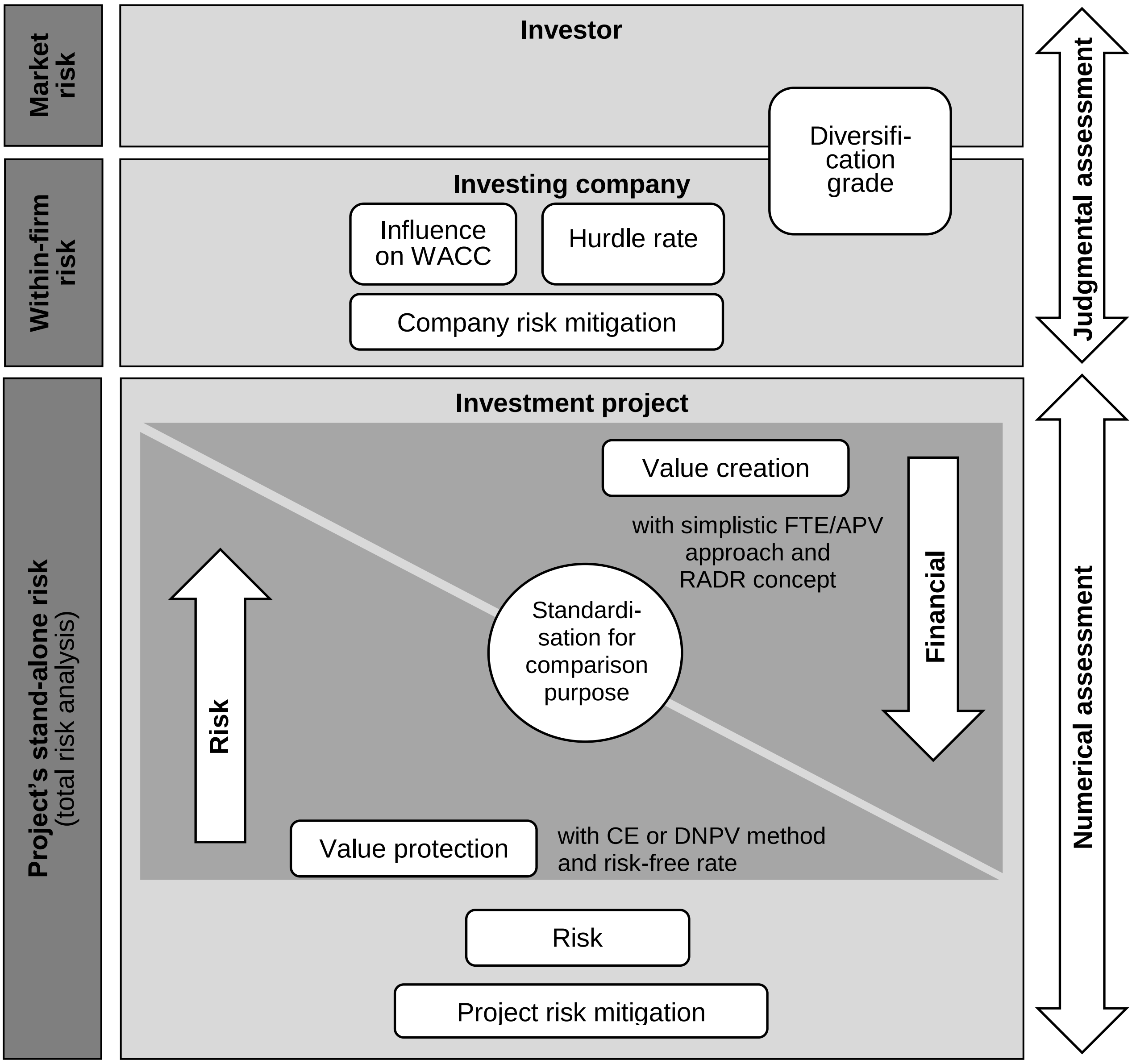


[1] Column showing whether duration is relevant for the considered risk category and has a potential effect (D).
[2] Resource insurances would also be applicable for this risk category, but are rarely applied according to QUAN results.
[3] Some portfolio diversification is possible even in case of systematic risks.
[4] Risk taking is relevant for cost components without hedging and for periods without full maintenaince contracts.

5.5.3 Integrated EVCaP Model

Based on the INF results from the performed MMR and as a refinement of several research works, including those of Ryan and Gallagher (2006) regarding the relevance of the CE method; Espinoza (2014, 2015), who stressed a simultaneous valuation with both a traditional DCF-based and the CE approach; and Taylor (2014b) about combining risk control and risk-taking strategies, an integrated equity value creation and value protection (EVCaP) model was developed as a coherent feasibility measure (Figure 53). It also integrates the investment perspective, either from the investment project, the investing company, or the investor, as suggested by Ehrhardt and Brigham (2016).

Figure 53: Integrated EVCaP model measures both financial and risk performance, from the perspective of the project's stand-alone, within-firm and market risk (author's own illustration).



Each project is evaluated from both i) a *financial performance* dimension (value creation), which is about 'risk taking' (Taylor, 2014b:80) with rather traditional DCF-based approaches, focusing on both threats and opportunities to compute an NPV and IRR, and ii) a *risk performance* dimension (value protection), which is about 'risk control' (Taylor, 2014b:80), focusing only on threats (negative divergence from target value), to calculate an NPV based on the CE method and an implied return rate thereof.

For the value creation dimension, the following set of valuation techniques can be applied that all supplement each other to serve different purposes:

- a simplistic FTE approach (IRR/NPV approach) for market communication, while knowing its methodological restrictions;
- the more consistent APV approach (the NPV approach), which is more suitable for the typical autonomous financial policies of RES-E investments, particularly for impairment tests;
- an output IRR to also consider the distribution potential of the cash flows to equity holders, including a distribution profile or a cash waterfall to equity holders; and
- a scenario analysis and a sensitivity analysis to compute a worst-case scenario or define the most influencing input factors and their influences respectively

The aim of the project risk assessment and the corresponding project risk mitigation is to provide a good understanding of the project, while the latter is also involved in a trade-off between protecting the projects from threats and providing enough opportunity for value creation (for example, regarding the question as to whether or not to contract a natural resource insurance).

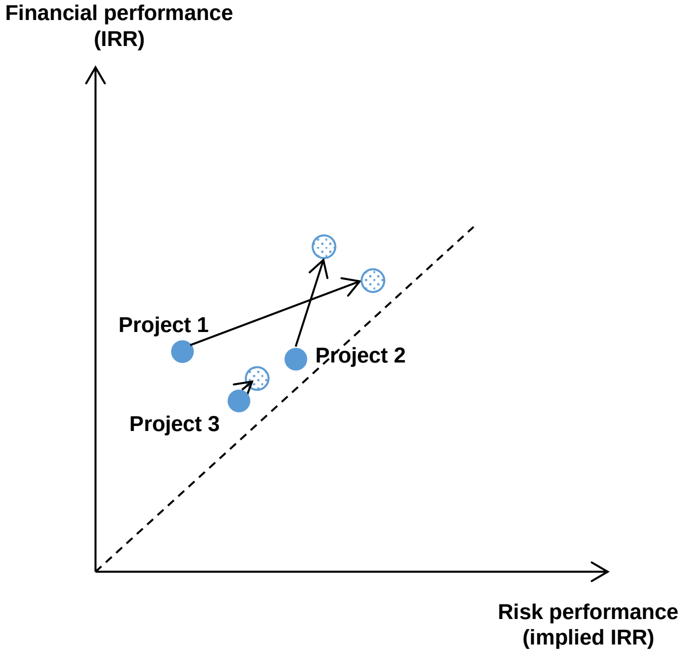
The value protection dimension is the computation of a specific certainty case, performed with specific guidelines to ensure maximum objectivity (section 2.4.4.4).

The application of each of the applied valuation techniques are standardised to enable the comparison of previous, missed, and future investments, including, for example, an equity-only approach for the value creation dimension to eliminate leverage effects.

To compare different projects regarding return rates, the valuation results of both dimensions are then plotted in a graph illustrating the financial performance on one axis and the risk performance on the other axis (Figure 54).[72] After performing a numerical analysis, following, for instance, the explanations and methods of Espinoza (2015) for a consistent application of the CE methods, senior management judgments can additionally be considered to include the investment's effect on the investment company and/or investors (portfolio effects). Having said that, a wise investor would never invest in one project alone in order not to be excessively exposed to unsystematic risks. Therefore, he or she would be eager to build and invest in a diversified portfolio to reach a certain level of diversification, which could also be treated in valuation approaches. In line with the concept of Ehrhardt and Brigham (2016), the suggested model accounts for the investment project-level risk and CoC effects on the investing firm and/or the investor in both financial and risk performance dimensions. Such judgmental considerations can be included in the calculation of both dimensions and expressed with a corresponding arrow for the potential IRR transition.

This could build the basis for a valuation concept that also ensures enough competitiveness on the investment market. With a CE or DNPV approach alone, the investor would probably not be competitive enough, since the consideration of unsystematic risks in the cash flows and the applied current, historic, low, risk-free rates would dramatically decrease the investor's offered investment prices.

Figure 54: Plot of financial performance (the IRR) versus risk performance (the implied IRR) for several project examples. The arrow indicates the effects on IRR and implied IRR based on judgmental considerations regarding potential diversification effects from the single investment to firm and/or investor level (blue filled dots represent the valuation of single project X, and blue patterned dots represent the valuation of project X considering diversification effects from a firm and/or investor perspective).



6 CONCLUSION AND OUTLOOK

6.1 Discussion

The research presents both reassuring as well as surprising INFs in answering the research questions (section 1.2), while still detecting a considerable gap between theory and practice in certain areas.

6.1.1 Risk Components and their Prioritisation, Processing, and Impact on Valuation

This section discusses the results and findings regarding the stated first research question: 'What are the risk components to be considered, and how are they prioritised, processed, and affected within the valuation of RES-E investments?'.

In assessing the risk of RES-E investments, the QUAN results demonstrate that political/regulatory, market, and weather-related volume risk are regarded as most crucial in RES-E project assessment, while the former is more crucial than the others, probably due to the high exposure of the government-guaranteed, predominantly issued FiTs to RES-E-based generation units. The latter two risk categories are, however, key components that are risk-adjusted in RES-E investment valuations (see below). Therefore, the study demonstrates that professionals consider both systematic risk (for example, political/regulatory risk) and unsystematic risk (for example, weather-related volume risk) in the valuation of such NTAs. This is notwithstanding the fact that natural resources are randomly distributed globally, and consequently an adequate portfolio of production sites with various energy transformation technologies could optimally diversify the unsystematic part of weather-related volume risk (see more about portfolio effects below). The QUAL results additionally demonstrate that weather-related volume risk is composed not only of unsystematic risk (i.e. the time-variant risk part, which is reduced through diversification over time) but also of systematic risk (i.e. the time-invariant risk part, for example potential systematic failures in historical resource references relevant to the extrapolated long-term resource prognoses). The relevance of duration in assessing risk components within valuation is presented in the QUAL phase, but only in relation to possible variations in future discount rates. Due to this fact, duration only seems to be considered with regard to political and regulatory risk (incl. the risk of FiT cuts), since this risk is mainly considered within the discount rate, in particular within the risk-free rate. In any case, it is a rare opportunity to investigate duration in risk assessment, since there seems to be little empirical evidence about its consideration in practice. In addition, duration is also relevant for market risk—a major systematic risk, which generally causes return rate increases the longer the duration is. However, the research participants seem to ignore this, which might be due to the fact that the majority of considered RES-E projects in this research are based on FiT and PPA and are hence not or at least not significantly exposed merchant risksl. An additional issue, which is also seldom reported, is found with regard to duration: the resource assessment states the available expected amount of resource within a 20- to 30-year period, for example for wind and PV, but it does not state what the distribution of resources within this period looks like. This is, however, quite relevant in DCF-based valuations with typical annual cash flow streams while applying an equal amount of resources each year. In reality, the annual amount of resources is randomly distributed within the whole project period, which can adversely affect DCF-based valuation. This is, for instance, experienced if there are lower resources in the first few years, which are then compensated for in the later years of the RES-E projects, assuming the resource assessment represents an approximately correct depiction of reality.

Putting the valuation of stand-alone projects in context of the investing company and its investors, the QUAL results illustrate that the effects of a portfolio are relevant for the RES-E investors; however, no participants report specific measures for how to consider the contribution of a single project to the portfolio, as proposed by Drukarczyk and Schüler (2009), Brigham and Houston (2012), and Ehrhardt and Brigham (2016). The relevance of considering the existing portfolios is also supported based on empirical findings from financial investors for whom portfolio diversification is incorporated into their way of carrying out investments, also as a main driving force for making investments (Wüstenhagen and Menichetti, 2012).

The survey results also indicate that a broad spectrum of risk mitigation measures are widely applied in RES-E investments. Clear evidence is found for materialised risk—experienced by the participants—influencing the subjective risk perception, which could then have an impact on the employed risk mitigation measures and on adjustments for risk in valuation. An especially significant finding is that participants who have experienced the materialisation of risk and have perceived more risk are more likely to implement more intense risk mitigation measurements.

As anticipated, the planning/designing phase is clearly considered to be the riskiest stage in RES-E investment projects. Even though all concerned participants and entities are objectively exposed to risk (Petrolia et al., 2013), risk assessment and risk mitigation processes remain subjectively affected due to the involved judgmental considerations. Having said that, it is demonstrated that risk assessment with the prioritisation of different risk components for a particular object and time or stage is always set in relation to the other available and known risk components. This is a complementary INF outcome from the QUAL phase, which solves the puzzling QUAN result about the assessment of each single risk component for every project stage; it provides valuable insights into how risk components are assessed. The research results also indicate that valuation and pricing mainly consider risk components with knowledge of the probability of occurrences and/or consequences. Valuating and pricing latent uncertainty with no knowledge of probability and consequences or with high improbability is hardly ever performed; i.e. the financial market does not seem to compensate for strictly latent uncertainty. In addition, the results illustrate that experiencing and perceiving risk are key within valuation processes in terms of the involved members in transaction teams and their experiences as well as in terms of making the optimal trade-off between implementing risk mitigation measures and accepting an appropriate level of risk taking and then defining the appropriate return expectation. However, the survey outcome does not reveal how they are explicitly considered in valuation. Although force majeure can have a profound effect on the value of assets, the participants do not explicitly mention it in the primary research phases with regard to the valuation of RES-E investments, as the qual phase findings indicate. This risk component seems to be mitigated as much as possible with insurances, as a standard in this sector. Since this risk component would then not be remunerated by the market if the risk is taken, it does not flow directly into valuation processes in terms of cash flow and discount rates.

The results also demonstrate that adjustments for risk are as common in RES-E valuation as they are in other sectors, but different in relation to the relevance of the various risk components. The main adjustment for risk in valuation is performed within the cash flows of RES-E projects, in contrast to the results of Block (2005), who surveyed a wider spectrum of industries. Adjustments in RES-E investment valuations are performed both for systematic and for many unsystematic risk components. An exception to the majority of risk adjustments within the project cash flows builds the political/regulatory risk that is mainly considered in valuation by adopting an appropriate discount rate. Valuation adjustments are even more frequently applied in the case of previously materialised risk for various risk components. Furthermore, a relevancy ranking is presented for key risk components for RES-E investments with regard to the applied type of valuation adjustment, headed by market risk, weather-related volume risk, operational risk, interest rate risk, and political/regulatory risk. While the result that political/regulatory risk is generally regarded as more severe than the other relevant market and weather-related volume risks is interesting, it is less relevant—however, only marginally— than the two latter risks within valuation adjustment for risk.

In addition to considering mainly the downside dimension of risk, the survey also focuses on the upside dimension of risk by evaluating the usage of opportunities and synergy effects in valuation. The results suggest that RES-E investors do not consistently consider the value of opportunities and/or synergy effects within valuation processes. Possible reasons for this behaviour are to keep a certain buffer for improvement at a later stage and to be able to secure or improve the return rate. These topics, as well as risk mitigation measures, tend to be neglected in theoretical and empirical financial research in the context of valuation approaches, even though they are considered to be key components of a coherent valuation approach.

6.1.2 Applied Valuation Techniques and Encountered Influences and Deficiencies

The results and findings with regard to the following second and third research questions are closely interrelated: 'What valuation techniques are applied in RES-E investment transactions, and what organisational characteristics influence these application choices?' and 'Why are certain methods applied in practice, and what deficiencies and influencing factors are encountered in valuation processes within RES-E investment transactions?'. Therefore, they are discussed together in this section.

With regard to capital budgeting approaches, the INF results about the usage of DCF-based methods in valuation of RES-E investments are reassuring. Discounted cash flow continues to be the dominant underlying investment evaluation technique; both sellers and acquirers accept it in RES-E project transactions. The QUAL phase demonstrates that the participants, both sellers and acquirers, apply the *simplified FTE approach* in RES-E investments. This approach reduces valuation complexity by applying one constant, single, discount rate instead of the more consistent period-specific discount rate adjustment, which considers the changing capital structure that is typical of RES-E investments. Most participants are not aware of this limitation of the simplified FTE approach. Only a few participants possess the finance theory knowledge that there are other more consistent DCF methods that are practical enough to apply in valuation processes for the studied investment type, such as the APV and CE approaches. Although the transaction market remains reluctant or even ignores DCF methods other than the simplified FTE approach, the findings within the QUAL research phases demonstrate that the rarely applied APV approach and CE method can be applied as complementary methods. The QUAL analysis reveals the *APV approach* as a valuable method for impairment test processes due to its optimal separation of operating and tax deducting cash flow. The findings also demonstrate thatthe *CE method* is a powerful tool to evaluate the investment project's value with regard to its ability to protect its value (value protection). It must, however, be ensured that the levels of CE are defined based on an objective methodology, as proposed by Espinoza and Morris (2013) and Espinoza and Rojo (2015). In doing so, the encountered difference between the equity and CE values must be as small as possible, since any difference found might be considered to be an upside potential, which is valued in transactions. In other words, it could be also regarded as an option price, for instance, for a future repowering, retrofitting, and prolonging of the project's lifetime, which is not directly included in the valuation (section 6.5). In line with the work of Espinoza (2014, 2015), a valuation using the traditional DCF-based approach with RADR (see below), complemented with a CE-based valuation, is an optimal and promising procedure for the analysis of potential RES-E investment opportunities, particularly for comparing mutually exclusive investments. In addition to CE method's advantages of separating risk and time value of money, as outlined by Zeckhauser and Viscusi (2008), it could also potentially—when applied appropriately—decrease the encountered subjectivity in risk assessment and mitigation (Espinoza and Morris, 2013, Espinoza and Rojo, 2015).

A strong preference for the *IRR* method is discovered in the QUAN phase, followed by the *NPV approach*, due to the former'sreported advantage of being able to compare various investments with different sizes. The QUAL phase supports this finding, demonstrating the optimal comparison possibility of the IRR results between mutually exclusive projects, which is however contradictory to finance theory that assigns the advantage of such an investment comparison to the NPV and that considers the NPV approach as the more consistent of the two approaches (Mauboussin, 2002a, Baker et al., 2010, Arnold, 2013, Ehrhardt and Brigham, 2016). In addition, a considerable gap for a complete exploitation of the possibilities in computational valuation methods prevails, failing to receive a more holistic valuation picture. In doing so, conventional DCF methods (the IRR and the NPV) would be supplemented with more sophisticated methods. Apart from the above mentioned powerful APV approach and CE method, the found and rarely used ROV could allow managers to actively and continuously respond to market changes (Leslie and Michaels, 1997, Villiger and Bogdan, 2005). Similarly probabilistic instead of deterministic methods based on scenario and sensitivity analyses, or even sophisticated simulations to imitate the operation of complex real circumstances, could provide better bases for decision (e.g. Rentizelas et al., 2007, Carmichael, 2011, Kuppinger and Wüst, 2011).

Less agreement in the RES-E investment community exists regarding how to set discount rates; various concepts exist, ranging from quite sophisticated to more pragmatic approaches. The result about the usage of the *WACC* concept, which is still considered to be the principle basic approach for determining the cost of equity or discount rates, is puzzling at first glance, although the single, company-wide discount rate is not as frequently applied as it used to be in the past (Brigham, 1975, Gitman and Mercurio, 1982, Bruner et al., 1998, Block, 2003). However, a surprising number of organisations still use their firms' risk instead of project risk within discount rates in RES-E valuations (section 6.3). On the other hand, the survey results indicate that the WACC is the basis from which to derive the prevailing country and technology/industry discount rates as well as the less popular divisional discount rates. Also rather surprising is the encountered low frequency for applying the *CAPM*—even though it has been developed for PTCs—which is considered to be the established, fundamental, theoretical principle for various applied concepts, including the WACC, the RADR, the hurdle rate, and the CE method approach. Therefore, a higher frequency for the CAPM would better correspond to these results. From the results in this research, however, it is unclear whether the participants understand the essence of the CAPM concept. Furthermore, the research does not reveal encountered disadvantages in applying the CAPM, such as its strictly historical perspective, in contrast to a more favourable, forward-looking approach by inferring from analysts' forecasts, as McNulty et al. (2002) present it, for instance, in the MCPM (sections 6.4 and 6.5). Moreover, the hurdle rate concept has gained considerable ground in the case of RES-E investments by German and Swiss investors, compared to previous surveys (e.g. Brigham, 1975, Bierman, 1993, Graham and Harvey, 2001), and the majority of the investigated population apply it today. Furthermore, while having both supporters (e.g. Weston, 1973, Titman and Martin, 2008, Ehrhardt and Brigham, 2016) and critics (e.g. Robichek and Myers, 1966, 1968, Espinoza, 2014) in academia, the *RADR* concept demonstrates increasing popularity in RES-E investments in the investigated population. Being investigated for the first time as a variable for estimating the CoC, it could be proven that *past experience* in setting discount rates is mainly applied supplementarily to the mentioned dominant methods. Although, generally speaking, the gap between theory and practice regarding CoC approaches is closing, the RADR concept is still applied only by a minority and therefore less frequently than the dominant WACC approach. Therefore, it is concluded that investing companies should implement coherent and rigid internal organisational processes to periodically define multiple hurdle rates specific to different business fields and types of investments, as well as project-specific return rates for their investment projects.

Some cultural differences could be detected between the considered Swiss and German subgroups, although market professionals tend to assess risk components and to adopt and neglect the same theoretical models and theories when managing their finances. The Germans rate political/regulatory risk as more severe, and they apply simulations more frequently as part of their valuation process. On the other hand, the Swiss use the total CoC of a project more frequently than the cost of equity. They also use the WACC, the CAPM, and country-specific discount rates more often, and they are likely to employ external DD as a risk mitigation measure more often.

From the perspective of organisations' characteristics, larger organisations are relatively likely to apply the WACC concept, country discount rates, external DD, the CAPM, and formal risk analyses within RES-E investment valuations, while small organisations rely on discount rates set by their investors and based on their past experiences. Moreover, higher leveraged companies are more likely to use the NPV and PB methods within their RES-E investment valuations. Only the results about larger organisations, country discount rates, and the CAPM, as well as the NPV and higher leveraged companies, are supported by the findings within other studies (e.g. Graham and Harvey, 2001, Brounen et al., 2004).

6.1.3 Proposed Valuation Concepts

With respect to the stated fourth research question—'How can the key equity value drivers of RES-E investments within a coherent valuation concept be described?'—a discussion of the findings is presented in the first part of this section.

The presented EVDIF model regarding the key equity value drivers is a comprehensive model, demonstrating the relevant components to be considered in RES-E valuation, the relationship between risk components (threats and opportunities) and investment return, and additional potentially influencing factors on valuation. As an enhanced model based on the concepts of Arnold (2013) and Fernandez (2016), it provides practitioners with valuable guidelines for determining which factors are relevant and should be considered in valuation, and for understanding the general business models of RES-E projects in order to both protect the investment against downside risk and create value. A unique aspect of this model is that it also presents the reported, potential equity-influencing factors, which are typically not shown in comparable models. After having delved into the topic and stepped out of the test tube into the social world, the EVDIF model tries to depict the valuation of RES-E projects in transactions and its dynamics in a social context and therefore in more realistic settings.

The second part of this section answers the fifth and final research question, namely 'How can the relationship between risk components and investment return be described, and how can the corresponding risk and financial performance be assessed as a basis for developing a revised valuation model for RES-E investments?'.

Two separate models have been developed to answer this research question. First, the presented uncertainty/risk consideration model provides some common principles for considering uncertainty and risk in RES-E projects as an additional foundation for the project's stand-alone valuation. Apart from considering how high the relevance of certain risk components and hence the evaluation thereof are for the overall risk of a project, the model presents a new form of graphic representation of how to prioritise, mitigate, and adjust valuation in terms of relevant risk categories in RES-E projects while finding the residual risk for risk-taking considerations and eventually value creation. The presented model is particularly suitable for long-duration projects and RES-E projects within low-risk environments (ready-to-build and operating projects with FiT or PPA); however, it could be adjusted accordingly for RES-E projects in high-risk environments or other infrastructure projects (section 6.5).

Second, going a step further, the developed, integrated EVCaP concept provides practitioners with a powerful tool that combines both worlds (theory and practice) by simultaneously calculating a practice-oriented valuation approach, which the market asks for, with a focus on creating value (for example, with the simplified FTE approach) and a value protection-oriented approach (for example, with the CE/DNPV approach). It is deliberately developed for usage by practitioners (section 6.3), and it is also applicable and understandable in decision-making processes; it concentrates on the most relevant input factors and follows a more heuristic approach (Gigerenzer and Brighton, 2009, Espinoza and Morris, 2013, Neth et al., 2014) in dealing with this topic.

6.2 Contribution to the Body of Knowledge

The thesis contributes to the body of knowledge in various ways. Based on a comprehensive evaluation of the relevant current literature on risk and uncertainty and their management, capital budgeting techniques, and the CoC, the current research gaps in asset pricing research for NTAs are derived, and a conceptual framework for valuation is presented as the basis for the performed research. The performed empirical study represents a unique form of research with regard to the applied research method—an explanatory, sequential, mixed-method research—in combination with RES-E projects as study objects.

The most important research results are provided by the primary quantitative (QUAN) and subsequent primary qualitative (QUAL) research phases, both of which were prepared for through the initial exploratory qualitative (qual) phase. The QUAN results focus on how German and Swiss practitioners apply the different available valuation techniques and processes in RES-E project investments, while the QUAL findings provide specific explanations for the found quantitative results and present the current understanding of the implemented and additional, available techniques and processes in practice. Interpreting and discussing the results of both primary phases, the subsequent INF phase is assigned a key role in the analysis. By providing more than just the sum of each single primary phase, the INF phase provides valuable insights, mainly in the form of converging and complementary findings and some diverging research findings.

As major contributions, these results and findings build the foundation for the three developed final concepts. All three concepts provide key contributions both to the theoretical body and in practice (section 6.3). First, the EVDIF model is an extension and adaption of Fernandez’s value driver model, specifically the characteristics of RES-E project investments. The subsequent uncertainty/risk consideration model constitutes an original contribution to knowledge from a practical point of view regarding how to deal with uncertainties and risk in RES-E projects. The final EVCaP model is again an extension and aggregation of various previous concepts based on profound theoretical concepts, again with a clear practical focus to be deliberately applied in practice.

The focus solely on the German and Swiss populations allows for the possibility to perform an in-depth analysis of the applied valuation techniques of organisations and key players. This would have been potentially less possible if the population was larger and geographically more distant from the researcher's location. However, by setting the system boundary with the two above-mentioned groups of investors who can pursue an international investment strategy, the research does not dare to generalise the findings to a global scale of investors (section 6.5).

Furthermore, the chosen research approach contributes to the body of knowledge for MMR designs in general and for performing empirical research in economics, behavioural finance, and valuation research. In doing so, the applied sequential QUAN-QUAL MMR design is deliberately supplemented with an initial exploratory qualitative phase as the basis for optimally developing the subsequent primary QUAN and QUAL phases. Since this approach, with an upstream exploratory qual phase, is regarded as particularly valuable for future applications in terms of preparation for the subsequent primary phases in MMR, it has been defined in Morses' terminology as a qual-QUAN-QUAL MMR design. Moreover, to the author's knowledge, MMR has not been applied much in asset pricing research and behavioural finance research within valuation processes, compared to other areas in social sciences with manifold empirical studies based on MMR designs. This empirical research clearly demonstrates how valuable and powerful MMR is to evaluate the current gap between theory and practice and to find explanations for the encountered situation in practice based on benchmarking for 'best practices' within the research population. These results and findings build an optimal and wide foundation for the proposed conceptual frameworks.

The applied approach and experiences within the QUAL phase provide additional inputs for the body of knowledge for future empirical surveys. First, the performed face-to-face interviews are clearly regarded as more valuable, compared to telephone interviews. This is because in the former interview type, the interviewees are more open, and they are willing to conduct a genuine dialogue, spend more time, and provide more details, while verbal communication provides hints regarding how questions are either understood or more convenient than others. However, as stated before, non-verbal communication is not overinterpreted within this research, since a genuine interpretation of non-verbal communication is only possible for trained researchers in psychological analyses. Second, in contrast to the performed survey, the interviews uncovered who has rather superficial knowledge about the topic and who has profound and deep knowledge about the topic. Finally, discussing real investment cases in the interview phase (QUAL phase) provides highly valuable insights, which allow one to both delve deeper into the subject—much deeper than by just answering interview questions—and complement and triangulate previous findings within the general interview section.

6.3 Contribution to Practice

The literature review provides practitioners with an interesting overview of the current literature in valuation, with the focus on NTAs. This is particularly valuable for practitioners, since a lack in the theoretical background is detected, for instance in the basic assumptions about the NPV and the IRR, FTE approaches, and different CoC approaches. However, the performed research demonstrates that there is still a profound gap between theory and practice for RES-E investments. This also means that there is a substantial amount of room for improvement in practice in both studied populations. Most practitioners in valuation are not aware of the wide spectrum of capital budgeting techniques, each technique's corresponding basic assumptions, and hence its strengths and weaknesses, nor are they aware that the most frequently applied capital budgeting technique in transaction (the simplified FTE approach) is a simplified method or that the APV approach would be the most consistent capital budgeting procedure for RES-E project valuations. With this in mind, this research contributes to an increased awareness in practice about the limitations of various applied valuation approaches. With regard to defining the CoC requirements, the applied approach is mostly oriented towards the company WACC. The majority of practitioners then concentrate solely on the valuation of the investment project, but they ignore the fact that the valuated investment might have a different risk profile than the investing company, which could then potentially affect the WACC of the investing firm or the risk profile of the investor's portfolio, either negatively or positively.

The experience of risk materialisation in previous investments has been reported in this study as a significantly influencing factor on performed risk assessments, applied risk materialisation, and the corresponding valuation of RES-E projects. This dependency and the applied risk materialisation in the context of valuation are among the unique topics being evaluated in this research, and they provide key findings to be applied in practice. The interdisciplinary composition of acquisition teams can correspondingly be extended with members who have gained both experience in the materialisation of specific risk (section 6.1.1) and knowledge of how to deal with such situations. As outlined in the literature review, unsystematic risk must be considered in valuation, since a complete diversification is seldom possible; this is specifically relevant in the case of volume-related weather risk. However, particularly in increasingly competitive environments with decreasing return rates, there is no way of avoiding the consideration of portfolio diversification instead of stand-alone valuation with total risk consideration. In doing so, the feasibility of an investment could be ensured by considering potential positive effects with portfolio diversification—a deeply embedded strategy by financial investors—particularly with regard to geographically, randomly distributed natural resources.

Apart from providing the theoretical foundation for capital budgeting techniques, CoC approaches, and uncertainty/risk considerations, the research illustrates the current status of their application in practice, and it presents appropriate concepts to close the mentioned gaps in practice. Newcomers and experienced investors alike can apply it in RES-E project investments. It provides practitioners with valuable insights into how their peers apply the different techniques and approaches in tabular form in the QUAN results. After having performed INFs with the QUAL results to explain the QUAN results, and with regard to the theoretical concepts in the literature review, these QUAN results can also be considered as the current status of applied approaches in line with 'best practices'. Furthermore, the presented equity value driver and influencing factor (EVDIF) model contributes in practice to the understanding of the key value, which is shaped by interaction with the investment market and additional determinants, while shifting the focus from a sole risk (threat) perspective to a value creation way of thinking. The proposed model also strives to increase the awareness of potential, but less obvious, influencing factors in valuation. In addition, the presented uncertainty/risk consideration model in valuation allows practitioners to efficiently evaluate how to best manage risk in each specific RES-E project. Furthermore, the proposed integrated equity value protection and value creation valuation (EVCaP) model provides practitioners—both professionals experienced in valuation and decision makers—with a powerful approach to evaluate, compare, and choose the most attractive investment from a stand-alone, project-specific perspective as well as from the investing firm’s and its investors’ points of view.

All three developed concepts were presented and discussed within workshops and teaching seminars composed of the acquisition, financing, and risk management teams of the researcher’s employer. Furthermore, some new theoretical insights from this research, which are regarded as valuable for practice, are currently integrated into a new software tool developed at the author’s employer. These insights include the APV method for impairment tests and the CE method for value protection tests, including the assessment of the effects of new acquisitions on the investment portfolio of the author’s employer.

6.4 Limitation of the Research

This work has been solely performed for RES-E projects (section 1.2), although some results could also be valuable for other infrastructure investment projects (section 6.5). The applied valuation approaches have been evaluated for various types of corporate investors, except the group of industrial, diversified companies that are also increasingly investing in RES-E projects (section 6.5) for which access is quite challenging. This thesis is also limited to RES-E projects in low-risk environments with regard to both operating risk (i.e. those projects with valid permits to build and operate generation units, and not projects in development) and financial risk (i.e. those investments with project financing [which is only possible in low-risk environments]) as well as low leveraged corporate financing structures. For the valuation of projects with higher uncertainties, *option valuation pricing,* as in ROV (Myers, 1977) and with the MCPM for defining equity return rates (McNulty et al., 2002), could become more relevant. The presented final concepts can be referred to and applied for all RES-E project stages. However, the EVDIF and EVCaP models are particular suitable for ready-to-build and operating RES-E projects with lower uncertainties and low financial risk (e.g. leverage), since they have been developed based on DCF- and CAPM-based approaches.

Furthermore, the QUAN phase was limited to a relatively small sample of German RES-E investors. This could lead to the results not being representative and generalisable to the whole population. Additional representative research should be conducted with surveys, also for additional countries. However, when applying triangulations, the QUAL phase could confirm the found results. As with similar studies (Graham and Harvey, 2001, Brounen et al., 2004), there is an essential reservation to be made. The research assumes that the participants act as agents of their companies, without being able to entirely verify whether their responses about views and opinions are translated into actions, although this research limitation was decreased by discussing investment decisions based on realistic investment scenarios. Since the QUAN phase focuses on scanning the whole spectrum of methodological applications, it is in turn not able to collect differentiated data for specific cases, such as specifically applied approaches in relation to technology, project stages, investment country, and project leverage. This simplification is somehow equalised with the in-depth discussions about applied approaches within the three specific investment scenarios provided in the QUAL phase. Even if the discussion of the investment scenario attempted to investigate not only orally explained knowledge but also knowledge expressed in behaviour, there would still be certain knowledge of the participants that could not be expressed and hence analysed. This understanding is in line with Michael Polanyi’s (1966) widely noted quote, ‘We can know more than we can tell’ (4). According to him, knowledge that can be expressed in words and numbers only represents the tip of the iceberg of the entire body of possible knowledge.

6.5 Direction for Further Research

Since this research had to be limited (section 1.2), additional new questions emerged during the research and were left unanswered (section 6.1), and specific research limitations were revealed (section 6.4), future research has much potential for more detailed investigations.

As a missing piece in this research, the effectiveness of the proposed concepts could be assessed in real investment cases and/or directly in organisations in further research, for instance within an action research setup. While implementing the proposed concepts that could not be covered in this research, a before-and-after investigation could be performed, providing valuable insights directly from an organisational level. This could shed light on this topic from another perspective. It might also allow one to overcome the mentioned potential limitations within this research regarding whether the participants really act as agents of their companies and whether their provided responses are put into action. Such a research design might also provide more specific details about how research participants have become professionalised with regard to potential influences on their behaviour in answering the research questions.

Assessing investors’ understanding of CAPM and how they apply CAPM in defining discount rates in more detail for RES-E projects could be the research objective of a separate future study by focusing particularly on qualitative research methods to gain in-depth knowledge about the applied processes. Furthermore, it could be investigated whether the challenges of McNulty and colleagues’ MCPM for NTAs—due to the absence of actively traded options and the lack of issued corporate bonds—could be solved, for instance by referring to the traded securities of comparable companies (analogy approach, section 2.5.2). In doing so, it might be possible to switch from an extrapolation from historical data to a more promising forward-looking approach in order to define appropriate equity return rates for NTAs. Some aspects of duration with regard to the variability of systematic and unsystematic risk components have been investigated, such as the relevant risk component in this study. However, the way in which project duration is considered in RES-E project valuation could be investigated in even more detail in future empirical studies, in line with the research of Campbell and Mei (1993) and Cornell (2000). Moreover, the way in which this duration could be improved, particularly for market risks for the after-FiT/PPA-period, but also for political/regulatory risks, could also be studied. Although duration for natural resources is less relevant due to the diversification potential of this mostly unsystematic risk—particularly for diversified portfolios—the unanswered question of how to better handle the reported, potentially adverse effects of randomly time-distributed natural resources in DCF-based valuation remains, and it could be investigated in future research. This could be combined with an investigation into how to consider the reported time-variant (unsystematic risk, i.e. geographically, randomly distributed natural resources) and time-invariant (systematic risk, i.e. systematic failures in natural resource assessments) parts of risk in terms of natural resources (section 6.1.1) with respect to the valuation of stand-alone RES-E projects and RES-E projects with a diversified portfolio. It could also be analysed whether there are other systematic risk components, which consist of a certain portion of unsystematic risk, such as political/regulatory risk, tax risk, and market risk, and what their influence would be on the valuation of RES-E projects. An additional interesting topic for future research is given by the unanswered question about how to reach an optimal trade-off between implementing risk mitigation measures, accepting an appropriate level of risk taking, and defining the appropriate return expectation in order to better understand the performed processes.

The decision-making processes and explicit behaviour of the different actors within valuations of RES-E investments as well as the optimal composition of investments teams, in addition to the reported advantage of professionals experienced in risk materialisation, could also be investigated in more detail, for instance by applying focus groups. In addition, unanswered questions or resulting new questions could be investigated in further research, such as how opportunities and/or synergy effects can be objectively considered within valuation processes and whether the differences between the encountered equity value (based on a traditional NPV method) and the CE value (based on a CE method) can be considered as valued opportunities or as an option price for the future repowering, retrofitting, and prolonging of the project’s lifetime, which is typically not directly included in traditional valuation. Further research projects could also investigate why practitioners apply hurdle rates more than the RADR, and how increasing merchant risks for projects with both a relevant amount of after-FiT/PPA-period or no FiT at all (and in relation to whether a PPA is contracted or not) and a simultaneous decrease in political risk (due to less state subsidies) changes risk assessment, valuation approaches, and decision making.

Since this research was limited to RES-E projects within low-risk environments, future empirical research could specifically investigate valuation approaches applied for RES-E projects within high-risk environments. This could, for instance, include either developing RES-E projects before receiving permits, high corporate loan leveraged entities investing in RES-E projects or RES-E projects exposed to the above-reported merchant risks (Aurora Energy Research, 2018, Energy Rev, 2018). Due to this study’s exclusion of industrial, diversified companies; farmers; associations;

and citizens, all of whom are also investing in RES-E projects, future research could close the gap in this respect. Due to positive experience of the applied research method and its solid methodological foundation, the developed sequential qual-QUAN-QUAL MMR approach could be applied in further empirical research studies to analyse valuation approaches for similar investments and additional groups of investors. An interesting future research topic could be a comparable empirical investigation into more culturally diverse investors, such as those from Asian and Anglo-Saxon countries, since a generalisation of the findings within this topic seems to be hardly possible on a global scale of investors. Likewise, empirical research about the same topic could be performed based on the same methodology for other infrastructure projects comparable to RES-E projects, for instance the operation of toll highways or toll tunnels. In doing so, their specifically relevant risk components, the applied valuation approaches, and the corresponding influence factors can be assessed while being able to verify the effectiveness of the proposed concepts herein as the basis for any further development for comparable investment projects. By comparing the results from other sectors to this sector, new and valuable insights could even be found for application in RES-E investment valuation.

6.6 Personal Reflection about Research Journey

Writing this Ph.D. thesis was a long road. It was characterised alternatively by academic activities and practical work, both of which contributed to the research and were influenced by each other, with the goal to reach a comprehensive piece of academic work—from which practitioners can learn. The idea to conduct research at a doctoral level began in 2014 at my current job, where I was interested in delving deeper into the theory within the involved topic—the valuation of RES-E projects—with the ambition to personally learn and make improvements to my practical work.

At the beginning, my research goal was to find a revised theory based on an improved function, which would have been solely a numerical approach, for example based on the AHP or with an expanded CAPM function. However, I soon discovered, also at work, that there are additional processes and influencing factors that cannot be grasped quantitatively, but rather qualitatively, and which are mainly considered in managerial judgments, for instance with regard to assessing the diversification effects in valuation. This reflection led me to adapt my research approach, and I took the decision to evaluate valuation professionals' knowledge and experience in the field, based on MMR, to demonstrate possible theory-practice gaps and learn from practitioners in order to ultimately be able to develop a comprehensive valuation model that includes both numerical and judgmental considerations.

Participating in three academic conferences in 2015, 2016, and 2017, as proposed by first supervisor Prof. Dolores S. Bengoa, allowed me the great opportunity to present the current status of my research to an interested academic audience each time. The interactions with other researchers and master students in similar areas provided me with additional food for thought, inspiration, and the ability to constantly increase my academic network. With the support of my supervisor, I took the opportunity to contact editors of journals—which turned out to be quite successful—to be able to publish the above-mentioned papers. Action learning circles with other researchers of my cohort, doctoral seminars, presentations at universities (ETH Zurich and Kalaidos University of Applied Sciences in Switzerland), and interaction and collaboration with other master and doctoral candidates in the same research area at the University of St. Gallen (HSG) and the Delft University of Technology have provided me with additional possibilities for peer debriefing with other academics and for the collection of valuable academic inputs.

In my professional life, there were also opportunities to present and exchange each progressive status of my research and to verify intermediate and final results. In one instance, I participated in a conference in Berlin, Germany, about investments in RES-E and financing matters in 2015, which was particularly aimed at practitioners and managers, to present my thoughts about risk assessment and return expectations of utilities. In an additional symposium in the same year, I attended a discussion forum organised by an investor group, addressing the questions of what future investments in RES-E projects will look like and what parameter are relevant.

In the summer of 2017, the research results were condensed to meet the managerial standards and then presented and discussed in two workshops with peers internally at my employer, EKZ, and to the CFO of EKZ. In addition, several outcomes from the research either are or are being implemented at work, such as the EVCaP model and the APV approach within a value simulation software for acquisitions and for impairment tests respectively and a manual to guide the user to the correct valuation approach.

7 BIBLIOGRAPHY AND REFERENCES

Acharya, V. V. & Pedersen, L. H. (2005) 'Asset Pricing with Liquidity Risk', *Journal of Financial Economics,* Vol. 77 No. 2, pp. 375-410.

Adamia, R., Goughb, O., Muradoglu, G. & Sivaprasadd, S. (2010) 'Returns and Leverage'. *2010 Oxford Business & Economics Conference Program.* St. Hugh's College, Oxford University, Oxford, UK [online] http://gcbe.us/2010_OBEC/data/Roberta%20Adami,%20Orla%20Gough,%20Gulnur%20Muradoglu,%20Sheeja%20Sivaprasad.pdf (Accessed 31 January 2014).

Agrawal, M., Huang, J. & Boland, J. (2013a) 'Probabilistic Forecasting of Wind Farm Output'. *20th International Congress on Modelling and Simulation.* Adelaide, Australia [online] http://www.mssanz.org.au/modsim2013/G1/agrawal.pdf (Accessed 2 Septembre 2016).

Agrawal, M. R., Boland, J. & Ridley, B. (2013b) 'Analysis of Wind Farm Output: Estimation of Volatility Using High-Frequency Data', *Environmental Modeling & Assessment,* Vol. 18 No. 4, pp. 481-492.

Agresti, A. & Kateri, M. (2011) *Categorical Data Analysis,* Springer, Berlin, Heidelberg, DE.

Agterbosch, S., Vermeulen, W. & Glasbergen, P. (2004) 'Implementation of Wind Energy in the Netherlands: the Importance of the Social–Institutional Setting', *Energy Policy,* Vol. 32 No. 18, pp. 2049-2066.

Aharoni, Y. (1966) 'The Foreign Investment Decision Process', *Thunderbird International Business Review (The International Executive),* Vol. 8 No. 4, pp. 13-14.

Akerlof, G. A. (1970) 'The Market for "Lemons": Quality Uncertainty and the Market Mechanism', *Quarterly Journal of Economics,* Vol. 84 No. 3, pp. 488-500.

Akintoye, A. S. & MacLeod, M. J. (1997) 'Risk Analysis and Management in Construction', *International Journal of Project Management,* Vol. 15 No. 1, pp. 31-38.

Al-Ali, J. & Arkwright, T. (2000) 'An Investigation of UK Companies Practices in the Determination, Interpretation and Usage of Cost of Capital', *Journal of Interdisciplinary Economics,* Vol. 11 No. 3-4, pp. 303-319.

Allen, I. E. & Seaman, C. A. (2007) 'Likert Scales and Data Analyses', *Quality Progress*, Vol. 40 No. 7, [online] (Accessed 10 November 2014).

Allianz (2015, November 24) *Allianz is Phasing Out Coal*, [Press release] https://www.allianz.com/en/press/news/financials/stakes_investments/151123_allianz-is-phasing-out-coal/ (Accessed 18 July 2018).

Allianz Capital Partners (2016) *Investing in Renewables*, [online] http://www.allianzcapitalpartners.com/our-business/renewables/ (Accessed 1 August 2018).

Alvesson, M. & Sköldberg, K. (2009) *Reflexive Methodology: New Vistas for Qualitative Research,* Sage.

Ambler, S. W. & Kroll, P. (2007) *Best Practices for Lean Development Governance, Part II: Processes and Measures,* IBM, [online] http://www.ibm.com/developerworks/rational/library/jul07/kroll_ambler/ (Accessed 13 March 2014).

Amihud, Y. & Mendelson, H. (1986) 'Asset Pricing and the Bid Ask Spread', *Journal of Financial Economics,* Vol. 17 No. 2, pp. 223-249.

Amihud, Y., Mendelson, H. & Pedersen, L. H. (2005) 'Liquidity and Asset Prices', *Foundations & Trends in Finance,* Vol. 1 No. 4, pp. 269-364.

Amram, M. & Kulatilaka, N. (1999) *Real Options: Managing Strategic Investment in an Uncertain World,* Harvard Business School Press, Boston, MA.

Andersen, T. J., Denrell, J. & Bettis, R. A. (2007) 'Strategic Responsiveness and Bowman's Risk–Return Paradox', *Strategic Management Journal,* Vol. 28 No. 4, pp. 407-429.

Ang, J. & Kohers, N. (2001) 'The Take-Over Market for Privately Held Companies: the US Experience', *Cambridge Journal of Economics,* Vol. 25 No. 6, pp. 723-748.

Angelopoulos, D., Brückmann, R., Jirouš, F., Konstantinavičiūtė, I., Noothout, P., Psarras, J., Tesnière, L. & Breitschopf, B. (2016) 'Risks and Cost of Capital for Onshore Wind Energy Investments in EU Countries', *Energy & Environment*, Vol. 27 No. 1, [online] http://journals.sagepub.com/doi/pdf/10.1177/0958305X16638573 (Accessed 15 June 2017).

Angwin, D. (2001) 'Mergers and Acquisitions across European Borders: National Perspectives on Preacquisition Due Diligence and the Use of Professional Advisers', *Journal of World Business,* Vol. 36 No. 1, pp. 32-57.

Appadoo, S. S., Bhatt, S. K. & Bector, C. R. (2008) 'Application of Possibility Theory to Investment Decisions', *Fuzzy Optimization and Decision Making,* Vol. 7 No. 1, pp. 35-57.

Arago, V. & Salvador, E. (2012) 'The Risk-Return Trade-Off in Europe: is there a Pro-Cyclical Risk Aversion?', *Economic Computation & Economic Cybernetics Studies & Research,* Vol. 46 No. 3, pp. 183-194.

Archer, M. (1982) 'Morphogenesis versus Structuration: on Combining Structure and Action', *The British Journal of Sociology,* Vol. 33 No. 4, pp. 455-483.

Archer, M. (1995) *Realist Social Theory: The Morphogenetic Approach,* Cambridge University Press, Cambridge, UK.

Archer, M., Bhaskar, R., Collier, A., Lawson, T. & Norrie, A. (1998) *Critical Realism: Essential Readings,* 1st ed. Routledge, London.

Archer, M., Decoteau, C., Gorski, P., Little, D., Porpora, D., Rutzou, T., Smith, C., Steinmetz, G. & Vandenberghe, F. (2016) *What is Critical Realism?*, [online] http://www.asatheory.org/current-newsletter-online/what-is-critical-realism (Accessed 25 July 2018).

Ariel, R. (1998) 'Risk Adjusted Discount Rates and the Present Value of Risky Costs', *The Financial Review,* Vol. 33 No. 1, pp. 17-30.

Arnold, G. (2008) *Corporate Financial Management,* 4th ed. Pearson Education, Harlow, UK.

Arnold, G. (2010) *Financial Times Guide to Investing - The Definitive Companion to Investment and the Financial Markets,* 2nd ed. FT Prentice Hall - Financial times, Harlow, UK.

Arnold, G. (2013) *Corporate Financial Management,* 5th ed. Pearson Education, Harlow, UK.

Arnold, G. C. & Hatzopoulos, P. D. (2000) 'The Theory-Practice Gap in Capital Budgeting: Evidence from the United Kingdom', *Journal of Business Finance & Accounting,* Vol. 27 No. 5-6, pp. 603-626.

Audi, R. (ed.) (1999) *The Cambridge Dictionary of Philosophy,* New York: Cambridge University Press.

Aurora Energy Research (2018) 'Managing Merchant Risk in Renewables', [online] https://www.auroraer.com/wp-content/uploads/2018/03/Aurora-Energy-Research-Managing-Merchant-Risk-in-Renewables-March-2018-1.pdf (Accessed 3 August 2018).

Aven, T., Vinnem, J. E. & Wiencke, H. (2007) 'A Decision Framework for Risk Management, with Application to the Offshore Oil and Gas Industry', *Reliability Engineering & System Safety,* Vol. 92 No. 4, pp. 433-448.

Awerbuch, S. (2000) 'Investing in Photovoltaics: Risk, Accounting and the Value of New Technology', *Energy Policy,* Vol. 28 No. 14, pp. 1023-1035.

Awerbuch, S. (2003) 'Determining the Real Cost-Why Renewable Power is More Cost-Competitive than Previously Believed', *Renewable Energy World,* Vol. 6 No. 2, pp. 52-61.

Ayyub, B. M. (2014) *Risk Analysis in Engineering and Economics,* CRC Press, Boca Raton, FL.

Azar, J. (2016) 'Portfolio Diversification, Market Power, and the Theory of the Firm', *Browser Download This Paper*.

Badger, R. E. (1925) *Valuation of Industrial Securities,* Prentice-Hall, New York.

Baird, I. S. & Thomas, H. (1985) 'Toward a Contingency Model of Strategic Risk Taking', *Academy of Management Review,* Vol. 10 No. 2, pp. 230-243.

Baker, H. K., Dutta, S. & Saadi, S. (2009) 'Corporate Finance Practices in Canada: Where Do We Stand?', *Multinational Finance Journal,* Vol. 15 No. 3/4, pp. 157-192.

Baker, H. K. & Puttonen, V. (2017) *Investment Traps Exposed: Navigating Investor Mistakes and Behavioral Biases,* Emerald Publishing Limited, Bingley, UK.

Baker, H. K., Singleton, J. C. & Veit, E. T. (2010) *Survey Research in Corporate Finance: Bridging The Gap Between Theory and Practice,* Oxford University Press, Oxford.

Baker, S., Ponniah, D. & Smith, S. (1999) 'Risk Response Techniques Employed Currently for Major Projects', *Construction Management & Economics,* Vol. 17 No. 2, pp. 205-213.

Ballwieser, W. & Hachmeister, D. (2013) *Unternehmensbewertung: Prozess, Methoden und Probleme,* Schäffer-Poeschel Verlag für Wirtschaft Steuern Recht GmbH.

Bamberg, G., Dorfleitner, G. & Krapp, M. (2006) 'Unternehmensbewertung unter Unsicherheit: Zur entscheidungstheoretischen Fundierung der Risikoanalyse [Translation: "On the Evaluation of Risky Streams: Theoretical Underpinnings of the Risk Analysis"]', *Zeitschrift für Betriebswirtschaft,* Vol. 76 No. 3, pp. 287-307.

Banz, R. W. (1981) 'The Relationship between Return and Market Value of Common Stocks', *Journal of Financial Economics,* Vol. 9 No. 1, pp. 3-18.

Barnea, A., Haugen, R. A. & Senbet, L. W. (1980) 'A Rationale for Debt Maturity Structure and Call Provisions in the Agency Theoretic Framework', *The Journal of Finance,* Vol. 35 No. 5, pp. 1223-1234.

Barro, R. J. (2006) 'Rare Disasters and Asset Markets in the Twentieth Century', *The Quarterly Journal of Economics,* Vol. 121 No. 3, pp. 823-866.

Basu, S. (1983) 'The Relationship between Earnings' Yield, Market Value and Return for NYSE Common Stocks: Further Evidence', *Journal of Financial Economics,* Vol. 12 No. 1, pp. 129-156.

Baumann, D. D. & Sims, J. H. (1978) 'Flood Insurance: Some Determinants of Adoption', *Economic Geography,* Vol. 54 No. 3, pp. 189-196.

Bazeley, P. (2004) 'Issues in Mixing Qualitative and Quantitative Approaches to Research', *Applying Qualitative Methods to Marketing Management Research*, pp. 141-156.

Bazeley, P. (2010) 'Computer-Assisted Integration of Mixed Methods Data Sources and Analyses', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods Research for the Social and Behavioral Sciences.* pp. 431-467, SAGE, Thousand Oaks, CA.

Beaver, W., Kettler, P. & Scholes, M. (1970) 'The Association Between Market Determined and Accounting Determined Risk Measures', *Accounting Review,* Vol. 45 No. 4, pp. 654-682.

Beedles, W. L. (1978) 'On the Use of Certainty Equivalent Factors as Risk Proxies', *Journal of Financial Research,* Vol. 1 No. 1, pp. 15-21.

Behrens, A. & Choobineh, F. (1992) 'Use of Intervals and Possibility Distributions in Economic Analysis', *Journal of the Operational Research Society,* Vol. 43 No. 9, pp. 907-918.

Bekaert, G., Erb, C. B., Harvey, C. R. & Viskanta, T. E. (1997) 'What Matters for Emerging Equity Market Investments', *Emerging Markets Quarterly,* Vol. 1 No. 2, pp. 17-46.

Benninga, S. & Protopapadakis, A. A. (1981) 'Real and Nominal Interest Rates Under Uncertainty: The Fisher Theorem and the Term Structure', *Journal of Political Economy,* Vol. 91 No. 5, pp. 856-867.

Bergek, A., Mignon, I. & Sundberg, G. (2013) 'Who Invests in Renewable Electricity Production? Empirical Evidence and Suggestions for Further Research', *Energy Policy,* Vol. 56, pp. 568-581.

Berger, P. G., Ofek, E. & Swary, I. (1996) 'Investor Valuation of the Abandonment Option', *Journal of Financial Economics,* Vol. 42 No. 2, pp. 257-287.

Beringer, S. (2010) *Cash-Flow and Unternehmensbeurteilung [Translation: "Cash-Flow and Company Valuation"],* Erich Schmidt, Berlin.

Berk, J. B. & DeMarzo, P. M. (2011) *Grundlagen der Finanzwirtschaft: Analyse, Entscheidung und Umsetzung [Translation: "Fundamentals of Financial Management: Analysis, Decision-Making and Implementation"],* Pearson Deutschland GmbH, München, D.

Bernhardt, K. J. (2000) *Risk, Uncertainty, and Management Implications*, National Program for Integrated Dairy Risk Management Education & Research, USDA Risk Management Agency, University of Wisconsin, Platteville, pp. 1-11.

Bernstein, P. L. (1996) 'The New Religion of Risk Management', *Harvard Business Review,* Vol. 74 No. 2, pp. 47-&.

Bettis, R. A. 'Risk Considerations in Modeling Corporate Strategy'. in *Academy of Management Proceedings*. Academy of Management, pp. 22-25.

Bhandari, L. C. (1988) 'Debt/Equity Ratio and Expected Common Stock Returns: Empirical Evidence', *Journal of Finance,* Vol. 43 No. 2, pp. 507-528.

Bhandari, N. C. (1981) 'Capital Expenditure Decisions under Risk and Uncertainty', *Advanced Management Journal,* Vol. 46 No. 4, pp. 52-61.

Bhaskar, R. (1975) *A Realist Theory of Science,* 1nd ed. Verso, London.

Bhaskar, R. (1979) *The Possibility of Naturalism: A Philosophical Critique of the Contemporary Human Sciences,* Humanities Press, Atlantic Highlands, NJ.

Bhaskar, R. (1989) *Reclaiming Reality,* Verso, London.

Bhaskar, R. (1998) 'General Introduction', *In:* Archer, M., Bhaskar, R., Collier, A., Lawson, T. & Norrie, A. (eds.) *Critical Realism: Essential Readings.* 1st ed, pp., Routledge, London.

Bhaskar, R. (2008) *A Realist Theory of Science,* 2nd ed. Routledge, London.

Bhaskar, R. (2010a) 'Contexts of Interdisciplinarity: Interdisciplinarity and Climate Change', *In:* Bhaskar, R., Frank, C., Hoyer, K. G. & Næss, P. (eds.) *Interdisciplinarity and climate change.* pp. 15-38, Routledge, London.

Bhaskar, R. (2010b) *Reclaiming Reality: A Critical Introduction to Contemporary Philosophy,* Taylor & Francis.

Bhaskar, R. (2014) *The Possibility of Naturalism: A Philosophical Critique of the Contemporary Human Sciences,* 4th ed. Routledge.

Bhaskar, R., Danermark, B. & Price, L. (2017) *Interdisciplinarity and Wellbeing: A Critical Realist General Theory of Interdisciplinarity,* Routledge.

Bhattacharya, A. & Kojima, S. (2012) 'Power Sector Investment Risk and Renewable Energy: A Japanese Case Study Using Portfolio Risk Optimization Method', *Energy Policy,* Vol. 40, pp. 69-80.

Bhattacharya, S. (1978) 'Project Valuation With Mean-Reverting Cash Flow Streams', *The Journal of Finance,* Vol. 33 No. 5, pp. 1317-1331.

Bierman, H. (1993) 'Capital Budgeting in 1992: A Survey', *Financial Management,* Vol. 22 No. 3, pp. 24-24.

Biesta, G. (2010) 'Pragmatism and the Philosophical Foundations of Mixed Methods Research', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 95-117, SAGE, Thousand Oaks, CA.

Bitaraf, S. & Shahriari, M. (2015) 'Decision Making Under Uncertainty - A Case Study', *International Journal of Risk Assessment and Management,* Vol. 18 No. 1, pp. 21-37.

Black, F. (1972) 'Capital Market Equilibrium with Restricted Borrowing', *Journal of Business,* Vol. 45 No. 3, pp. 444-454.

Black, F. & Scholes, M. (1973) 'The Pricing of Options and Corporate Liabilities', *Journal of Political Economy,* Vol. 81 No. 3, pp. 637.

Blackburn, S. (2005) *Truth: A Guide,* Oxford University Press, Oxford, UK.

Blaikie, N. (2000) 'Designing Social Research', *Polity, UK*.

Blaikie, N. (2009) *Designing Social Research,* 2nd ed. Polity Press, Cambridge, UK.

Blaikie, N. W. (1991) 'A Critique of the Use of Triangulation in Social Research', *Quality and Quantity,* Vol. 25 No. 2, pp. 115-136.

Block, S. (2003) 'Divisional Cost of Capital: A Study of Its Use by Major US Firms', *The Engineering Economist,* Vol. 48 No. 4, pp. 345-362.

Block, S. (2005) 'Are There Differences in Capital Budgeting Procedures Between Industries? An Empirical Study', *The Engineering Economist,* Vol. 50 No. 1, pp. 55-67.

Bock, K. & Trück, S. (2011) 'Assessing Uncertainty and Risk in Public Sector Investment Projects', *Technology and Investment,* Vol. 2 No. 02, pp. 105.

Bodie, Z., Kane, A. & Marcus, A. (2014) *Investments,* McGraw-Hill Education, Berkshire.

Bodnar, G. M., Hayt, G. S. & Marston, R. C. (1998) 'Wharton Survey of Financial Risk Management by US Non-Financial Firms', *Financial Management*, [online] http://finance.wharton.upenn.edu/~bodnarg/courses/readings/survey98.pdf (Accessed 28 January 2014).

Bogdan, R. & Biklen, S. (2007) Qualitative Research for Education: An Introduction to Theory and Practice. Boston: Allyn and Bacon.

Boland, J. W., lgorzata Korolkiewicz, M., Agrawal, M. & Huang, J. 'Forecasting Solar Radiation on Short Time Scales Using a Coupled Autoregressive and Dynamical System (CARDS) Model'. in *50th Annual Conference Australian Solar Energy Society*, Melbourne, Australia. AuSES-Australian Solar Energy Society, pp. 1-10.

Böttcher, J. (2009) *Finanzierung von Erneuerbare-Energien-Vorhaben [Translation: "Financing of Renewable Energy Projects"],* Oldenbourg, München.

Böttcher, J. & Blattner, P. (2010) *Projektfinanzierung [Translation: "Project Financing"],* Oldenbourg, München.

Botzen, W. J., Aerts, J. C. & van den Bergh, J. C. (2009) 'Willingness of Homeowners to Mitigate Climate Risk Through Insurance', *Ecological Economics,* Vol. 68 No. 8, pp. 2265-2277.

Bowman, E. H. (1980) 'A Risk/Return Paradox for Strategic Management', *Sloan Management Review,* Vol. 21 No. 3, pp. 17-31.

Boyd, R. (2002) Scientific Realism. *In:* Zalta, E. N. (ed.) *The Stanford Encyclopedia of Philosophy.* https://plato.stanford.edu/archives/sum2002/entries/scientific-realism/ (Accessed 18 August 2018).

Brach, M. A. (2003) *Real Options in Practice,* John Wiley & Sons.

Brandt, M. W. & Wang, K. Q. (2003) 'Time-varying risk aversion and unexpected inflatio', *Journal of Monetary Economics,* Vol. 50, pp. 1457–1498.

Brealey, R. A., Myers, S. C. & Allen, F. (2011) *Principles of corporate finance,* 10th ed. The McGraw-Hill Companies, Inc., New York.

Breeden, D. T. (1979) 'An intertemporal asset pricing model with stochastic consumption and investment opportunties', *Journal of Financial Economics,* Vol. 7 No. 3, pp. 265-296.

Brennan, M. (1971) 'A note on dividend irrelevance and the Gordon valuation model', *The Journal of Finance,* Vol. 26 No. 5, pp. 1115-1121.

Brennan, M. J. & Trigeorgis, L. (2000) *Project flexibility, agency, and competition: new developments in the theory and application of real options,* Oxford University Press, USA.

Brennan, M. J. & Xia, Y. (2003) 'Risk and valuation under an intertemporal capital asset pricing model', *Social Science Research Network, Rodney L. White Center for Financial Research*, [online] <http://ssrn.com/abstract=418922> or <http://dx.doi.org/10.2139/ssrn.418922> (Accessed 2014, March 15).

Brewer, J. & Hunter, A. (1989) *Multimethod research: A synthesis of styles,* SAGE, Newbury Park, CA.

Brewer, M. B. & Crano, W. D. (2000) 'Research design and issues of validity', *Handbook of research methods in social and personality psychology*, pp. 3-16.

Brigham, E. F. (1975) 'Hurdle rates for screening capital expenditure proposals', *Financial Management,* Vol. 4 No. 3, pp. 17-26.

Brigham, E. F. & Ehrhardt, M. C. (2008) *Financial Managment: Theory and Practice,* Thomson Learning, Mason OH.

Brigham, E. F. & Houston, J. F. (2012) *Fundamentals of financial management,* Consice 7th ed. South-Western Cengage Learning, Mason, OH.

Brigham, E. F., Shome, D. K. & Vinson, S. R. (1985) 'The Risk Premium Approach to Measuring a Utility's Cost of Equity', *Financial Management (1972),* Vol. 14 No. 1, pp. 33-45.

Britzelmaier, B. (2013) *Wertorientierte Unternehmensführung [Translation: "Value-Oriented Management"],* 2nd ed. Kiehl, Herne, DE.

Britzelmaier, B., Kraus, P., Häberle, M., Mayer, B. & Beck, V. 'Value-Based Management in SMEs - A Critical Analysis of the Applicability and Determination of the Cost of Capital'. in *5th Annual EuroMed Conference of the EuroMed Academy of Business*, Glion-Montreux, Switzerland. pp. 214-224.

Bröer, N. & Däumler, K. (1986) 'Investitionsrechnungsmethoden in der Praxis. Eine Umfrage [Translation: "Investment Accounting Methods in Practice. A Survey"', *Buchführung, Bilanz, Kostenrechnung, Herne*, 13 [online].

Bromiley, P., McShane, M., Nair, A. & Rustambekov, E. (2015) 'Enterprise Risk Management: Review, Critique, and Research Directions', *Long Range Planning,* Vol. 48 No. 4, pp. 265-276.

Brosius, F. (1998) *SPSS 8 - Professionelle Statistik unter Windows [Translation: "SPSS 8 - Professional Statistics in Windows],* MITP-Verlag GmbH, Bonn, DE.

Brounen, D., De Jong, A. & Koedijk, K. (2004) 'Corporate Finance in Europe Confronting Theory with Practice', *EFA 2004 Maastricht Meetings Paper No. 2769*, [online] http://ssrn.com/abstract=559415 (Accessed 24 February 2015).

Brounen, D., De Jong, A. & Koedijk, K. (2006) 'Capital Structure Policies in Europe: Survey Evidence', *Journal of Banking & Finance,* Vol. 30 No. 5, pp. 1409-1442.

Brown, R. & Brignall, S. (2007) 'Reflections on the Use of a Dual-Methodology Research Design to Evaluate Accounting and Management Practice in UK University Central Administrative Services', *Management Accounting Research,* Vol. 18 No. 1, pp. 32-48.

Bruck, M., Goudarzi, N. & Sandborn, P. 'A levelized Cost of Energy (LCOE) Model for Wind Farms that Includes Power Purchase Agreement (PPA) Energy Delivery Limits'. in *ASME 2016 - Power Conference PowerEnergy2016*, Charlotte, NC, USA. American Society of Mechanical Engineers, pp. V001T010A007-V001T010A007.

Bruner, R. F., Eades, K. M., Harris, R. S. & Higgins, R. C. (1998) 'Best Practices in Estimating the Cost of Capital: Survey and Synthesis', *Financial Practice and Education,* Vol. 8 No. 1, pp. 13-28.

Brunwasser, H. J. & McGowan, C. (1989) 'The Evaluation of International Capital Investment Decisions by United States Domiciled Multinationals: A Survey of Current Practice', *American Business Review,* Vol. 7 No. 1, pp. 23-29.

Bryman, A. (2006) 'Integrating Quantitative and Qualitative Research: How is it Done?', *Qualitative research,* Vol. 6 No. 1, pp. 97-113.

Bryman, A. (2007) 'Barriers to integrating quantitative and qualitative research', *Journal of mixed methods research,* Vol. 1 No. 1, pp. 8-22.

Bryman, A., Becker, S. & Sempik, J. (2008) 'Quality Criteria for Quantitative, +ualitative and Mixed Methods Research: A View from Social Policy', *International Journal of Social Research Methodology,* Vol. 11 No. 4, pp. 261-276.

Bryman, A. & Bell, E. (2011) *Business Research Methods,* 3rd ed. Oxford university press, Oxford, UK.

Buehler, K., Freeman, A. & Hulme, R. (2008) 'Owning the Right Risks', *Harvard Business Review,* Vol. 86 No. 9, pp. 102-110.

Bufka, J., Schiereck, D. & Zinn, K. (1999) 'Kapitalkostenbestimmung für diversifizierte Unternehmen: Ein empirischer Methodenvergleich [Translation: "Estimation of Cost of Capital of Diversified Companies: a Comparison of Empirical Methods"]', *Zeitschrift für Betriebswirtschaft,* Vol. 69 No. 1, pp. 115-131.

Bullard, S. H., Gunter, J. E., Doolittle, M. L. & Arano, K. G. (2002) 'Discount Rates for Nonindustrial Private Forest Landowners in Mississippi: How High a Hurdle?', *Southern Journal of Applied Forestry,* Vol. 26 No. 1, pp. 26-31.

Bullen, P. (2013) *Risk Management - Tools,* Management Alternatives, [online] http://www.mapl.com.au/risk/risk4.htm (Accessed 26 July 2016).

Bürer, M. J. & Wüstenhagen, R. (2009) 'Which Renewable Energy Policy is a Venture Capitalist's Best Friend? Empirical Evidence from a Survey of International Cleantech Investors', *Energy Policy,* Vol. 37 No. 12, pp. 4997-5006.

Burns, R. M. & Walker, J. (1997) 'Capital Budgeting Techniques Among the Fortune 500: A Rationale Approach', *Managerial Finance,* Vol. 23 No. 9, pp. 3-15.

Burrell, G. & Morgan, G. (1979) *Sociological Paradigms and Organisational Analysis,* Heinemann, London.

Butler, J. & Schachter, B. (1989) 'The Investment Decision: Estimation Risk and Risk Adjusted Discount Rates', *Financial Management,* Vol. 18 No. 4, pp. 13-22.

BWE (2015) *Akteursstruktur von Windenergieprojekten in Deutschland [Translation: "Stakeholder Structure of Wind Energy Projects in Germany],* https://www.wind-energie.de/sites/default/files/download/publication/akteursstrukturen-von-windenergieprojekten-deutschland/20150218_studie_akteursvielfalt_final.pdf (Accessed 2 July 2017).

Cain, M. D., Denis, D. J. & Denis, D. K. (2011) 'Earnouts: A study of Financial Contracting in Acquisition Agreements', *Journal of Accounting and Economics,* Vol. 51 No. 1, pp. 151-170.

Câmara, A., Chung, S. L. & Wang, Y. H. (2009) 'Option Implied Cost of Equity and Its Properties', *Journal of Futures Markets: Futures, Options, and Other Derivative Products,* Vol. 29 No. 7, pp. 599-629.

Campbell, D. T. (1957) 'Factors Relevant to the Validity of Experiments in Social Settings', *Psychological Bulletin,* Vol. 54 No. 4, pp. 297-312.

Campbell, D. T. & Fiske, D. W. (1959) 'Convergent and Discriminant Validation by the Multitrait-Multimethod Matrix', *Psychological Bulletin,* Vol. 56 No. 2, pp. 81-105.

Campbell, J. Y. (1987) 'Stock Returns and the Term Structure', *Journal of Financial Economics,* Vol. 18 No. 2, pp. 373-399.

Campbell, J. Y. & Mei, J. (1993) 'Where Do Betas Come From? Asset Price Dynamics and the Sources of Systematic Risk', *The Review of Financial Studies,* Vol. 6 No. 3, pp. 567-592.

Campbell, J. Y. & Vuolteenaho, T. (2004) 'Bad Beta, Good Geta', *American Economic Review,* Vol. 94 No. 5, pp. 1249-1275.

Capron, L. & Shen, J.-C. (2007) 'Acquisitions of Private vs. Public Firms: Private Information, Target Selection, and Acquirer Returns', *Strategic Management Journal,* Vol. 28 No. 9, pp. 892-911.

Carhart, M. M. (1997) 'On Persistence in Mutual Fund Performance', *Journal of Finance,* Vol. 52 No. 1, pp. 57-82.

Carifio, J. & Perla, R. J. (2007) 'Ten Common Misunderstandings, Misconceptions, Persistent Myths and Urban Legends about Likert Scales and Likert Response Formats and Their Antidotes', *Journal of Social Sciences,* Vol. 3 No. 3, pp. 106-116.

Carlson, A. (2002) 'On Cost-Effective Technical Measures to Avoid Environmental Damages of Regional Energy Systems', *International Journal of Energy Research,* Vol. 26 No. 12, pp. 1103-1115.

Carmichael, D. G. (2011) 'An Alternative Approach to Capital Investment Appraisal', *The Engineering Economist,* Vol. 56 No. 2, pp. 123-139.

Carmichael, D. G. (2014) *Infrastructure Investment: An Engineering Perspective,* CRC Press, Boca Raton, FL.

Carmichael, D. G. (2016) 'Risk–a Commentary', *Civil Engineering and Environmental Systems,* Vol. 33 No. 3, pp. 177-198.

Carmichael, D. G. & Balatbat, M. C. (2008) 'Probabilistic DCF Analysis and Capital Budgeting and Investment - A Survey', *The Engineering Economist,* Vol. 53 No. 1, pp. 84-102.

Carter, S. M. & Little, M. (2007) 'Justifying Knowledge, Justifying Method, Taking Action: Epistemologies, Methodologies, and Methods in Qualitative Research', *Qualitative Health Research,* Vol. 17 No. 10, pp. 1316-1328.

Casey, C. (2004) 'Neue Aspekte des Roll Back-Verfahrens in der Unternehmensbewertung [Translation: "New Aspects of the Roll-Back Approach in Company Valuation"]', *Zeitschrift fur Betriebswirtschaft,* Vol. 74 No. 2, pp. 139-164.

Cassell, C. (2009) 'Interviews in Organizational Research', *In:* Bryman, A. & Buchanan, D. (eds.) *The Sage Handbook of Organizational Research Methods.* pp. 500-516, SAGE, London.

Chan, L. K., Hamao, Y. & Lakonishok, J. (1991) 'Fundamentals and Stock Returns in Japan', *Journal of Finance,* Vol. 46 No. 5, pp. 1739-1789.

Chang, B.-Y., Christoffersen, P., Jacobs, K. & Vainberg, G. (2011) 'Option-Implied Measures of Equity Risk', *Review of Finance*, [online] https://ssrn.com/abstract=1416753 (Accessed 1 July 2017).

Chapman, C. & Ward, S. (2003) *Project Risk Management: Processes, Techniques and Insights,* 2nd ed. John Wiley & Sons Ltd, West Sussex, UK.

Chen, C. W. S., Gerlach, R. H. & Lin, A. M. H. (2011) 'Multi-Regime Nonlinear Capital Asset Pricing Models', *Quantitative Finance,* Vol. 11 No. 9, pp. 1421-1438.

Chen, H.-Y. (1967) 'Valuation under Uncertainty', *Journal of Financial and Quantitative Analysis,* Vol. 2 No. 03, pp. 313-325.

Chen, N.-f., Roll, R. & Ross, S. A. (1986) 'Economic Forces and the Stock Market', *Journal of Business,* Vol. 56 No. 3, pp. 383-403.

Cheng, E. W. L., Li, H. & Ho, D. C. K. (2002) 'Analytic Hierarchy Process (AHP): A Defective Tool When Used Improperly', *Measuring Business Excellence,* Vol. 6 No. 4, pp. 33-37.

Cheng, P., Lin, Z. & Liu, Y. (2013) 'Liquidity Risk of Private Assets: Evidence from Real Estate Markets', *Financial Review,* Vol. 48 No. 4, pp. 671-696.

Cheremushkin, S. V. (2009) 'Revisiting Modern Discounting of Risky Cash Flows: Imbedding Uncertainty Resolution Functions into Risk-Adjusted Discount Rates and Certainty Equivalent Factors (Revised)', [online] https://ssrn.com/abstract=1526683 (Accessed 14 November 2016).

Chesla, C. A. (1989) 'Parents' Illness Models of Schizophrenia', *Archives of Psychiatric Nursing,* Vol. 3 No. 4, pp. 218-225.

Cholasuke, C., Bhardwa, R. & Antony, J. (2004) 'The Status of Maintenance Management in UK Manufacturing Organisations: Results from a Pilot Survey', *Journal of Quality in Maintenance Engineering,* Vol. 10 No. 1, pp. 5-15.

Chong, J., Jin, Y. & Phillips, M. (2013) 'The Entrepreneur's Cost of Capital: Incorporating Downside Risk in the Buildup Method (Working Paper, Posting Prohibited)', [online] http://www.macrorisk.com/wp-content/uploads/2013/04/MRA-WP-2013-e.pdf (Accessed 4 March 2014).

Christy, G. A. (1966) *Capital Budgeting: Current Practices and Their Efficiency,* Bureau of Business and Economic Research, University of Oregon, Eugene, OR.

Chua, J. H., Wu, Z. & Chang, P. C. (2006) 'The Full-Information Approach for Estimating Divisional Betas: Implementation Issues and Tests', *Journal of Applied Finance*, Vol. 16 No. 1, [online] http://ssrn.com/abstract=926173 (Accessed 5 April 2016).

Cleden, D. (2012) *Managing Project Uncertainty,* Routledge, London.

Cochrane, J. H. (1991) 'Production-Based Asset Pricing and the Link Between Stock Returns and Economic Fluctuations', *Journal of Finance,* Vol. 46 No. 1, pp. 209-237.

Cochrane, J. H. (2000) *Asset Pricing,* Princeton University Press, Princeton, NJ.

Cochrane, J. H. (2005) 'The Risk and Return of Venture Capital', *Journal of Financial Economics,* Vol. 75 No. 1, pp. 3-52.

Coenenberg, A. G. & Schultze, W. (2002) 'Unternehmensbewertung: Konzeptionen und Perspektiven [Translation: "Company Valuation: Concepts and Perspectives"]', *DBW,* Vol. 62 No. 6, pp. 597-621.

Coenenberg, A. G. & Schultze, W. (2006) 'Methoden der Unternehmensbewertung [Translation: "Methods of Company Valuation"]', *In:* Wirth, B. W. (ed.) *Handbuch Mergers & Acquisitions Management.* pp. 471-500, Gabler, Wiesbaden.

Coghlan, D. & Brannick, T. (2014) *Doing Action Research in Your Own Organization,* SAGE, Thousand Oaks, CA.

Cohen, J. (1988) *Statistical Power Analysis for the Behavior Science,* 2nd ed. Lawrance Eribaum Association, Hillsdale, NJ.

Cohen, L., Manion, L. & Morrison, K. (2013) *Research Methods in Education,* Routledge, London.

Cohen, M. A. & Huchzermeier, A. (1999) 'Global Supply Chain Management: A Survey of Research and Applications', *In:* Tayur, S., Ganeshan, R. & Magazine, M. J. (eds.) *Quantitative Models for Supply Chain Management.* pp. 669-702, Kluwer Academic Publishers, Dordrecht.

Collan, M., Fullér, R. & Mezei, J. (2009) 'A Fuzzy Pay-Off Method for Real Option Valuation', *Journal of Applied Mathematics & Decision Sciences,* Vol. 2009 No. 13, pp. 1-14.

Collan, M., Haahtela, T. & Kyläheiko, K. (2016) 'On the Usability of Real Option Valuation Model Types under Different Types of Uncertainty', *International Journal of Business Innovation and Research,* Vol. 11 No. 1, pp. 18-37.

Collins, K. M. T., Onwuegbuzie, A. J. & Sutton, I. L. (2006) 'A Model Incorporating the Rationale and Purpose for Conducting Mixed Methods Research in Special Education and Beyond', *Learning Disabilities: A Contemporary Journal,* Vol. 4 No. 1, pp. 67-100.

Committee for Oversight and Assessment of U.S. Department of Energy Project Management - National Research Council (COA-DOE) (2005) *The Owner's Role in Project Risk Management,* The National Academies Press, Washington, D.C.

Connor, G. (1984) 'A Unified Beta Pricing Theory', *Journal of Economic Theory,* Vol. 34 No. 1, pp. 13-31.

Connor, G. & Korajczyk, R. A. (1989) 'An Intertemporal Equilibrium Beta Pricing Model', *Review of Financial Studies,* Vol. 2 No. 3, pp. 373-392.

Cook, T. D., Campbell, D. T. & Day, A. (1979) *Quasiexperimentation: Design & Analysis Issues for Field Settings,* Houghton Mifflin, Boston, MA.

Cook, T. D. & Reichardt, C. S. (eds.) (1979) *Qualitative and Quantitative Methods in Evaluation Research,* Vol. 1. Beverly Hills, CA: SAGE Publications.

Cooper, D. R. & Schindler, P. S. (2003) *Business Research Methods,* Vol. 9. McGraw-Hill, New York.

Copeland, T. & Antikarov, V. (2003) *Real Options: A Practitioners Guide,* Cengage Learning, New York.

Copeland, T. & Weiner, J. (1990) 'Proactive Management of Uncertainty', *McKinsey Quarterly,* Vol. 10 No. 4, pp. 133-152.

Copeland, T., Weston, J. F. & Shastri, K. (2005) *Financial Theory and Corporate Policy,* 4th ed. Addison-Wesely, Boston, MA.

Copeland, T. E., Koller, T. & Murrin, J. (2002) *Unternehmenswert: Methoden und Strategien für eine wertorientierte Unternehmensführung [Translation: "Corporate Value: Methods and Strategies for Value-Based Corporate Governance"],* 3nd ed. Campus Verlag, Frankfurt/New York.

Copur, Z. (2015) *Handbook of Research on Behavioral Finance and Investment Strategies: Decision Making in the Financial Industry: Decision Making in the Financial Industry,* IGI Global, Hershey, PA.

Cornelius, I. & Davies, M. (1997) *Shareholder Value,* Financial Times: Financial Publishing, London.

Cornell, B. (1999) 'Risk, duration, and capital budgeting: New evidence on some old questions', *The Journal of Business,* Vol. 72 No. 2, pp. 183-200.

Cornell, B. (2000) 'Equity Duration, Growth Options and Asset Pricing', *The Journal of Portfolio Management,* Vol. 26, pp. 183-200.

Cornell, B., Hirshleifer, J. I. & James, E. P. (1997) 'Estimating the Cost of Equity Capital', *Contemporary Finance Digest,* Vol. 1 No. 1, pp. 5-13.

Cotner, J. S. & Fletcher, H. D. (2000) 'Computing the Cost of Capital for Privately Held Firms', *American Business Review,* Vol. 18 No. 2, pp. 27-33.

Couture, T. & Gagnon, Y. (2010) 'An Analysis of Feed-in Tariff Remuneration Models: Implications for Renewable Energy Investment', *Energy Policy,* Vol. 38 No. 2, pp. 955-965.

Covaleski, M. A. & Dirsmith, M. W. (1990) 'Dialectic Tension, Double Reflexivity and the Everyday Accounting Researcher: on Using Qualitative Methods', *Accounting, Organizations and Society,* Vol. 15 No. 6, pp. 543-573.

Creswell, J. W. (1999) 'Mixed-Method Research: Introduction and Application', *In:* Cijek, T. (ed.) *Handbook of Educational Policy.* pp. 455-472, Academic Press, San Diego, CA.

Creswell, J. W. (2002) *Educational Research: Planning, Conducting, and Evaluating Quantitative,* Prentice Hall, Upper Saddle River, NJ.

Creswell, J. W. (2011) 'Controversies in Mixed Methods Research', *In:* Denzin, N. K. & Lincoln, Y. S. (eds.) *The SAGE Handbook of Qualitative Research.* 4th ed, pp. 269-284, SAGE, Thousand Oaks, CA.

Creswell, J. W. (2013) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches,* SAGE, Thousand Oaks, CA.

Creswell, J. W. & Plano Clark, V. L. (2011a) 'Choosing a Mixed Methods Design', *In:* Creswell, J. W. & Plano Clark, V. L. (eds.) *Designing and Conducting Mixed Methods Research.* 2nd ed, pp. 53-106, SAGE, Thousand Oaks, CA.

Creswell, J. W. & Plano Clark, V. L. (2011b) *Designing and Conducting Mixed Methods Research,* 2nd ed. SAGE, Thousand Oaks, CA.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L. & Hanson, W. E. (2003) 'Advanced Mixed Methods Research Designs', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 209-240, SAGE, Thousand Oaks, CA.

Cronbach, L. J. (1951) 'Coefficient Alpha and the Internal Structure of Tests', *Psychometrika,* Vol. 16 No. 3, pp. 297-334.

Csapi, V. (2013) 'Applying Real Options Theory in the Electrical Energy Sector', *Public Finance Quarterly (0031-496X),* Vol. 58 No. 4, pp. 469-483.

Cua, F. C. & Garret, T. C. (2009) 'Understanding Ontology and Epistemology in Information Systems

research', *In:* Cater-Steel, A. & Al-Hakim, L. (eds.) *Information Systems Research Methods, Epistemology, and Applications.*, pp. 35–56, Information Science Reference, Hershey, PA.

Curry, L. & Nunez-Smith, M. (2015) *Mixed Methods in Health Sciences Research: A Practical Primer,* SAGE Publications, Thousand Oaks, CA.

Curtis, S., Gesler, W., Smith, G. & Washburn, S. (2000) 'Approaches to Sampling and Case Selection in Qualitative Research: Examples in the Geography of Health', *Social Science & Medicine,* Vol. 50 No. 7, pp. 1001-1014.

Cyert, R. & March, J. G. (1963) *A Behavioral Theory of the Firm,* Prentice-Hall, Englewood Cliffs, NJ.

da Silva Bastos, C. F. & Martins, A. M. F. (2007) 'O Cálculo do Custo do Capital nas Decisões de Investimento em Activos Reais em Portugal: Uma Análise Empírica'. in *Conocimiento, Innovación y Emprendedores: Camino al Futuro*, Lisboa. Logroño, ES: Universidad de La Rioja, pp. 857-870.

Damodaran, A. (2001) *Corporate Finance: Theory and Practice. ,* 2nd ed. John Wiley & Sons, New York.

Damodaran, A. (2005a) 'Marketability and Value: Measuring the Illiquidity Discount', *Social Science Research Network*, [online] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=841484 (Accessed 10 November 2013).

Damodaran, A. (2005b) 'The Promise and Peril of Real Option', *NYU*, [online] http://people.stern.nyu.edu/adamodar/pdfiles/papers/realopt.pdf (Accessed 15 March 2014).

Damodaran, A. (2005c) 'Value and Risk: Beyond Betas', *Financial Analysts Journal,* Vol. 61 No. 2, pp. 38-43.

Damodaran, A. (2005d) 'The Value of Synergy', *SSRN*, [online] https://ssrn.com/abstract=841486 or http://dx.doi.org/10.2139/ssrn.841486 (Accessed 13 May 2017).

Damodaran, A. (2008) 'What is the Riskfree Rate? A Search for the Basic Building Block', *Social Science Research Network*, [online] http://ssrn.com/abstract=1317436 (Accessed 5 January 2014).

Damodaran, A. (2010) 'Comatose Markets: What if Liquidity is Not the Norm?', *Social Science Research Network*, [online] http://ssrn.com/abstract=1729408 (Accessed 5 January 2014).

Damodaran, A. (2011a) *Alternatives to the CAPM: Part 1: Relative Risk Measures*, [online] http://aswathdamodaran.blogspot.ch/2011/04/alternatives-to-capm-part-1-relative.html (Accessed 13 January 2014).

Damodaran, A. (2011b) *Alternatives to the CAPM: Part 2: Proxy Models*, [online] http://aswathdamodaran.blogspot.ch/2011/04/alternatives-to-capm-part-2-proxy.html (Accessed 13 January 2014).

Damodaran, A. (2011c) *Alternatives to the CAPM: Part 5: Risk Adjusting the cash flows*, [online] http://aswathdamodaran.blogspot.ch/2011/04/alternatives-to-capm-5-risk-adjusting.html (Accessed 13 January 2014).

Damodaran, A. (2012) *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset,* 3rd ed. John Wiley & Sons, Hoboken, NJ.

Damodaran, A. (2013) 'Equity Risk Premiums (ERP): Determinants, Estimation and Implications - The 2013 Edition', *Social Science Research Network*, [online] http://ssrn.com/abstract=2238064 (Accessed 20 September 2013).

Damodaran, A. (2017) 'Equity Risk Premiums (ERP): Determinants, Estimation and Implications - The 2017 Edition', *Social Science Research Network*, [online] http://ssrn.com/abstract=2238064 (Accessed 20 September 2013).

Damodaran, A. (n.d.) 'The Adjusted Present Value Approach', [online] http://pages.stern.nyu.edu/~adamodar/New_Home_Page/valquestions/apv.htm (Accessed 6 July 2017).

Danermark, B., Ekstrom, M. & Jakobsen, L. (2005) *Explaining Society: An Introduction to Critical Realism in the Social Sciences,* Routledge, London.

Dash, S. R. & Mahakud, J. (2013) 'A Comparative Assessment of Unconditional Multifactor Asset-pricing Models', *Journal of Management Research (09725814),* Vol. 13 No. 1, pp. 35-54.

Datar, S., Frankel, R. & Wolfson, M. (2001) 'Earnouts: The Effects of Adverse Selection and Agency Costs on Acquisition Techniques', *Journal of Law, Economics, and Organization,* Vol. 17 No. 1, pp. 201-238.

Datta, L. (1994) 'Paradigm Wars: A Basis for Peaceful Coexistence and Beyond', *In:* Reichardt, C. S. & Rallis, S. F. (eds.) *New Directions for Evaluation, No. 61.* pp. 53-70, Jossey-Bass, San Francisco.

David, M. & Sutton, C. D. (2011) *Social research: An introduction,* 2nd ed. SAGE, London, UK.

Davidson, C. (2009) 'Transcription: Imperatives for Qualitative Research', *International Journal of Qualitative Methods,* Vol. 8 No. 2, pp. 35-52.

Davies, R., Goedhart, M. & Koller, T. (2012) 'Avoiding a Risk Premium that Unnecessarily Kills Your Project', *McKinsey Quarterly*, Vol. 2, [online] http://www.washburn.edu/faculty/rweigand/McKinsey/McKinsey-Avoiding-Risk-Premium-That-Kills-A-Project-2012.pdf (Accessed 30 June 2017).

De Vaus, D. A. (2002) *Surveys in Social Research,* Psychology Press, St. Leonards, AUS.

Dellinger, A. B. & Leech, N. L. (2007) 'Toward a Unified Validation Framework in Mixed Methods Research', *Journal of Mixed Methods Research,* Vol. 1 No. 4, pp. 309-332.

Deloitte (2014) *Establishing the Investment Case Wind Power*, Deloitte. [online] https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-er-deloitte-establishing-the-wind-investment-case-2014.pdf (Accessed 15 May 2017).

Deloitte (2015) *Establishing the Investment Case - Wind Power,* Deloitte, Copenhagen, DK.

Delorme, R. 'Realism in Economics: Critical or Complex'. in *XIth Conference of The European Association for Evolutionary Political Economy Charles University of Prague*, Prague. Citeseer, pp. 4-7.

Dhaliwal, D., Heitzman, S. & Zhen, O. (2006) 'Taxes, Leverage, and the Cost of Equity Capital', *Journal of Accounting Research,* Vol. 44 No. 4, pp. 691–723.

Dierkes, S., Diedrich, R. & Gröger, H.-C. (2009) 'Unternehmensbewertung bei wertabhängiger und autonomer Finanzierungspolitik unter Berücksichtigung einer Kursgewinnbesteuerung [Translation: "Company Valuation in the Case of Value-Dependent and Autonomous Financing Policies Taking into Account a Price Gain Tax"]', *Zeitschrift für Betriebswirtschaft,* Vol. 79 No. 3, pp. 275-301.

Dimitrov, V. & Jain, P. C. (2008) 'The Value-Relevance of Changes in Financial Leverage Beyond Growth in Assets and GAAP Earnings', *Journal of Accounting, Auditing & Finance,* Vol. 23 No. 2, pp. 191-222.

Dimson, E., Marsh, P. & Staunton, M. (2002a) 'Global Evidence on the Equity Risk Premium', *Journal of Applied Corporate Finance,* Vol. 15 No. 4, pp. 27-38.

Dimson, E., Marsh, P. & Staunton, M. (2002b) *Triumph of the Optimists: 101 Years of Global Investment Returns,* Princeton University Press, Princeton, NJ.

Dixit, A. K. & Pindyck, R. S. (1995) 'The Options Approach to Capital Investment', *Harvard Business Review,* Vol. 73 No. 3, pp. 105-115.

DNV GL (2018) 'Energy Transition Outlook 2018 - A Global and Regional Forecast to 2050', [online] https://eto.dnvgl.com/2018/download (Accessed 10 September 2018).

Dobson, P. (2002) 'Critical Realism and Information Systems Research: Why Bother with Philosophy?', [online] (Accessed 24 May 2014).

Downward, P., Finch, J. H. & Ramsay, J. (2002) 'Critical Realism, Empirical Methods and Inference: A Critical Discussion', *Cambridge Journal of Economics,* Vol. 26 No. 4, pp. 481-500.

Dressler, R. A. & Kreuz, R. J. (2000) 'Transcribing Oral Discourse: A Survey and a Model System', *Discourse Processes,* Vol. 29 No. 1, pp. 25-36.

Driessen, J., Lin, T.-C. & Phalippou, L. (2012) 'A New Method to Estimate Risk and Return of Nontraded Assets from Cash Flows: The Case of Private Equity Funds', *Journal of Financial and Quantitative Analysis,* Vol. 47 No. 3, pp. 511-535.

Drukarczyk, J. & Schüler, A. (2009) *Unternehmensbewertung [Translation: "Company Valuation"],* Verlag Franz Vahlen, München, DE.

Duffie, D. & Zame, W. (1989) 'The Consumption-Based Capital Asset Pricing Model', *Econometrica,* Vol. 57 No. 6, pp. 1279-1297.

Dunn, B., Kamath, H. & Tarascon, J.-M. (2011) 'Electrical Energy Storage for the Grid: A Battery of Choices', *Science,* Vol. 334 No. 6058, pp. 928-935.

Easterby-Smith, M., Thorpe, R. & Jackson, P. (2012) *Management Research,* SAGE Publications, Thousand Oaks, CA.

EEA (2017) *Trends and Projections in Europe 2017 - Tracking Progress towards Europe's Climate and Energy Targets (EEA Report No. 17/2017)*, Luxembourg. https://www.eea.europa.eu/themes/climate/trends-and-projections-in-europe/trends-and-projections-in-europe-2017/index (Accessed 10 January 2018).

Efron, B. & Tibshirani, R. J. (1993) *An Introduction to the Bootstrap,* Chapman & Hall, New York.

Ehrhardt, M. C. (2001) *The Search for Value: Measuring the Company's Cost of Capital,* Oxford University Press, Oxford, UK.

Ehrhardt, M. C. & Bhagwat, Y. N. (1991) 'A Full-Information Approach for Estimating Divisional Betas', *The Journal of the Financial Management Association,* Vol. 20 No. 2, pp. 60-69.

Ehrhardt, M. C. & Brigham, E. F. (2016) *Corporate Finance: A Focused Approach,* Cengage Learning, Boston, MA.

Eisenhardt, K. M. (1989) 'Building Theories from Case Study Research', *Academy of Management Review,* Vol. 14 No. 4, pp. 532-550.

Elton, E. J., Gruber, M. J., Brown, S. J. & Goetzmann, W. N. (2010) *Modern Portfolio Theory and Investment Analysis,* 8th ed. John Wiley & Sons, Inc., New York.

Energy Rev (2018) 'Merchant risk: When a PPA alone just isn't enough', [online] https://energy-rev.com/2018/04/12/merchant-risk-when-a-ppa-alone-just-isnt-enough/ (Accessed 3 August 2018).

EnergyVortex.com (n.d.) *Energy Dictionary - Independent Power Producer (IPP), Non-Utility Generator (NUG)* [online] https://energyvortex.com/energydictionary/independent_power_producer_(ipp)__non_utility_generator_(nug).html (Accessed 30 August 2017).

Ericsson, J. & Karlsson, S. (2004) 'Choosing Factors in a Multifactor Asset Pricing Model: A Bayesian Approach', *SSE/EFI Working Paper Series in Economics and Finance*, [online] http://swopec.hhs.se/hastef/papers/hastef0524.pdf (Accessed 20 January 2014).

Erzberger, C. (1998) *Zahlen und Wörter: Die Verbindung quantitativer und qualitativer Daten und Methoden im Forschungsprozess [Translation: "Numbers and Words: The Combination of Quantitative and Qualitative Data and Methods in the Research Process"],* Deutscher Studien Verlag, Weinheim, DE.

Erzberger, C. & Kelle, U. (2003) 'Making Inferences in Mixed Methods: The Rules of Integration', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 457-488, SAGE, Thousand Oaks, CA.

Erzberger, C. & Prein, G. (1997) 'Triangulation: Validity and Empirically-Based Hypothesis Construction', *Quality and Quantity,* Vol. 31 No. 2, pp. 141-154.

Espinoza, R. D. (2014) 'Separating Project Risk from the Time Value of Money: A Step Toward Integration of Risk Management and Valuation of Infrastructure Investments', *International Journal of Project Management,* Vol. 32 No. 6, pp. 1056-1073.

Espinoza, R. D. (2015) 'The Cost of Risk: An alternative to Risk Adjusted Discount Rates', [online] https://www.researchgate.net/profile/David_Espinoza4/publication/304012087_THE_COST_OF_RISK_AN_ALTERNATIVE_TO_RISK_ADJUSTED_DISCOUNT_RATES/links/5762c08008ae0eda64311047.pdf (Accessed 3 October 2016).

Espinoza, R. D. & Morris, J. W. (2013) 'Decoupled NPV: A Simple, Improved Method to Value Infrastructure Investments', *Construction Management and Economics,* Vol. 31 No. 5, pp. 471-496.

Espinoza, R. D. & Rojo, J. (2015) 'Using DNPV for Valuing Investments in the Energy Sector: A Solar Project Case Study', *Renewable Energy,* Vol. 75, pp. 44-49.

Everett, J. E. & Schwab, B. (1979) 'On the Proper Adjustment for Risk Through Discount Rates in a Mean-Variance Framework', *Financial Management*, pp. 61-65.

EY (2010) *Risk Appetite: The Strategic Balancing Act*, http://www.ey.com/gl/en/services/advisory/risk-appetite--the-strategic-balancing-act (Accessed 20 June 2017).

Fama, E. F. (1968) 'Risk, Return and Equilibrium: Some Clarifying Comments', *Journal of Finance,* Vol. 23 No. 1, pp. 29-40.

Fama, E. F. (1977) 'Risk-Adjusted Discount Rates and Capital Budgeting Under Uncertainty', *Journal of Financial Economics,* Vol. 5 No. 1, pp. 3-24.

Fama, E. F. (1996) 'Multifactor Portfolio Efficiency and Multifactor Asset Pricing', *Journal of Financial & Quantitative Analysis,* Vol. 31 No. 4, pp. 441-465.

Fama, E. F. & French, K. R. (1992) 'The Cross-Section of Expected Stock Returns', *Journal of Finance,* Vol. 47 No. 2, pp. 427-465.

Fama, E. F. & French, K. R. (1993) 'Common Risk Factors in the Returns on Stocks and Bonds', *Journal of Financial Economics,* Vol. 33 No. 1, pp. 3-56.

Fama, E. F. & French, K. R. (1995) 'Size and Book-to-Market Factors in Earnings and Returns', *Journal of Finance,* Vol. 50 No. 1, pp. 131-155.

Fama, E. F. & French, K. R. (1996) 'Multifactor Explanations of Asset-Pricing Anomalies', *Journal of Finance,* Vol. 51 No. 1, pp. 55-84.

Fama, E. F. & French, K. R. (1997) 'Industry Costs of Equity', *Journal of Financial Economics,* Vol. 43 No. 2, pp. 153-193.

Farlex Financial Dictionary (2009) *Total Risk*, [online] https://financial-dictionary.thefreedictionary.com/Total+risk (Accessed 15 January 2017).

Fernandez, P. (2007a) 'The Most Common Errors in Valuation (Working Paper No. 449)', *University of Navarra. IESE Business School*, [online] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1025424 (Accessed 10 February 2017).

Fernandez, P. (2007b) 'Valuing Companies by Cash Fow Dscounting: Ten Methods and Nine Theories', *Managerial Finance,* Vol. 11 No. 33, pp. 853–876.

Fernandez, P. (2015) 'Valuing Companies by Cash Flow Discounting: Ten Methods and Nine Theories', *EFMA 2002 London Meetings, SSRN*, [online] https://ssrn.com/abstract=256987 (Accessed 7 July 2017).

Fernandez, P. (2016) 'Company Valuation Methods (Working Paper No. 714)', *University of Navarra. IESE Business School*, [online] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=274973 (Accessed 10 February 2017).

Ferson, W. E. & Harvey, C. R. (1991) 'The Variation of Economic Risk Premiums', *Journal of Political Economy,* Vol. 99 No. 2, pp. 385-415.

Field, A. (2013) *Discovering Statistics Using IBM SPSS Statistics,* 4th ed. SAGE, London.

Fielding, N. G. & Fielding, J. L. (1986) *Linking Data: The Articulation of Qualitative and Quantitative Methods in Social Research,* SAGE, Beverly Hills, CA.

Financial Glossary (2011) *Total Risk*, [online] https://financial-dictionary.thefreedictionary.com/Total+risk (Accessed 15 January 2017).

Finon, D. & Perez, Y. (2007) 'The Social Efficiency of Instruments of Promotion of Renewable Energies: A Transaction-Cost Perspective', *Ecological Economics,* Vol. 62 No. 1, pp. 77-92.

Fisher, I. (1930) *The Theory of Interest, as Determined by Impatience to Spend Income and Opportunity to Invest It,* Macmillan, New York.

Fleetwood, S. (1999) *Critical Realism in Economics: Development and Debate,* Routledge, London.

Flick, U. (2014) *An Introduction to Qualitative Research,* 5th ed. SAGE, Los Angeles, CA.

Fowler, F. (2009) *Survey Research Methods,* 4th ed. SAGE, Thousand Oaks, CA.

Franzoni, F., Nowak, E. & Phalippou, L. (2012) 'Private Equity Performance and Liquidity Risk', *Journal of Finance,* Vol. 67 No. 6, pp. 2341-2373.

Fremgen, J. M. (1973) 'Capital Budgeting Practices: A Survey', *Management Accounting,* Vol. 54 No. 11, pp. 19-25.

Fricke, W. & Totterdill, P. (2004) *Action Research in Workplace Innovation and Regional Development,* John Benjamins Publishing.

Friedman, M. (1962) *Price Theory, A Provisional Text,* Aldine, Chigago.

Froot, K. A. & Stein, J. C. (1998) 'Risk Management, Capital Budgeting, and Capital Structure Policy for Financial Institutions: An Integrated Approach', *Journal of Financial Economics,* Vol. 47 No. 1, pp. 55-82.

Fuller, R. J. & Kerr, H. S. (1981) 'Estimating the Divisional Cost of Capital: An Analysis of the Pure-Play Technique', *Journal of Finance,* Vol. 36 No. 5, pp. 997-1009.

Fusch, P. I. & Ness, L. R. (2015) 'Are We There Yet? Data Saturation in Qualitative Research', *The Qualitative Report,* Vol. 20 No. 9, pp. 1408-1416.

Gaweł, B., Rębiasz, B. & Skalna, I. 'Application of Probability and Possibility Theory in Investment Appraisal'. in *International Conference on Information Systems Architecture and Technology*. Springer, pp. 47-56.

Gigerenzer, G. & Brighton, H. (2009) 'Homo Heuristicus: Why Biased Minds Make Better Inferences', *Topics in Cognitive Science,* Vol. 1 No. 1, pp. 107-143.

Gilbert, E. (2004) 'Investment Basics XLIX. An Introduction to Real Options', *Investment Analysts Journal,* Vol. 33 No. 60, pp. 49-52.

Gilbert, E. & Reichert, A. (1995) 'The Practice of Financial Management Among Large United States Corporations', *Financial Practice and Education,* Vol. 5 No. 1, pp. 16-23.

Gitman, L. J. (1995) *Foundations of Managerial Finance,* 4th ed. HarperCollins, New York.

Gitman, L. J. & Forrester Jr, J. R. (1977) 'A Survey of Capital Budgeting Techniques Used by Major US Firms', *Financial Management,* Vol. 6 No. 3, pp. 66-71.

Gitman, L. J. & Maxwell, C. E. (1987) 'A Longitudinal Comparison of Capital Budgeting Techniques Used by Major US Firms: 1986 versus 1976', *Journal of Applied Business Research (JABR),* Vol. 3 No. 3, pp. 41-50.

Gitman, L. J. & Mercurio, V. A. (1982) 'Cost of Capital Techniques Used by Major US Firms: Survey and Analysis of Fortune's 1000', *Financial Management,* Vol. 14 No. 4, pp. 21-29.

Gitman, L. J. & Vandenberg, P. A. (2000) 'Cost of Capital Techniques Used by Major US Firms: 1997 vs. 1980', *Financial Practice and Education,* Vol. 10 No. 2, pp. 53-68.

Gläser, J. & Laudel, G. (2010) *Experteninterviews und qualitative Inhaltsanalyse - als Instrument rekonstruierender Untersuchungen (Translation: "Expert Interviews and Qualitative Content Analysis - as an Instrument of Reconstructing Investigations"],* 4th ed. Springer-Verlag, Wiesbaden, DE.

Glik, D. C., Parker, K., Muligande, G. & Hategikamana, B. (1986) 'Integrating Qualitative and Quantitative Survey Techniques', *International Quarterly of Community Health Education,* Vol. 7 No. 3, pp. 181-200.

Global Capital Finance (2014) *The European Renewable Energy Investor Landscape*, [online] http://cleanenergypipeline.com/Resources/CE/ResearchReports/The%20European%20Renewable%20Energy%20Investor%20Landscape.pdf (Accessed 30 July 2016).

Gordon, M. J. & Shapiro, E. (1956) 'Capital Equipment Analysis: The Required Rate of Profit', *Management Science,* Vol. 3 No. 1, pp. 102-110.

Gorski, P. S. (2013) What is Critical Realism? And Why Should You Care? Los Angeles, CA: SAGE Publications.

Gough, J. C. (1996) 'Environmental Decision Making for Groundwater Systems', [online] (Accessed 10 May 2017).

Grace-Martin, K. (2016) *Can Likert Scale Data ever be Continuous?*, [online] http://www.theanalysisfactor.com/can-likert-scale-data-ever-be-continuous/ (Accessed 20 August 2016).

Graham, J. R. & Harvey, C. R. (2001) 'The Theory and Practice of Corporate Finance: Evidence from the Field', *Journal of Financial Economics,* Vol. 60 No. 2, pp. 187-243.

Grande, T. L. (2014a) *Calculating and Interpreting Cronbach's Alpha Using SPSS,* [online] https://www.youtube.com/watch?v=Kz8OdR6lV44 (Accessed 2 August 2016).

Grande, T. L. (2014b) *Factor Analysis Using SPSS,* [online] https://www.youtube.com/watch?v=pRA3Wapx7fY (Accessed 16 July 2018).

Grande, T. L. (2015a) *Chi-Square Goodness of Fit Test in SPSS,* [online] https://www.youtube.com/watch?v=kgbl3_E4Sus (Accessed 2 August 2016).

Grande, T. L. (2015b) *Selecting a Post Hoc Test after ANOVA in SPSS* [online] https://www.youtube.com/watch?v=J8lYgn0-3oA (Accessed 2 August 2016).

Greene, J. C. (2000) 'Understanding Social Programs through Evaluation', *In:* Denzin, N. K. & Lincoln, Y. S. (eds.) *Handbook of Qualitative Research.* pp. 981-999, SAGE, Thousand Oaks, CA.

Greene, J. C. (2007) *Mixed Methods in Social Inquiry,* Jossey-Bass, San Francisco, CA.

Greene, J. C. (2015) 'Preserving Distinctions within the Multimethod and Mixed Methods Research Merger', *In:* Hesse-Biber, S. & Johnson, R. B. (eds.) *The Oxford Handbook of Multimethod and Mixed Methods Research Inquiry.* pp.

Greene, J. C. & Caracelli, V. J. (1997) *Advances in Mixed-Method Evaluation: The Challenges and Benefits of Integrating Diverse Paradigms,* Jossey-Bass Publishers, San Francisco.

Greene, J. C., Caracelli, V. J. & Graham, W. F. (1989) 'Toward a Conceptual Framework for Mixed-Method Evaluation Designs', *Educational Evaluation and Policy Analysis,* Vol. 11 No. 3, pp. 255-274.

Greene, J. C. & Hall, J. N. (2010) 'Dialectics and Pragmatism: Being of Consequence', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 119-143, SAGE, Thousand Oaks, CA.

Gregory, G. (1988) *Decision Analysis,* Plenum Press, New York.

Grix, J. (2002) 'Introducing students to the generic terminology of social research', *Politics,* Vol. 22 No. 3, pp. 175-186.

Groves, R. M., Fowler Jr, F. J., Couper, M. P., Lepkowski, J. M., Singer, E. & Tourangeau, R. (2011) *Survey Methodology,* John Wiley & Sons, Hoboken, NJ.

Guba, E. G. & Lincoln, Y. S. (1989) *Fourth Generation Evaluation,* SAGE, Thousand Oaks, CA.

Guerrero-Baena, M. D., Gómez-Limón, J. A. & Frut Cardozo, J. V. (2013) 'La Valoración de Inversiones Productivas: Una Aproximación Metodológica Basada en la Dreación de Valor Financiero e Intelectual [Translation: "The Capital Budgeting Process: A Methodological Approach Based on Financial and Intellectual Value Creation"]', *Intangible Capital,* Vol. 9 No. 4, pp. 1145-1169.

Guerron-Quintana, P. A. (2012) 'Risk and Uncertainty', *Business Review, Federal Reserve Bank of Philadelphia* No. Q1, [online] (Accessed 2 February 2014).

Guest, G. (2013) 'Describing Mixed Methods Research: An Alternative to Typologies', *Journal of Mixed Methods Research,* Vol. 7 No. 2, pp. 141-151.

Guest, G., Bunce, A. & Johnson, L. (2006) 'How Many Interviews Are Enough? An Experiment with Data Saturation and Variability', *Field Methods,* Vol. 18 No. 1, pp. 59-82.

Günther, T. (1997) *Unternehmenswertorientiertes Controlling [Translation: "Enterprise Value Oriented Controlling"],* Vahlen, München, DE.

Gup, B. E. & Norwood III, S. W. (1982) 'Divisional Cost of Capital: a Practical Approach', *Financial Management,* Vol. 11 No. 1, pp. 20-24.

Hagenloch, T. (2007) *Value Based Management und Discounted Cash Flow–Ansätze,* Book on Demand, Norderstedt.

Hall, B. & Howard, K. (2008) 'A Synergistic Approach Conducting Mixed Methods Research with Typological and Systemic Design Considerations', *Journal of Mixed Methods Research,* Vol. 2 No. 3, pp. 248-269.

Hall, R. (2013) 'Mixed Methods: In Search of a Paradigm', *In:* Le, T. & Lê, Q. (eds.) *Conducting Research in a Changing and Challenging World.* pp. 71-78, Nova Science Publishers, New York.

Halliwell, L. J. 'A Critique of Risk-Adjusted Discounting'. in *ASTIN Colloquium [online] http://www.casact.org/coneduc/reinsure/astin/2000/halliwell1.doc (Accessed 14 November 2016)*.

Halliwell, L. J. 'The Conditional Validity of Risk-Adjusted Discounting'. in *Casualty Actuarial Society E-Forum*, Spring. pp. 1-20.

Hamada, R. S. (1969) 'Portfolio Analysis, Market Equilibrium and Corporation Finance', *The Journal of Finance,* Vol. 24 No. 1, pp. 13-31.

Hamada, R. S. (1972) 'The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stock', *Journal of Finance,* Vol. 27 No. 2, pp. 435-452.

Hamada, R. S. (1977) 'Discussion on "Capital Budgeting and the Capital Asset Pricing Model: Good News and Bad News"', *Journal of Finance,* Vol. 32 No. 2, pp. 333-336.

Hanson, W. E., Creswell, J. W., Clark, V. L. P., Petska, K. S. & Creswell, J. D. (2005) 'Mixed Methods Research Designs in Counseling Psychology', *Journal of Counseling Psychology,* Vol. 52 No. 2, pp. 224.

Hansson, S. O. (2011) *"Risk" - The Stanford Encyclopedia of Philosophy,* University of Stanford [online] http://plato.stanford.edu/archives/win2012/entries/risk/ (Accessed 5 January 2014).

Harris, R. S. & Pringle, J. J. (1985) 'Risk-Adjusted Discount Rates - Extensions from the Average-Risk Case', *Journal of Financial Research,* Vol. 8 No. 3, pp. 237-244.

Hart, S. L. (1971) 'Axiology--Theory of Values', *Philosophy and Phenomenological Research*, pp. 29-41.

Hartmann, M. & Hassan, A. (2006) 'Application of Real Options Analysis for Pharmaceutical R&D Project Valuation—Empirical Results from a Survey', *Research Policy,* Vol. 35 No. 3, pp. 343-354.

Hassani, B. K. (2015) 'Risk Appetite in Practice: Vulgaris Mathematica', *IUP Journal of Financial Risk Management,* Vol. 12 No. 1, pp. 7-22.

Hastak, M. & Halpin, D. W. (2000) 'Assessment of Life-Cycle Benefit-Cost of Composites in Construction', *Journal of Composites for Construction,* Vol. 4 No. 3, pp. 103-111.

Hastak, M. & Shaked, A. (2000) 'ICRAM-1: Model for International Construction Risk Assessment', *Journal of Management in Engineering,* Vol. 16 No. 1, pp. 59-69.

Hastings, W. K. (1970) 'Monte Carlo Sampling Methods Using Markov Chains and Their Applications', *Biometrika,* Vol. 57 No. 1, pp. 97-109.

Hawawini, G. A. & Viallet, C. (2011) *Finance For Executives,* 4th ed. South-WesternCengage Learning, Mason, OH.

Hay, C. (2006) 'Political Ontology', *In:* Goodin, R. E. & Tilly, C. (eds.) *The Oxford Handbook of Contextual Political Analysis.* pp. 78-96, Oxford University Press, Oxford, UK.

Healey, M. J. & Rawlinson, M. B. (1994) Interviewing Techniques in Business and Management Research. London: Dartmouth Publishing.

Heise, D. R. (1970) 'The Semantic Differential and Attitude Research', *Attitude Measurement*, [online] http://www.indiana.edu/~socpsy/papers/AttMeasure/attitude..htm (Accessed 10 November 2014).

Henkel, J. (2008) 'The Risk-Return Paradox for Strategic Management: Disentangling True and Spurious Effects', *Social Science Research Network*, [online] (Accessed 20 January 2014).

Henry, G. T. (1990) *Practical Sampling,* SAGE, Newbury Park, CA.

Hermes, N., Smid, P. & Yao, L. (2007) 'Capital Budgeting Practices: A Comparative Study of the Netherlands and China', *International Business Review,* Vol. 16 No. 5, pp. 630-654.

Heron, J. & Reason, P. (1997) 'A Participatory Inquiry Paradigm', *Qualitative Inquiry,* Vol. 3 No. 3, pp. 274-294.

Hillier, F. S. (1963) 'The Derivation of Probabilistic Information for the Evaluation of Risky Investments', *Management Science,* Vol. 9 No. 3, pp. 443-457.

Hillier, F. S. (1969) *A Basic Approach to the Evaluation of Risky Interrelated Investments*, Stanford, CA. DTIC Document, University of Stanford. [online] http://www.dtic.mil/dtic/tr/fulltext/u2/696999.pdf (Accessed 16 November 2016).

Hillson, D. & Murray-Webster, R. (2007) *Understanding and Managing Risk Attitude,* Gower Publishing Ltd, Hants, UK.

Hofstede, G. (1983) 'The Cultural Relativity of Organizational Practices and Theories', *Journal of International Business Studies,* Vol. 14 No. 2, pp. 75-89.

Holden, M. T. & Lynch, P. (2004) 'Choosing the Appropriate Methodology: Understanding Research Philosophy', *The Marketing Review,* Vol. 4 No. 4, pp. 397-409.

Holstenkamp, L. & Kahla, F. (2016) 'What Are Community Energy Companies Trying to Accomplish? An Empirical Investigation of Investment Motives in the German Case', *Energy Policy,* Vol. 97, pp. 112-122.

Holton, G. A. (2004) 'Defining Risk', *Financial Analysts Journal,* Vol. 60 No. 6, pp. 19–25.

Hommel, M. & Dehmel, I. (2010) *Unternehmensbewertung Case by Case [Translation: "Company Valuation Case by Case"],* Verlag Recht und Wirtschaft, Frankfurt am Main, Germany.

Hommel, U. & Pritsch, G. (1998) 'Investitionsbewertung mit dem Realoptionsansatz [Translations: "Investment Valuation with a Real Option Approach"]', *WHU-Forschungspapier,* No. 50, [online] https://opus4.kobv.de/opus4-whu/files/554/WHU-FP_050.pdf (Accessed 30 July 2018).

Horrigan, P. (2007) *Epistemology: An Introduction to the Philosophy of Knowledge,* iUniverse, Lincoln, NE.

Hostettler, S. (2002) *Economic Value Added (EVA),* Paul Haupt, Berne, CH.

how2stats (2011a) *Cronbach's Alpha - SPSS,* [online] https://www.youtube.com/watch?v=2gHvHm2SE5s (Accessed 3 August 2016).

how2stats (2011b) *Levene's test - SPSS (Part 1 - 3),* [online] https://www.youtube.com/watch?v=81Yi0cTuwzw (Accessed 3 August 2016).

how2stats (2012) *Dealing with Unequal Variances and Sample Sizes - SPSS (Part 1 and 2)* [online] https://www.youtube.com/watch?v=LMRYyB6ujTQ (Accessed 3 August 2016).

how2stats (2014) *Do the t-test and ANOVA Really Assume Normality? (part 1 - 3),* [online] https://www.youtube.com/watch?v=yNdlGRz-Z04 (Accessed 3 August 2016).

how2stats (2015) *ANOVA - Unequal Variances Unequal Sample Sizes - Brown-Forsythe & Welch F tests,* [online] https://www.youtube.com/watch?v=SNsDgNhRANA (Accessed 3 August 2016).

Howson, P. (2003) *Due Diligence: The Critical Stage in Mergers and Acquisitions,* Gower Publishing, Burlington, VT.

Hürlimann, C. & Bengoa, S. D. (2015) 'A Revised Theory to Estimate Returns in Renewable Energy Investments'. *In:* Vrontis, D., Weber, Y. & Tsoukatos, E., eds. in *8th Annual Conference of the EuroMed Academy of Business - Innovation, Entrepreneurship and Sustainable Value Chain in a Dynamic Environment*, Verona, Italy. EuroMed Press, pp. 2056-2057.

Hürlimann, C. & Bengoa, S. D. (2016) 'Valuation Process in Renewable Energy Investments: A Survey among Investment Professionals'. *In:* Vrontis, D., Weber, Y. & Tsoukatos, E., eds. in *9th Annual Conference of the EuroMed Academy of Business - Innovation, Entrepreneurship and Digital Ecosystems*, Warsaw, Poland. EuroMed Press, pp. 2008-2013.

Hürlimann, C. & Bengoa, S. D. (2017a) 'Corporate Finance in Renewable Energy Investments - A Review about Theory and Practice', *Global Economics and Business Review,* Vol. 19 No. 5, pp. 592-631.

Hürlimann, C. & Bengoa, S. D. (2016) 'Valuating Renewable Energy Investment within Transactions: A Comparative Review among Practitioners'. *In:* Vrontis, D., Weber, Y. & Tsoukatos, E., eds. in *10th Annual Conference of the EuroMed Academy of Business - Global and National Business Theories and Practice: Bridging the Past with the Future*, Rom, Italy. EuroMed Press, pp. 720-739.

Hürlimann, C., Bengoa, S. D. & Al-Ali, J. (in press) 'Theory and Practice of Valuation Approaches in Renewable Energy Investments: a Survey among Investment Professionals', *World Review of Entrepreneurship, Management and Sustainable Development*.

IEA (2015) *Energy and Climate Change: World Energy Outlook Special Briefing for COP21*, Paris. https://www.iea.org/media/news/WEO_INDC_Paper_Final_WEB.PDF (Accessed 30 June 2016).

Inselbag, I. & Kaufold, H. (1997) 'Two DCF Approaches for Valuing Companies under Alternative Financing Strategies (and How to Choose between Them)', *Journal of Applied Corporate Finance,* Vol. 10 No. 1, pp. 114-122.

International Electro-Technical Commission (IEC) (2008) *IEC 31010:2009: Risk Management - Risk Assessment Techniques,* [online] https://www.iso.org/obp/ui/#iso:std:iec:31010:ed-1:v1:en (Accessed 23 November 2017).

International Organization for Standardization (ISO) (2009) *31000:2009 - Risk Management,* International Organisation for Standardization [online] https://www.iso.org/iso-31000-risk-management.html (Accessed 16 June 2017).

Investopedia (n.d.-a) *Financial Risk*, [online] https://www.investopedia.com/terms/f/financialrisk.asp (Accessed 11 July 2018).

Investopedia (n.d.-b) *Free Cash Flow - FCF*, [online] https://www.investopedia.com/terms/f/freecashflow.asp (Accessed 20 August 2018).

Investopedia (n.d.-c) *Internal Rate of Return*, [online] https://www.investopedia.com/walkthrough/corporate-finance/4/npv-irr/internal-rate-return.aspx (Accessed 20 August 2018).

Investopedia (n.d.-d) *Net Present Value - NPV*, [online] https://www.investopedia.com/terms/n/npv.asp (Accessed 20 August 2018).

Investopedia (n.d.-e) *Non-Resource Finance*, [online] https://www.investopedia.com/terms/n/non-recoursefinance.asp (Accessed 15 September 2017).

IRENA (2012) 'Renewable Energy Technologies: Cost Analysis Series - Hydropower', [online] https://www.irena.org/documentdownloads/publications/re_technologies_cost_analysis-hydropower.pdf (Accessed 18 August 2018).

Istvan, D. F. (1961) 'The Economic Evaluation of Capital Expenditures', *The Journal of Business,* Vol. 34 No. 1, pp. 45-51.

Ivankova, N. V. (2015) *Mixed Methods Applications in Action Research: From Methods to Community Action,* SAGE, Thousand Oaks, CA.

Ivankova, N. V., Creswell, J. W. & Stick, S. L. (2006) 'Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice', *Field Methods,* Vol. 18 No. 1, pp. 3-20.

Jagannathan, R. & Meier, I. (2002) *Do We Need CAPM for Capital Budgeting?*, Unpublished Working Paper, National Bureau of Economic Research, Northwestern University, Evanston, IL, [online] http://www.ucema.edu.ar/u/jd/Inversiones/Articulos/Paper_Model_CAPM_in_practice.pdf (Accessed 30 June 2017).

Jägemann, C., Fürsch, M., Hagspiel, S. & Nagl, S. (2013) 'Decarbonizing Europe's Power Sector by 2050—Analyzing the Economic Implications of Alternative Decarbonization Pathways', *Energy Economics,* Vol. 40, pp. 622-636.

Jegadeesh, N. & Titman, S. (1993) 'Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency', *The Journal of Finance,* Vol. 48 No. 1, pp. 65-91.

Jick, T. D. (1979) 'Mixing Qualitative and Quantitative Methods: Triangulation in Action', *Administrative Science Quarterly,* Vol. 24 No. 4, pp. 602-611.

Jin, Y. & Jorion, P. (2006) 'Firm Value And Hedging: Evidence from Oil and Gas Producers', *The Journal of Finance,* Vol. 61 No. 2, pp. 893-919.

Johnson, B. & Christensen, L. (2000) *Educational Research: Quantitative and Qualitative Approaches,* Allyn & Bacon, Boston, MA.

Johnson, B. & Turner, L. A. (2003) 'Data Collection Strategies in Mixed Methods Research', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 297-319, SAGE, Thousand Oaks, CA.

Johnson, P. & Duberley, J. (2000) *Understanding Management Research: An Introduction to Epistemology,* SAGE, Thousand Oaks, CA.

Johnson, R. B. & Gray, R. (2010) 'A History of Philosophical and Theoretical Issues for Mixed Methods Research', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 69-94, SAGE, Thousand Oaks, CA.

Johnson, R. B. & Onwuegbuzie, A. J. (2004) 'Mixed Methods Research: A Research Paradigm Whose Time Has Come', *Educational Researcher,* Vol. 33 No. 7, pp. 14-26.

Johnson, R. B., Onwuegbuzie, A. J. & Turner, L. A. (2007) 'Toward a Definition of Mixed Methods Research', *Journal of Mixed Methods Research,* Vol. 1 No. 2, pp. 112-133.

Kahneman, D. & Thaler, R. H. (2006) 'Anomalies: Utility Maximization and Experienced Utility', *The Journal of Economic Perspectives,* Vol. 20 No. 1, pp. 221-234.

Kahneman, D. & Tversky, A. (1979) 'Prospect Theory: An Analysis of Decision under Risk', *Econometrica,* Vol. 47 No. 2, pp. 263-291.

Kaliprasad, M. (2006) 'Proactive Risk Management', *Cost Engineering Economist,* Vol. 48 No. 12.

Kalkbrenner, B. J. & Roosen, J. (2016) 'Citizens’ Willingness to Participate in Local Renewable Energy Projects: The Role of Community and Trust in Germany', *Energy Research & Social Science,* Vol. 13 March, pp. 60-70.

Kane, M. & Trochim, W. M. (2007) *Concept Mapping for Planning and Evaluation,* SAGE, Thousand Oaks, CA.

Kanellis, P. & Papadopoulos, T. (2009) 'Conducting Research in Information Systems: an Epistemological Journey', *In:* Cater-Steel, A. & Al-Hakim, L. (eds.) *Information Systems Research Methods, Epistemology, and Applications.* pp. 1-34, Information Science Reference, Hershey, PA.

Kaplan, S. N. & Schoar, A. (2005) 'Private Equity Performance: Returns, Persistence, and Capital Flows', *Journal of Finance,* Vol. 60 No. 4, pp. 1791-1823.

Keim, D. B. & Stambaugh, R. F. (1986) 'Predicting Returns in the Stock and Bond Markets', *Journal of Financial Economics,* Vol. 17 No. 2, pp. 357-390.

Kelle, U. & Erzberger, C. (1999) 'Integration qualitativer und quantitativer Methoden. Methodologische Modelle und ihre Bedeutung für die Forschungspraxis [Translation: "The Integration of Qualitative and Quantitative Methods. Methodological Models and Their Significance for Practising Social Research"]', *Kölner Zeitschrift für Soziologie und Sozialpsychologie,* Vol. 51 No. 3, pp. 509-531.

Kemna, A. G. Z. (1993) 'Case Studies on Real Options', *The Journal of the Financial Management Association,* Vol. 22 No. 3, pp. 259-270.

Kemper, E. A., Stringfield, S. & Teddlie, C. (2003) 'Mixed Methods Sampling Strategies in Social Science Research', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 273-296, SAGE, Thousand Oaks, CA.

Kester, G. W., Chang, R. P., Echanis, E. S., Haikal, S., Mansor, I. M., Skully, M. T., Tsui, K.-C. & Wang, C.-J. (1999) 'Capital Budgeting Practices in the Asia Pacific Region: Australia, Hong Kong, Indonesia, Malaysia, Philippines, and Singapore', *Financial Practice and Education,* Vol. 9 No. 1, pp. 25-33.

Kierulff, H. (2008) 'MIRR: A Better Measure', *Business Horizons,* Vol. 51 No. 4, pp. 321-329.

Kim, S. H., Crick, T. & Farragher, E. J. (1984) 'Foreign Capital Budgeting Practices Used by the US and Non-US Multinational Companies', *The Engineering Economist,* Vol. 29 No. 3, pp. 207-215.

King, N. (2004) 'Using Interviews in Qualitative Research', *In:* Cassell, C. & Symon, G. (eds.) *Essential Guide to Qualitative Methods in Organizational Research.* pp. 11-22, SAGE, London.

Klammer, T. (1972) 'Empirical Evidence of the Adoption of Sophisticated Capital Budgeting Techniques', *Journal of Business,* Vol. 45 No. 3, pp. 387-397.

Klammer, T., Koch, B. & Wilner, N. (1991) 'Capital Budgeting Practices – A Survey of Corporate Use', *Journal of Management Accounting Research,* Vol. 3 No. 1, pp. 113-130.

Knight, F. H. (1921a) *Risk, Uncertainty, and Profit*, Boston, MA: Hart, Schaffner & Marx; Houghton Mifflin Co., [online] http://www.econlib.org/library/Knight/knRUPCover.html.

Knight, F. H. (1921b) *Risk, Uncertainty, and Profit,* Houghton Mifflin Co., Boston and New York.

Kohers, N. & Ang, J. (2000) 'Earnouts in Mergers: Agreeing to Disagree and Agreeing to Stay', *The Journal of Business,* Vol. 73 No. 3, pp. 445-476.

Koller, T., Goedhart, M. & Wessels, D. (2010) *Valuation: Measuring and Managing the Value of Companies,* 5th ed. JohnWiley & Sons, Inc., Hoboken, NJ.

Koller, T., Goedhart, M. & Wessels, D. (2015) *Valuation: Measuring and Managing the Value of Companies,* 6th ed. JohnWiley & Sons, Inc., Hoboken, NJ.

Korteweg, A. (2010) 'The Net Benefits to Leverage', *Journal of Finance,* Vol. 65 No. 6, pp. 2137-2170.

Kost, C., Shammugam, S., Jülch, V., Nguyen, H.-T. & Schlegel, T. (2018) 'Levelized Cost of Electricity Renewable Energy Technologies', *Fraunhofer Institute for Solar Energy Systems ISE*, [online] https://www.ise.fraunhofer.de/content/dam/ise/en/documents/publications/studies/EN2018_Fraunhofer-ISE_LCOE_Renewable_Energy_Technologies.pdf (Accessed 18 August 2018).

Krishnaswamy, K., Sivakumar, A. I. & Mathirajan, M. (2009) *Management Research Methodology: Integration of Principles, Methods and Techniques,* Pearson Education India, Delhi.

Kristensen, V., Aven, T. & Ford, D. (2006) 'A New Perspective on Renn and Klinke's Approach to Risk Evaluation and Management', *Reliability Engineering & System Safety,* Vol. 91 No. 4, pp. 421-432.

Krueger, P., Landier, A. & Thesmar, D. (2015) 'The WACC fallacy: The Real Effects of Using a Unique Discount Rate', *The Journal of Finance,* Vol. 70 No. 3, pp. 1253-1285.

Krueger, R. A. & Casey, M. A. (1994) *Focus Groups: A Practical Guide for Applied Research,* SAGE, Thousand Oaks, CA.

Kruschwitz, L. & Löffler, A. (1999) 'Sichere und unsichere Steuervorteile bei der Unternehmensbewertung I [Translation: "Safe and Uncertain Tax Advantages in the Company Assessment I"]', *Arbeitspapier Freie Universität Berlin, Berlin*, [online] https://www.econbiz.de/archiv/b/fub/bank/steuervorteile.pdf (Accessed 7 July 2017).

Kruschwitz, L. & Löffler, A. (2006) *Discounted Cash Flow: A Theory of the Valuation of Firms,* John Wiley & Sons, Chichester, UK.

Kruschwitz, L. & Lorenz, D. (2011) 'Eine Anmerkung zur Unternehmensbewertung bei autonomer und wertorientierter Verschuldung [Translation: "A Comment on the Company Valuation for Autonomous and Value-Oriented Debt]', *Corporate Finance Biz,* Vol. 2 No. 2, pp. 94-96.

Kuhner, C. & Maltry, H. (2006) *Unternehmensbewertung [Translation: "Company Valuation"],* Springer, Heidelberg, DE.

Kuppinger, B. & Wüst, K. (2011) 'Just a Game? How Continuous Time Modelling Can Ameliorate Corporate Strategy Games', *World Review of Entrepreneurship, Management and Sustainable Development,* Vol. 7 No. 4, pp. 422-439.

Küting, K. & Eidel, U. (1999) 'Marktwertansatz contra Ertragswert- und Discounted Cash Flow-Verfahren [Translation: "Fair Value Approach versus Net Asset Value and Discounted Cash Flow Approaches"]', *Finanz Betrieb,* Vol. 9 No. 1999, pp. 225-231.

Kuzel, A. J. (1992) 'Sampling in Qualitative Inquiry', *In:* Crabtree, B. & Miller, W. (eds.) *Doing Qualitative Research.* pp. 31–44, SAGE, Newbury Park, CA.

Laerd Statistics (2013) *Cronbach's Alpha (α) using SPSS Statistics*, [online] https://statistics.laerd.com/spss-tutorials/kruskal-wallis-h-test-using-spss-statistics.php (Accessed 21 August 2016).

Laitenberger, J. (2006) 'Rendite und Kapitalkosten [Translation: "Return and Capital Costs"]', *Zeitschrift für Betriebswirtschaft,* Vol. 76 No. 1, pp. 79-101.

Langlois, R. N. & Cosgel, M. M. (1993) 'Frank Knight on risk, Uncertainty, and the Firm: A New Interpretation', *Economic Inquiry,* Vol. 31 No. 3, pp. 456-465.

Langniss, O., Helby, P., Joosen, S., Lorenzoni, A., Mitchell, C. & Schlotterbeck, M. (1999) *Financing Renewable Energy Systems,* DLR, Stuttgart, DE.

Lankes, H.-P. & Venables, A. J. (1997) 'Foreign Direct Investment in Eastern Europe and the Former Soviet Union: Results from a Survey of Investors', *In:* Zecchini, S. (ed.) *Lessons from the Economic Transition.* pp. 555-565, Springer, NL.

Laux, H., Gillenkirch, R. M. & Schenk-Mathes, H. Y. (2014) 'Rationale Entscheidung bei Risiko: Das Bernoulli-Prinzip [Translation: "Rational Decision-Making at Risk: the Bernoulli Principle"]', *In:* Laux, H., Gillenkirch, R. M. & Schenk-Mathes, H. Y. (eds.) *Entscheidungstheorie [Translation: "Decision theory"].* pp. 113-153, Springer, Berlin / Heidelberg, Germany.

Lawson, T. (1989) 'Abstraction, Tendencies and Stylised Facts: A Realist Approach to Economic Analysis', *Cambridge Journal of Economics,* Vol. 13 No. 1, pp. 59-78.

Lawson, T. (1998) 'Transcendental Realism', *In:* Davis, J., Hands, D. W. & Ma"ki, U. (eds.) *The Handbook of Economic Methodology.* pp. 504-510, Edward Elgar, Cheltenham, UK.

Leech, N. L. & Onwuegbuzie, A. J. (2009) 'A Typology of Mixed Methods Research Designs', *Quality & Quantity,* Vol. 43 No. 2, pp. 265-275.

LeRoy, S. F. & Singell Jr, L. D. (1987) 'Knight on Risk and Uncertainty', *Journal of Political Economy,* Vol. 95 No. 2, pp. 394-406.

Leslie, K. J. & Michaels, M. P. (1997) 'The Real Power of Real Options', *The McKinsey Quarterly,* Vol. 1997 No. 3, pp. 4-22.

Lettau, M., Ludvigson, S. C. & Wachter, J. A. (2008) 'The Declining Equity Premium: What Role Does Macroeconomic Risk Play?', *The Review of Financial Studies,* Vol. 21 No. 4, pp. 1653-1687.

Lettau, M. & Wachter, J. A. (2007) 'Why is Long-Horizon Equity Less Risky? A Duration-Based Explanation of the Value Premium', *The Journal of Finance,* Vol. 62 No. 1, pp. 55-92.

Levy, H. (1990) 'Small Firm Effect: Are There Abnormal Returns in the Market?', *Journal of Accounting, Auditing & Finance,* Vol. 5 No. 2, pp. 235-270.

Lewins, A. & Silver, C. (2009) *Choosing a Caqdas Package*, 6th ed., [online] http://eprints.ncrm.ac.uk/791/1/2009ChoosingaCAQDASPackage.pdf (Accessed 5 May 2017).

Lewis, T. G., Stelter, D. M., Casata, T. & Reiter, M. (1994) *Steigerung des Unternehmenswertes: Total Value Management [Translation: "Increasing the Enterprise Value: Total Value Management"],* Verlag Moderne Industrie, Landsberg/Lech, Germany.

Liebreich, M. (2005) 'Financing RE - Risk Management in Financing Renewable Energy Projects', *Refocus,* Vol. 6 No. 4, pp. 18-20.

Likert, R. (1932) 'A Technique for the Measurement of Attitudes', *Archives of Psychology,* Vol. 22 No. 140, pp. 1-55.

Lincoln, Y. & Guba, E. G. (1985) *Naturalistic Inquiry,* SAGE, Newbury Park, CA.

Lintner, J. (1965a) 'Security Prices, Risk, and Maximal Gains from Diversification', *The Journal of Finance,* Vol. 20 No. 4, pp. 587-615.

Lintner, J. (1965b) 'The Valuation of Risk and the Selection of Risky Investments in Stock Portfolios and Capital Budgets', *Review of Economics & Statistics,* Vol. 47 No. 1, pp. 13-37.

Lipp, J. (2007) 'Lessons for Effective Renewable Electricity Policy from Denmark, Germany and the United Kingdom', *Energy Policy,* Vol. 35 No. 11, pp. 5481-5495.

Ljungqvist, A. & Richardson, M. (2003) 'The Cash Flow, Return and Risk Characteristics of Private Equity', working paper, *National Bureau of Economic Research*, [online] http://www.nber.org/papers/w9454 (Accessed 10 January 2014).

Lo, A. W. & MacKinley, A. C. (1990) 'Data-Snooping Biases in Tests of Financial Asset Pricing Models', *Review of Financial Studies,* Vol. 3 No. 3, pp. 431-467.

Locarek-Junge, H. (1997) *Finanzmathematik [Translation: "Financial Mathematics"],* 3rd ed. Oldenbourg, München, Germany.

Locarek-Junge, H. & Loßagk, S. (2011) 'Die Fallstudie - Konstistente Unternehmensbewertung bei unterschiedlicher Finanzierungspolitik [Translation: "The Case Study - Constistent Company Valuation with Different Financial Policies"]', *Wirtschaftsstudium-WISU,* Vol. 40 No. 3, pp. 364-366.

Loderer, C., Jörg, P., Pichler, K., Roth, L., Wälchli, U. & Zraggen, P. (2010) *Handbuch der Bewertung - Band 1: Projekte [Translation: "Handbook of Valuation - Part 1: Projects"],* Neue Zürcher Zeitung, Zurich, CH.

Lonergan, W. (2009) 'Pre and Post Tax Discount Rates and Cash Flows - A Technical Note', [online] https://www.researchonline.mq.edu.au/vital/access/services/Download/mq:10341/DS01 (Accessed 11 July 2017).

Lopes, M. & Flavell, R. (1998) 'Project Appraisal - A Framework to Assess Non-Financial Aspects of Projects during the Project Life Cycle', *International Journal of Project Management,* Vol. 16 No. 4, pp. 223-233.

Lorterapong, P. & Moselhi, O. (1996) 'Project-Network Analysis Using Fuzzy Sets Theory', *Journal of Construction Engineering and Management,* Vol. 122 No. 4, pp. 308-318.

Loßagk, S. (2014) *Die Bewertung nicht börsennotierter Unternehmen: Eine empirische Untersuchung zur Erklärung des systematischen Risikos mittels rechnungswesenbasierter Daten [Translation: "The Valuation of Non-Traded Companies: An Empirical Study to Explain the Systematic Risk by Means of Accounting Based Data"],* Josef Eul, Lohmar, Germany.

Luborsky, M. R. & Rubinstein, R. L. (1995) 'Sampling in Qualitative Research: Rationale, Issues, and Methods', *Research on Aging,* Vol. 17 No. 1, pp. 89-113.

Lund_Research_Ltd (2013) *Types of Variable,* Lund Research Ltd, [online] https://statistics.laerd.com/statistical-guides/types-of-variable.php (Accessed 26 July 2016).

MacLean, L. M., Meyer, M. & Estable, A. (2004) 'Improving Accuracy of Transcripts in Qualitative Research', *Qualitative Health Research,* Vol. 14 No. 1, pp. 113-123.

March, J. G. & Shapiro, Z. (1987) 'Managerial Perspectives on Risk and Risk Taking', *Management Science,* Vol. 33 No. 11, pp. 1404-1418.

Marks, N. (2011) 'Just What Is Risk Appetite and How Does It Differ from Risk Tolerance?', [online] (Accessed 16 June 2017).

Marshall, A. (1927) *Principles of Economics: An Introductory Volume,* Macmillan, London.

Mason, M. 'Sample Size and Saturation in PhD Studies Using Qualitative Interviews'. in *Forum qualitative Sozialforschung/Forum: Qualitative Social Research*.

Mathews, S., Datar, V. & Johnson, B. (2007) 'A Practical Method for Valuing Real Options: The Boeing Approach', *Journal of Applied Corporate Finance,* Vol. 19 No. 2, pp. 95-104.

Matzen, F. J. (2005) *Unternehmensbewertung von Wohnungsbauunternehmen. Unter besonderer Berücksichtigung der Besteuerung und Finanzierung [Translation: "Company Valuation of Housing Construction Companies. Taking Particular Account of Taxation and Financing"],* Phd, European Business School. Rudolf Müller Verlag, Köln.

Mauboussin, M. J. (2002a) 'Revisiting Market Efficiency: The Stock Market as a Complex Adaptive System', *Journal of Applied Corporate Finance,* Vol. 14 No. 4, pp. 47-55.

Mauboussin, M. J. (2002b) 'Valuation: An Epistemological View', *Strategic Investor Relations,* Vol. 2002 No. Spring, pp. 1-4.

Maxwell, J. A. (1992) 'Understanding and Validity in Qualitative Research', *Harvard Educational Review,* Vol. 62 No. 3, pp. 279-301.

Maxwell, J. A. (1996) Qualitative Research Design Thousand Oaks, CA: SAGE.

Maxwell, J. A. & Loomis, D. M. (2003) 'Mixed Methods Design: An Alternative Approach', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 241-272, SAGE, Thousand Oaks, CA.

Maxwell, J. A. & Mittapalli, K. (2010) 'Realism as a Stance for Mixed Methods Research', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 145-168, SAGE, Thousand Oaks, CA.

Maynard, D. (2013) *SPSS - Post Hoc Tests for One-Way ANOVA,* [online] https://www.youtube.com/watch?v=AE69FOLeFpA (Accessed 10 August 2016).

McEnally, R. W. & Upton, D. E. (1979) 'A Reexamination of the Ex Post Risk-Return Tradeoff on Common stocks', *Journal of Financial & Quantitative Analysis,* Vol. 14 No. 2, pp. 395-419.

McEvoy, P. & Richards, D. (2006) 'A Critical Realist Rationale for Using a Combination of Quantitative and Qualitative Methods', *Journal of Research in Nursing,* Vol. 11 No. 1, pp. 66-78.

McLafferty, I. (2004) 'Focus Group Interviews as a Data Collecting Strategy', *Journal of Advanced Nursing,* Vol. 48 No. 2, pp. 187-194.

McLaney, E., Pointon, J., Thomas, M. & Tucker, J. (2004) 'Practitioners' Perspectives on the UK Cost of Capital', *The European Journal of Finance,* Vol. 10 No. 2, pp. 123-138.

McLellan, E., MacQueen, K. M. & Neidig, J. L. (2003) 'Beyond the Qualitative Interview: Data Preparation and Transcription', *Field Methods,* Vol. 15 No. 1, pp. 63-84.

McMahon, R. G. & Stanger, A. M. (1995) 'Understanding the Small Enterprise Financial Objective Function', *Entrepreneurship: Theory and Practice,* Vol. 19 No. 4, pp. 21-40.

McNulty, J. J., Yeh, T. D., Schulze, W. S. & Lubatkin, M. H. (2002) 'What's Your Real Cost of Capital', *Harvard Business Review,* Vol. 80 No. 10, pp. 114-121.

Meder, B., Le Lec, F. & Osman, M. (2013) 'Decision Making in Uncertain Times: What Can Cognitive and Decision Sciences Say about or Learn from Economic Erises?', *Trends in Cognitive Sciences,* Vol. 17 No. 6, pp. 257-260.

Megginson, W. L. (1997) *Corporate Finance Theory,* Addison-Wesley, Reading, MA.

Meitner, M. & Streitferdt, F. (2012) 'Zum Unlevering und Relevering von Betafaktoren—Stellungnahme zu Kruschwitz/Löffler/Lorenz, WPg 2011, S. 672 [Translation: "About the Unlevering and Relevering of Betafaktor—Opinion on Kruschwitz / Löffler / Lorenz, WPg 2011, p. 672"]', *Die Wirtschaftsprüfung,* Vol. 65 No. 19, pp. 1037-1047.

Merton, R. C. (1973) 'An Intertemporal Capital Asset Pricing Model', *Econometrica,* Vol. 41 No. 5, pp. 867-887.

Meyer, N. I. & Koefoed, A. L. (2003) 'Danish Energy Reform: Policy Implications for Renewables', *Energy Policy,* Vol. 31 No. 7, pp. 597-607.

Michael, R. S. (2001) 'Crosstabulation & Chi Square', *Indiana University, Bloomington, IN.*, [online] http://www.indiana.edu/~educy520/sec5982/week_12/chi_sq_summary011020.pdf (Accessed 29 August 2016).

Michelez, J., Rossi, N., Blazquez, R., Martin, J., Mera, E., Christensen, D., Peineke, C., Graf, K., Lyon, D. & Stevens, G. (2011) *Risk Quantification and Risk Management in Renewable Energy Projects*, IEA. [online] http://iea-retd.org/wp-content/uploads/2011/11/RISK-IEA-RETD-2011-6.pdf (Accessed 24 April 2018).

Mielcarz, P. & Mlinarič, F. (2014) 'The superiority of FCFF over EVA and FCFE in Capital Budgeting', *Economic Research,* Vol. 27 No. 1, pp. 559–572.

Migilinskas, D. & Ustinovičius, L. 'Methodology of Risk and Uncertainty Management in Construction's Technological and Economical Problems'. *In:* Zavadskas, E., Kaklauskas, A. & Skibniewski, M. J., eds. in *The 25th International Symposium on Automation and Robotics in Construction ISARC - 2008*, Vilnius, Lithuania. pp. 789–795.

Miles, J. A. & Ezzell, J. R. (1985) 'Reformulating Tax Shield Valuation: A Note', *The Journal of Finance,* Vol. 40 No. 5, pp. 1485-1492.

Miles, M. B. & Huberman, A. M. (1994) *Qualitative Data Analysis: An Expanded Sourcebook,* 2nd ed. SAGE, Thousand Oaks, CA.

Miller, K. D. & Chen, W.-R. (2004) 'Variable Organizational Risk Preferences: Tests of the March-Shapira Model', *Academy of Management Journal,* Vol. 47 No. 1, pp. 105-115.

Miller, L. T. & Park, C. S. (2002) 'Decision Making Under Uncertainty—Real Options to the Rescue?', *Engineering Economist,* Vol. 47 No. 2, pp. 105-150.

Miller, P. J. & Cameron, R. (2011) 'Mixed Method Research Designs: A Case Study of Their Adoption in a Doctor of Business Administration Program', *International Journal of Multiple Research Approaches,* Vol. 5 No. 3, pp. 387-402.

Miller, S. (2003) 'Impact of Mixed Methods and Design on Inference Quality', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* 1st ed, pp. 423-456, SAGE, Thousand Oaks, CA.

Milligan, M. R., Kirby, B., Gramlich, R. & Goggin, M. (2009) 'Impact of Electric Industry Structure on High Wind Penetration Potential', *National Renewable Energy Laboratory*, [online] https://www.nrel.gov/docs/fy09osti/46273.pdf (Accessed 23 July 2018).

Mingers, J. (2004) 'Realizing Information Systems: Critical Realism as an Underpinning Philosophy for Information Systems', *Information and Organization,* Vol. 14 No. 2, pp. 87-103.

Mitchell, C., Bauknecht, D. & Connor, P. M. (2006) 'Effectiveness Through Risk Reduction: A Comparison of the Renewable Obligation in England and Wales and the Feed-in System in Germany', *Energy Policy,* Vol. 34 No. 2, pp. 297-305.

Mitchell, V. (1996) 'Assessing the Reliability and Validity of Questionnaires: An Empirical Example', *Journal of Applied Management Studies,* Vol. 5 No. 2, pp. 199-208.

Modigliani, F. & Miller, M. H. (1958) 'The Cost of Capital, Corporation Finance and the Theory of Investment', *American Economic Review,* Vol. 48 No. 3, pp. 261.

Modigliani, F. & Miller, M. H. (1963) 'Corporate Income Taxes and the Cost of Capital: A Correction', *The American Economic Review,* Vol. 53 No. 3, pp. 433-443.

Modigliani, F. & Pogue, G. A. (1974) 'An Introduction to Risk and Return', *Financial Analysts Journal,* Vol. 30 No. 2, pp. 68-80.

Mohamed, S. & McCowan, A. K. (2001) 'Modelling Project Investment Decisions Under Uncertainty Using Possibility Theory', *International Journal of Project Management,* Vol. 19 No. 4, pp. 231-241.

Mohanty, S. K. & Nandha, M. (2011) 'Oil Shocks and Equity Returns:: An Empirical Analysis of the US Transportation Sector', *Review of Pacific Basin Financial Markets & Policies,* Vol. 14 No. 1, pp. 101-128.

Monette, D. R., Sullivan, T. J. & DeJong, C. R. (2013) *Applied Social Research: A Tool for the Human Services,* Cengage Learning, Boston, MA.

Monnin, P. 2015. Low Interest Rates: An Opportunity for Renewables. [online] https://www.cepweb.org/low-interest-rates-an-opportunity-for-renewables/ (accessed 27 February 2017).

Mooney, C. Z. (1997) *Monte Carlo Simulation,* SAGE Publications, Thousand Oaks, CA.

Moore, J. S. & Reichert, A. K. (1983) 'An Analysis of the Financial Management Techniques Currently Employed by Large US Corporations', *Journal of Business Finance & Accounting,* Vol. 10 No. 4, pp. 623-645.

Morgan, D. L. (1998) 'Practical Strategies for Combining Qualitative and Quantitative Methods: Applications to Health Research', *Qualitative Health Research,* Vol. 8 No. 3, pp. 362-376.

Morgan, D. L. (2014) *Integrating Qualitative and Quantitative Methods: A Pragmatic Approach,* SAGE, Los Angeles, CA.

Morrison, R. (2016) *The Principles of Project Finance,* Routledge, London, New York.

Morse, J. (1991) 'Approaches to Qualitative-Quantitative Methodological Triangulation', *Nursing Research,* Vol. 40 No. 2, pp. 120-123.

Morse, J. M. (2003) 'Principles of Mixed Methods and Multimethod Research Design', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 189-208, SAGE, Thousand Oaks, CA.

Morse, J. M. & Niehaus, L. (2009) *Principles and Procedures of Mixed Methods Design,* Left Coast Press, Walnut Creek, CA.

Moschandreas, D. & Karuchit, S. (2005) 'Risk Uncertainty Matters: an Engineer's View', *International Journal of Risk Assessment and Management,* Vol. 5 No. 2-4, pp. 167-192.

Moskowitz, T. J. & Vissing-Jørgensen, A. (2002) 'The Returns to Entrepreneurial Investment: A Private Equity Premium Puzzle?', *American Economic Review,* Vol. 92 No. 4, pp. 745-778.

Mossin, J. (1966) 'Equilibrium in a Capital Asset Market', *Econometrica,* Vol. 34 No. 4, pp. 768-783.

Mougeot, N. (2018) 'The Synthetic Cost of Liquidity', *SSRN*, [online] https://ssrn.com/abstract=3189052 (Accessed 20 August 2018).

Moxter, A. (1983) *Grundsätze ordnungsmäßiger Unternehmensbewertung [Translation: "Principles of Proper Company Valuation"],* Gabler, Wiesbaden, DE.

Mukherjee, T., Kiymaz, H. & Baker, H. (2004) 'Merger Motives and Target Valuation: A Survey of Evidence from CFOs', *Journal of Applied Finance,* Vol. 14 No. 2, pp. 7-24.

Myers, S. & Majd, S. (1990) 'Abandonment Value and Project Life', *Advances in Futures and Options Research,* Vol. 4, pp. 1-21.

Myers, S. C. (1974) 'Interactions of Corporate Financing and Investment Decisions-Implications for Capital Budgeting', *The Journal of Finance,* Vol. 29 No. 1, pp. 1-25.

Myers, S. C. (1977) 'Determinants of Corporate Borrowing', *Journal of Financial Economics,* Vol. 5 No. 2, pp. 147-175.

Myers, S. C. & Turnbull, S. M. (1977) 'Capital Budgeting and the Capital Asset Pricing Model: Good News and Bad News', *The Journal of Finance,* Vol. 32 No. 2, pp. 321-333.

Næss, P. (2010) 'The Dangerous Climate of Disciplinary Tunnel Vision', *In:* Bhaskar, R., Frank, C., Høyer, K. G., Naess, P. & Parker, J. (eds.) *Interdisciplinarity and Climate Change - Transforming Knowledge and Practice for Our Global Future.* pp. 68-98, Routledge, London.

Neth, H., Meder, B., Kothiyal, A. & Gigerenzer, G. (2014) 'Homo Heuristicus in the Financial World: From Risk Management to Managing Uncertainty', *Journal of Risk Management in Financial Institutions,* Vol. 7 No. 2, pp. 134-144.

Newman, I., Ridenour, C., Newman, C. & DeMarco, G. M. P., Jr. (2003) 'A Typology of Research Purposes and Its Relationship to Mixed Methods Research', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 167-188, SAGE, Thousand Oaks, CA.

NGO Security (2010) *Using the Likert Scale to Assess Risk* Humanitarian and Non Governmental Organization Safety & Security, [online] http://ngosecurity.blogspot.ch/2010/02/using-likert-scale-to-assess-risk.html (Accessed 26 July 2016).

Nielsen, K. M. (2011) 'The Return to Direct Investment in Private Firms: New Evidence on the Private Equity Premium Puzzle', *European Financial Management,* Vol. 17 No. 3, pp. 436-463.

Niglas, K. (2001) 'Paradigms and Methodology in Educational Research'. *European Conference on Educational Research on 5-8 Sept 2001.* Lille, FR [online], http://www.leeds.ac.uk/educol/documents/00001840.htm (Accessed 18 Dezember 2017).

Niglas, K. (2010) 'The Multidimensional Model of Research Methodology. An Integrated Set of Continua', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 215–236, SAGE, Thousand Oaks, CA.

Niglas, K. (2017) *Katrin Niglas Uurimismetodoloogiast Ja -Paradigmadest [Translation: "Katrin Niglas Forschungsmethodik und Paradigmen"]*, [online] https://www.tlu.ee/opmat/ka/opiobjekt/Kasvatusfilosoofilised_paradigmad/katrin_niglas_uurimismetodoloogiast_ja_paradigmadest.html (Accessed 18 December 2017).

Niiniluoto, I. (1991) 'Realism, scientfic', *In:* Burkhardt, H. & Smith, B. (eds.) *The Handbook of Metaphysics and Ontology.* pp., Analytica/Philosophia Verlag, München, DE.

Nolan, D. P. (2015) *Safety and Security Review for the Process Industries - Application of HAZOP, PHA, What-IF and SVA Reviews,* 4th ed. Elsevier, Waltham, MA.

Noothout, P., de Jager, D., Tesnière, L., van Rooijen, S., Karypidis, N., Brückmann, R., Jirouš, F., Breitschopf, B., Angelopoulos, D. & Doukas, H. (2016) 'The Impact of Risks in Renewable Energy Investments and the Role of Smart Policies', *DiaCore Report*, [online] http://climateobserver.org/wp-content/uploads/2016/02/diacore-2016-impact-of-risk-in-res-investments.pdf (Accessed 23 July 2018).

Norris, J. R. (1998) *Markov Chains,* Cambridge University Press, Cambridge, UK.

Nunnally, J. (1978) *Psychometric Theory,* 2nd ed. McGraw-Hill, New York.

O'Donoghue, T. & Punch, K. (2003) *Qualitative Educational Research in Action: Doing and Reflecting,* Routledge, London.

O'Sullivan, A. & Sheffrin, S. (2005) *Economics: Economic Principle in Action,* Pearson Prentice Hall, Upper Saddle River, NJ.

O’Cathain, A. (2010) 'Assessing the Quality of Mixed Methods Research: Toward a Comprehensive Framework', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioral Research.* pp. 531-555, SAGE, Thousand Oaks, CA.

Oblak, D. J. & Helm Jr, R. J. (1980) 'Survey and Analysis of Capital Budgeting Methods Used by Multinationals', *Financial Management,* Vol. 9 No. 4, pp. 37-41.

Olsen, W. 'Dialectical Triangulation and Empirical Research'. in *6th IACR Annual Conference, 16–18th August*, University of Bradford.

Olsen, W. (2004) 'Methodological Triangulation and Realist Research: An Indian Exemplar', *In:* Carter, B. & New, C. (eds.) *Making Realism Work: Realist Social Theory and Empirical Research.* pp. 135-150, Routledge, London.

Onwuegbuzie, A. J. & Johnson, R. B. (2006) 'The Validity Issue in Mixed Research', *Research in the Schools,* Vol. 13 No. 1, pp. 48-63.

Orsag, S. & McClure, K. G. (2013) 'Modified Net Present Value as a Useful Tool for Synergy Valuation in Business Combinations', *UTMS Journal of Economics*, Vol. 4 No. 2, [online] https://www.econstor.eu/bitstream/10419/105318/1/766682137.pdf (Accessed 2 December 2017).

Osborne, M. J. (2010) 'A Resolution to the NPV–IRR Debate?', *The Quarterly Review of Economics and Finance,* Vol. 50 No. 2, pp. 234-239.

Palliam, R. (2005a) 'Application of a Multi-Criteria Model for Determining Risk Premium', *The Journal of Risk Finance,* Vol. 6 No. 4, pp. 341-348.

Palliam, R. (2005b) 'Estimating the Cost of Capital: Considerations for Small Business', *The Journal of Risk Finance,* Vol. 6 No. 4, pp. 335-340.

Pastor, L., Sinha, M. & Swaminthan, B. (2008) 'Estimating the Intertemporal Risk-Return Tradeoff Using the Implied Cost of Capital', *The Journal of Finance*, Vol. 63 No. 6, [online] http://www.nber.org/papers/w11941.pdf?new_window=1 (Accessed 31 January 2014).

Pastor, L. & Veronesi, P. (2011) 'Uncertainty about Government Policy and Stock Prices', Chicago Booth Research Paper No. 10-25, *Social Science Research Network, Fama-Miller Working Paper Series*, [online] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1625572 (Accessed 31 January 2014).

Patchett, E. & Horgan, J. (2011) 'A Contemporary View of Portfolio Risk and Diversification', *Benefits Magazine,* Vol. 48 No. 1, pp. 30-37.

Patton, M. Q. (1990) *Qualitative Evaluation and Research Methods,* 2nd ed. SAGE, Thousand Oaks, CA.

Patton, M. Q. (2002) *Qualitative Research & Evaluation Methods,* 3rd ed. SAGE, London, UK.

Pawelzik, K. U. (2012) 'Explizites und implizites Fremdkapital bei der Unternehmensbewertung [Translation: "Explicit and Implicit Debt in the Company Valuation"]', *Die Wirtschaftsprüfung,* Vol. 65 No. 17, pp. 936-950.

Payne, J. D., Heath, W. C. & Gale, L. R. (1999) 'Comparative Financial Practice in the US and Canada: Capital Budgeting and Risk Assessment', *Financial Practice and Education,* Vol. 9 No. 10, pp. 16-24.

Peemöller, V. H. (2005) 'Bewertung von Klein-und Mittelbetrieben [Translation: "Valuation of Small and Medium Sized Companies"]', *Betriebs-Berater,* Vol. 60 No. 30, pp. 30-35.

Penman, S. H., Richardson, S. A. & Tuna, I. (2007) 'The Book-to-Price Effect in Stock Returns: Accounting for Leverage', *Journal of Accounting Research,* Vol. 45 No. 2, pp. 427-467.

Penn, I. (2018, July 24) *The $3 Billion Plan to Turn Hoover Dam Into a Giant Battery,* The New York Times, [online] https://www.nytimes.com/interactive/2018/07/24/business/energy-environment/hoover-dam-renewable-energy.html (Accessed 7 August 2018).

Penwarden, R. (2013) *How to Write a Proper Survey Introduction*, [online] (Accessed 11 October 2015).

Pereira, L. M., de Oliveira Ribeiro, C. & Securato, J. R. (2012) 'Agricultural Commodities Pricing Model Applied to the Brazilian Sugar Market', *Australian Journal of Agricultural & Resource Economics,* Vol. 56 No. 4, pp. 542-557.

Pereiro, L. E. (2010) 'The Beta Dilemma in Emerging Markets', *Journal of Applied Corporate Finance,* Vol. 22 No. 4, pp. 110–122.

Perridon, L., Steiner, M. & Rathgeber, A. W. (2014) *Finanzwirtschaft der Unternehmung [Translation: "Financial Management of the Company"],* Vahlen, München, D.

Perry, J. S. & Herd, T. J. (2004) 'Reducing M&A Risk Through Improved Due Diligence', *Strategy & Leadership,* Vol. 32 No. 2, pp. 12-19.

Petersen, C., Plenborg, T. & Schøler, F. (2006) 'Issues in Valuation of Privately Held Firms', *The Journal of Private Equity,* Vol. 10 No. 1, pp. 33-48.

Petrolia, D. R., Landry, C. E. & Coble, K. H. (2013) 'Risk Preferences, Risk Perceptions, and Flood Insurance', *Land Economics,* Vol. 89 No. 2, pp. 227-245.

Petry, G. H. (1975) 'Effective Use of Capital Budgeting Tools', *Business Horizons,* Vol. 18 No. 5, pp. 57-65.

Petry, G. H. & Sprow, J. (1994) 'The Theory and Practice of Finance in the 1990s', *The Quarterly Review of Economics and Finance,* Vol. 33 No. 4, pp. 359-381.

Petty, W. J., Scott Jr, D. F. & Bird, M. M. (1975) 'The Capital Expenditure Decision-Making Process of Large Corporations', *The Engineering Economist,* Vol. 20 No. 3, pp. 159-172.

Pfister, C. (2003) *Divisionale Kapitalkosten: Theorie und Anwendung [Translation: "Divisional Cost of Capital: Theory and Application"],* Paul Haupt, Berne, CH.

Piel, J.-H., Humpert, F. J. & Breitner, M. H. (2018) 'Applying a Novel Investment Evaluation Method with Focus on Risk—A Wind Energy Case Study', *In:* Fink, A., Fügenschuh, A. & Geiger, M. J. (eds.) *Operations Research Proceedings 2016.* pp. 193-199, Springer, Heidelberg, D.

Pike, R. (1996) 'A Longitudinal Survey on Capital Budgeting Practices', *Journal of Business Finance & Accounting,* Vol. 23 No. 1, pp. 79-92.

Pike, R. H. (1983) 'A Review of Recent Trends in Formal Capital Budgeting Processes', *Accounting and Business Research,* Vol. 13 No. 51, pp. 201-208.

Pinches, G. E. & Vashist, M. (1996) *Essentials of Financial Management,* Addison-Wesley, Boston, MA.

Ping, C., Zhenguo, L. & Yingchun, L. (2013) 'Liquidity Risk of Private Assets: Evidence from Real Estate Markets', *Financial Review,* Vol. 48 No. 4, pp. 671-696.

Pitman, M. A. & Maxwell, J. A. (1992) 'Qualitative Approaches to Evaluation: Models and Methods', *In:* LeCompte, M. D., Millroy, W. L. & Preissle, J. (eds.) *The Handbook of Qualitative Research in Education.* pp. 770, Academic Press, San Diego, CA.

Plano Clark, V. L. & Ivankova, N. V. (2016) *Mixed Methods Research: A Guide to the Field,* SAGE, Los Angeles, London.

Polanyi, M. (1966) 'The Logic of Tacit Inference', *Philosophy,* Vol. 41 No. 155, pp. 1-18.

Popp, M. (2012) 'Vergangenheits- und Lageanalyse [Translation: "Past and Situation Analysis"]', *In:* Peemöller, V. H. (ed.) *Praxishandbuch der Unternehmensbewertung.* 5th ed, pp. 173-218, nbw, Herne / Berlin, DE.

Poterba, J. M. & Summers, L. H. (1995) 'A CEO Survey of US Companies' Time Horizons and Hurdle Rates', *Sloan Management Review,* Vol. 37 No. 1, pp. 43-53.

Power, M. (2004) *The Risk Management of Everything: Rethinking the Politics of Uncertainty,* Demos, London.

Pratt, S. & Niculita, A. (2008) *Valuing a Business, The Analysis and Appraisal of Closely Held Businesses,* McGraw Hill, New York.

Pratt, S. P. & Grabowski, R. J. (2002) *Cost of Capital,* 2nd ed. John Wiley & Sons, Inc., Hoboken, NJ.

Pratt, S. P., Reilly, R. F. & Schweihs, R. P. (2000) *Valuing a Business,* McGraw-Hill Companies, New York.

Project Management Institute (PMI) (2009) *Practice Standard for Project Risk Management,* 4th ed. Project Management Institute, Newtown Square, PA.

Rabiee, F. (2004) 'Focus-Group Interview and Data Analysis', *Proceedings of the Nutrition Society,* Vol. 63 No. 04, pp. 655-660.

Rappaport, A. (1998) *Creating Shareholder Value: The New Standard for Business Performance,* The FreePress, New York.

Raz, T. & Michael, E. (2001) 'Use and Benefits of Tools for Project Risk Management', *International Journal of Project Management,* Vol. 19 No. 1, pp. 9-17.

Reason, P. & Bradbury, H. (2001) *Handbook of Action Research: Participative Inquiry and Practice,* SAGE, Thousand Oaks, CA.

Regan, C. M., Bryan, B. A., Connor, J. D., Meyer, W. S., Ostendorf, B., Zhu, Z. & Bao, C. (2015) 'Real Options Analysis for Land Use Management: Methods, Application, and Implications for Policy', *Journal of Environmental Management,* Vol. 161, pp. 144-152.

Reichardt, C. S. & Cook, T. D. (1979) 'Beyond Qualitative Versus Quantitative Methods.', *In:* Reichardt, C. S. & Cook, T. D. (eds.) *Qualitative and Quantitative Methods in Evaluation Research.* pp., SAGE, Beverly Hills, CA.

Reichardt, C. S. & Rallis, S. F. (1994) 'The Relationship Between the Qualitative and Quantitative Research Traditions', *In:* Reichardt, C. S. & Rallis, S. F. (eds.) *New Directions for Evaluation.* pp. 5-11, Jossey-Bass, San Francisco.

Reichert, A. K., Moore, J. S. & Byler, E. (1988) 'Financial Analysis Among Large US Corporations: Recent Trends and the Impact of the Personal Computer', *Journal of Business Finance & Accounting,* Vol. 15 No. 4, pp. 469-485.

Reichmuth, T. (ed.) (2013) *Die Finanzierung der Energiewende in der Schweiz [Translation: "The Financing of the Energy Transition in Switzerland"],* Zürich, CH: Verlag Neu Züricher Zeitung.

Reinganum, M. R. (1981) 'A New Empirical Perspective on the CAPM', *Journal of Financial and Quantitative Analysis,* Vol. 16 No. 4, pp. 439-462.

Remenyi, D., Williams, B., Money, A. & Swartz, E. (1998) Doing Research in Business and Management – An Introduction to Process and Method (1998). London: SAGE Publications.

Rentizelas, A., Tziralis, G. & Kirytopoulos, K. (2007) 'Incorporating Uncertainty in Optimal Investment Decisions', *World Review of Entrepreneurship, Management and Sustainable Development,* Vol. 3 No. 3-4, pp. 273-283.

Riahi-Belkaoui, A. (2016) *Capital Budgeting and Leasing*, https://www.researchgate.net/profile/Ahmed_Riahi-Belkaoui/publications, [online] (Accessed 30 March 2017).

Richter, F. (1998) 'Unternehmensbewertung bei variablem Verschuldungsgrad [Translation: "Company Valuation at Variable Debt"]', *Zeitschrift für Bankrecht und Bankwirtschaft,* Vol. 10 No. 6, pp. 379-389.

Richter, M. (2013) 'Business Model Innovation for Sustainable Energy: German Utilities and Renewable Energy', *Energy Policy,* Vol. 62, pp. 1226-1237.

Rietz, T. A. (1988) 'The Equity Risk Premium - A Solution', *Journal of Monetary Economics,* Vol. 22 No. 1, pp. 117-131.

Rihoux, B., Ragin, C. C., Yamasaki, S. & Bol, D. (2009) 'Conclusions - The Way(s) Ahead', *In:* Rihoux, B. & Ragin, C. C. (eds.) *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques.* pp. 167-178, SAGE, Los Angeles, CA.

RIMS (2012) *RIMS Executive Report - The Risk Perspective: Exploring Risk Appetite and Risk Tolerance*, https://www.rims.org/resources/ERM/Documents/RIMS_Exploring_Risk_Appetite_Risk_Tolerance_0412.pdf (Accessed 15 June 2017).

Ritchie, J., Lewis, J., Nicholls, C. M. & Ormston, R. (2013) *Qualitative Research Practice: A Auide for Social Science Students and Researchers,* SAGE, Thousand Oaks, CA.

Robichek, A. A. & MacDonald, J. (1966) *Financial Management in Transition, Long Range Planning Service*, Report No. 268, Stanford Research Institute, Menlo Park, CA. [online].

Robichek, A. A. & Myers, S. C. (1966) 'Conceptual Problems in the Use of Risk-Adjusted Discount Rates', *Journal of Finance,* Vol. 21 No. 4, pp. 727-730.

Robichek, A. A. & Myers, S. C. (1968) 'Valuation Under Uncertainty: Comment', *Journal of Financial and Quantitative Analysis,* Vol. 3 No. 4, pp. 479-483.

Robson, C. (2002) *Real World Research,* Blackwell, Oxford, UK.

Rodger, C. & Petch, J. (1999) 'Uncertainty & Risk Analysis - A Practical Guide from Business Dynamics', *Business Dynamics, PricewaterhouseCoopers*, Vol. 4, [online] http://www.michaelsamonas.gr/images/Mixalhs/resources/Uncertainty__Risk-Analysis.pdf (Accessed 15 June 2016).

Rodríguez, M. C. & Nickel, M. N. (2002) 'Is the Risk-Return Paradox Still Alive? (Working Paper)', *Universidad Carlos III de Madrid*, [online] http://e-archivo.uc3m.es/bitstream/id/66/wb024818.pdf/;jsessionid=2533587307B24B3E68B503F5D2AB70B5 (Accessed 19 January 2014).

Rogge, K. S., Pfluger, B. & Geels, F. W. (2018) 'Transformative Policy Mixes in Socio-Technical Scenarios: The Case of the Low-Carbon Transition of the German Electricity System (2010–2050)', *Technological Forecasting and Social Change*.

Rohrmann, B. (1998) 'The Risk Notion: Epistemological and Empirical Considerations', *In:* Stewart, M. G. & Melchers, R. E. (eds.) *Integrated Risk Assessment: Applications and Regulations.* pp. 39-46, Balkema, Rotterdam, NL.

Rohrmann, B. (2005) 'Risk Attitude Scales: Concepts, Questionnaires, Utilizations', *Project report - University of Melbourne/Australia*, Vol. 13, [online] http://www.rohrmannresearch.net/pdfs/rohrmann-racreport.pdf (Accessed 3 May 2016).

Roland, H. E. & Moriarty, B. (1990) *System Safety Engineering and Management,* John Wiley & Sons, Hoboken, NJ.

Roques, F., Hiroux, C. & Saguan, M. (2010) 'Optimal Wind Power Deployment in Europe - A Portfolio Approach', *Energy Policy,* Vol. 38 No. 7, pp. 3245-3256.

Rose, M. (2001) *Risk versus Uncertainty, or Mr. Slate versus Great-Aunt Matilda,* Library of Economics and Liberty, [online] http://www.econlib.org/library/Columns/Teachers/riskuncertainty.html (Accessed 15 December 2013).

Rosenberg, B., Reid, K. & Lanstein, R. (1985) 'Persuasive Evidence of Market Inefficiency', *Journal of Portfolio Management,* Vol. 11 No. 3, pp. 9-17.

Ross, S. A. (1976) 'The Arbitrage Theory of Capital Asset Pricing', *Journal of Economic Theory,* Vol. 13 No. 3, pp. 341-360.

Ross, S. A., Westerfield, R. W. & Jaffe, J. F. (2008) *Corporate Finance,* 8th ed. McGraw-Hill Higher Education, New York.

Rossman, G. B. & Wilson, B. L. (1985) 'Numbers and Words: Combining Quantitative and Qualitative Methods in a Single Large-Scale Evaluation Study', *Evaluation Review,* Vol. 9 No. 5, pp. 627-643.

Rugman, A. M. (1976) 'Risk Reduction by International Diversification', *Journal of International Business Studies,* Vol. 7 No. 2, pp. 75-80.

Ryan, B., Scapens, R. W. & Theobald, M. (2002) *Research Method and Methodology in Finance and Accounting,* 2nd ed. Thomson, London.

Ryan, P. A. & Gallagher, T. J. (2006) 'Implied Risk Adjusted Discount Rates'. Paper presented at Academy of Business Education, Savannah, GA [online] https://docs.wixstatic.com/ugd/4ccb80_c318f274d56c4f9c8840610e28107922.pdf (Accessed 31 July 2017).

Ryan, P. A. & Ryan, G. P. (2002) 'Capital Budgeting Practices of the Fortune 1000: How Have Things Changed?', *Journal of Business and Management,* Vol. 8 No. 4, pp. 355.

Saaty, T. L. (1980) *The Analytic Hierarchy Process: Planning, Priority Setting, Resources Allocation,* McGraw-Hill, New York.

Saaty, T. L. (1990) 'How to Make a Decision: The Analytic Hierarchy Process', *European Journal of Operational Research,* Vol. 48 No. 1, pp. 9-26.

Sackmann, J. (2007) *Risk vs. Uncertainty*, [online] http://www.hardballtimes.com/main/article/risk-vs-uncertainty/ (Accessed 5 May 2017).

Samson, S., Reneke, J. A. & Wiecek, M. M. (2009) 'A Review of Different Perspectives on Uncertainty and Risk and an Alternative Modeling Paradigm', *Reliability Engineering & System Safety,* Vol. 94 No. 2, pp. 558-567.

Sangster, A. (1993) 'Capital Investment Appraisal Techniques: A Survey of Current Usage', *Journal of Business Finance and Accounting,* Vol. 20 No. 3, pp. 307-307.

Santiago, L. P. & Vakili, P. (2005) 'On the Value of Flexibility in R&D Projects', *Management Science,* Vol. 51 No. 8, pp. 1206-1218.

Sarin, R. K. & Weber, M. (1993) 'Risk-Value Models', *European Journal of Operational Research,* Vol. 70 No. 2, pp. 135-149.

Saunders, M., Lewis, P. & Thornhill, A. (2009) *Research Methods for Business Students,* Pearson Education Limited, Essex, UK.

Sayer, A. (2000) *Realism and Social Science,* SAGE, London.

Sayer, A. (2004) 'Foreword: Why Critical Realism?', *In:* Fleetwood, S. & Ackroyd, S. (eds.) *Critical Realist Applications in Organisation and Management Studies.* pp. 6, Routledge, London.

Schall, L. D., Sundem, G. L. & Geijsbeek, W. R. (1978) 'Survey and Analysis of Capital Budgeting Methods', *Journal of Finance,* Vol. 33 No. 1, pp. 281-287.

Schindler, R. M. (2011) *Pricing Strategies: A Marketing Approach,* SAGE, Thousand Oaks, CA.

Schlegel, D. (2015) *Cost-of-Capital in Managerial Finance - An Examination of Practices in the German Real Economy Sector,* Springer, Cham, CH.

Schleicher-Tappeser, R. (2012) 'How Renewables Will Change Electricity Markets in the Next Five Years', *Energy Policy,* Vol. 48, pp. 64-75.

Schmidt, T. S. (2014) 'Low-Carbon Investment Risks and De-Risking', *Nature Climate Change,* Vol. 4 No. 4, pp. 237.

Schoonenboom, J. & Johnson, R. B. (2017) 'How to Construct a Mixed Methods Research Design', *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie*, [online] https://link.springer.com/article/10.1007/s11577-017-0454-1 (Accessed 8 October 2017).

Schultze, W. (2003) *Methoden der Unternehmensbewertung: Gemeinsamkeiten, Unterschiede, Perspektiven [Translation: "Methods of the Company Assessment: Similarities, Differences, Perspectives"],* IDW-Verlag, Düsseldorf, D.

Schutz, A. (1970) *Alfred Schutz on Phenomenology and Social Relations,* University of Chicago Press, Chicago, IL.

Scott, D. L. (2003) *Wall Street Words,* 3rd ed. Houghton Mifflin, Boston, MA.

Shah, S. (2011) 'Spanish Government faces Lawsuits over Solar Feed in Tariff Cuts from ASIF'. *Green World Investor*, [Online]. 25 January. http://www.greenworldinvestor.com/2011/01/25/spanish-government-faces-lawsuits-over-solar-feed-in-tariff-cuts-from-asif/ (Accessed 10 January 2015).

Shao, L. P. & Shao, A. T. (1996) 'Risk Analysis and Capital Budgeting Techniques of US Multinational Enterprises', *Managerial Finance,* Vol. 22 No. 1, pp. 41-57.

Sharot, T. (2011) 'The Optimism Bias', *Current Biology,* Vol. 21 No. 23, pp. R941-R945.

Sharpe, W. F. (1964) 'Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk', *Journal of Finance,* Vol. 19 No. 3, pp. 425-442.

Shockley, R. L. (2007) *An Applied Course in Real Options Valuation,* Thomson Higher Education, Mason, OH.

Sick, G. A. (1986) 'A Certainty-Equivalent Approach to Capital Budgeting', *Financial Management,* Vol. 15 No. 4, pp. 23-32.

Sieben, G. (1995) 'Unternehmensbewertung: Discounted Cash Flow-Verfahren und Ertragswertverfahren – Zwei völlig unterschiedliche Ansätze [Translation: "Company Valuation: Discounted Cash Flow Procedures and Income Value Methods - Two Completely Different Approaches"]', *1995): Internationale Wirtschaftsprüfung, FS für Hans Havermann, Düsseldorf, DE*.

Skea, J. (2015) 'The Clean Energy Imperative', *In:* Donovan, C. W. (ed.) *Renewable Energy Finance: Powering the Future.* pp. 17-46, Imperial College Press, London.

Smith, J. K. (1983) 'Quantitative versus Qualitative Research: An Attempt to Clarify the Issue', *Educational Researcher,* Vol. 12 No. 3, pp. 6-13.

Smithson, C. & Simkins, B. J. (2005) 'Does Risk Management Add Value? A Survey of the Evidence', *Journal of Applied Corporate Finance,* Vol. 17 No. 3, pp. 8-17.

Söderholm, P. & Pettersson, M. (2011) 'Offshore Wind Power Policy and Planning in Sweden', *Energy Policy,* Vol. 39 No. 2, pp. 518-525.

Solomon, E. 'Return on Investment: The Relation of Book-Yield to True Yield'. in *Fall Meeting of the Society of Petroleum Engineers of AIME*. Society of Petroleum Engineers.

Spremann, K. & Ernst, D. (2011) *Unternehmensbewertung: Grundlagen und Praxis [Translation: "Company Valuation: Basics and Practice"],* Oldenburger Wirtschaftsverlag, München, DE.

Stanley, M. T. & Block, S. B. (1984) 'A Survey of Multinational Capital Budgeting', *Financial Review,* Vol. 19 No. 1, pp. 36-54.

Steckler, A., McLeroy, K. R., Goodman, R. M., Bird, S. T. & McCormick, L. (1992) Toward Integrating Qualitative and Quantitative Methods: An Introduction. Thousand Oaks, CA: SAGE.

Steffen, B. (2018) 'The Importance of Project Finance for Renewable Energy Projects', *Energy Economics,* Vol. 69, pp. 280-294.

Steffen, B. & Schmidt, T. S. (2018) *Current and Future Energy Performance of Power Generation Technologies in Switzerland*, Swiss Academy of Engineering Sciences (SATW). ETH Zurich. [online] https://www.satw.ch/fileadmin/user_upload/documents/02_Themen/05_Energie/SATW-Energy-Performance-Switzerland-Report-EN.pdf#page=3&zoom=auto,-158,784 (accessed on 30 June 2018).

Steffen, B. & Weber, C. (2013) 'Efficient Storage Capacity in Power Systems with Thermal and Renewable Generation', *Energy Economics,* Vol. 36, pp. 556-567.

Steiner, M. & Wallmeier, M. (1999) 'Unternehmensbewertung mit Discounted Cash Flow-Methoden und dem Economic Value Added-Konzept [Translation: "Company Valuation Using Discounted Cash Flow Methods and the Economic Value Added Concept"]', *Finanz Betrieb,* Vol. 1 No. 5, pp. 1-10.

Stern, J. M., Stewart, G. B. & Chew, D. H. (1995) 'The EVA® Financial Management System', *Journal of Applied Corporate Finance,* Vol. 8 No. 2, pp. 32-46.

Stewart, J. J., Allison, P. N. & Johnson, R. S. (2001) 'Putting a Price on Biotechnology', *Nature Biotechnology,* Vol. 19 No. 9, pp. 813-817.

Stremersch, S., Wuyts, S. & Frambach, R. T. (2001) 'The Purchasing of Full-Service Contracts:: An Exploratory Study within the Industrial Maintenance Market', *Industrial Marketing Management,* Vol. 30 No. 1, pp. 1-12.

STROM.info (n.d.) *IPP (Independent Power Producer),* STROM.info, [online] http://www.strom.info/ipp-independent-power-producer.html (Accessed 30 August 2017).

Sundberg, K.-H. & Engzell, T. (2007) 'AHP-modellen och kapitalkostnaden i onoterade bolag: En lösning på värderingsproblematiken i onoterade bolag? [Translation: "The AHP-Model and Cost of Capital in Unlisted Companies: A Solution to Valuation in Unlisted Companies?"]', *Institutionen för ekonomisk och industriell utveckling*, [online] http://www.diva-portal.org/smash/get/diva2:22998/FULLTEXT01.pdf (Accessed 21 September 2014).

Sutton, I. (2014) *Process Risk and Reliability Management,* 2nd ed. Gulf Professional Publishing, Oxford, UK.

Taleb, N. N. (2010) *The Black Swan: The Impact of the Highly Improbable,* 2nd ed. Penguin, London.

Tashakkori, A. & Teddlie, C. (1998) *Mixed Methodology: Combining Qualitative and Quantitative Approaches,* SAGE, Thousand Oaks, CA.

Tashakkori, A. & Teddlie, C. (2003) 'The Past and the Future of Mixed Methods Research: from Data Triangulation to Mixed Model Designs', *In:* Tashakkori, A. & Teddlie, C. (eds.) *SAGE Handbook of Mixed Methods in Social and Behavioural Research.* pp. 671-701, SAGE, Thousand Oaks, CA.

Tashakkori, A. & Teddlie, C. (2010) *SAGE Handbook of Mixed Methods in Social and Behavioural Research,* SAGE, Thousand Oaks, CA.

Tattam, D. (2015) *Risk Appetite: How Hungry Are You For risk?,* Protecht Risk Management Insights, [online] http://blog.protecht.com.au/risk-appetite (Accessed 17 June 2017).

Tavakol, M. & Dennick, R. (2011) 'Making Sense of Cronbach's Alpha', *International Journal of Medical Education,* Vol. 2, pp. 53-55.

Taylor, J. J. (2014a) *Statistical Soup: ANOVA, ANCOVA, MANOVA, & MANCOVA*, [online] http://www.statsmakemecry.com/smmctheblog/stats-soup-anova-ancova-manova-mancova (Accessed 26 July 2016).

Taylor, L. (2014b) *Practical Enterprise Risk Management: How to Optimize Business Strategies Through Managed Risk Taking,* Kogan Page Publishers, London.

Teddlie, C. & Tashakkori, A. (2009) *Foundations of Mixed Methods Research: Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences,* SAGE, Thousand Oaks, CA.

Tellis, W. M. (1997) 'Application of a Case Study Methodology', *The Qualitative Report,* Vol. 3 No. 3, pp. 1-19.

Thakkar, R. (2015) *Low Interest Rates and Technology Drive Renewable Energy,* livemint, [online] http://www.livemint.com/Money/JHyIpkj4j0iT8zeFD8q1dO/Low-interest-rates-and-technology-drive-renewable-energy.html (Accessed 27 February 2017).

TheRMUoHP Biostatistics Resource Channel (2012) *How to Use SPSS:Chi Square Test for Independence or Crosstabulation (2x4)* [online] https://www.youtube.com/watch?v=S918nNTCTjA (Accessed 26 July 2016).

Tijdhof, L. (2007a) *WACC: Practical Guide for Strategic Decision- Making – Part 1,* Zanders - Treasury and Finance Solutions, [online] http://zanders.eu/nl/latest-insights/wacc-practical-guide-for-strategic-decision-making-part-1/ (Accessed 11 July 2017).

Tijdhof, L. (2007b) *WACC: Practical Guide for Strategic Decision- Making – Part 5,* Zanders - Treasury and Finance Solutions, [online] http://zanders.eu/nl/latest-insights/wacc-practical-guide-for-strategic-decision-making-part-5-2/ (Accessed 11 July 2017).

Tijdhof, L. (2007c) *WACC: Practical Guide for Strategic Decision- Making – Part 8,* Zanders - Treasury and Finance Solutions, [online] http://zanders.eu/nl/latest-insights/wacc-practical-guide-for-strategic-decision-making-part-8/ (Accessed 11 July 2017).

Tilley, S. A. & Powick, K. D. (2002) 'Distanced data: Transcribing other people's research tapes', *Canadian Journal of Education/Revue canadienne de l'education,* Vol. 27 No. 2/3, pp. 291-310.

Titman, S. & Martin, J. D. (2008) *Valuation: The Art and Science of Corporate Investment Decisions,* Pearson, Addison-Wesley, Boston, MA.

trend:research (2013) *Anteile einzelner Marktakteure an Erneuerbare Energien-Anlagen in Deutschland (Translation: "Shares of Individual Market Players to Renewable Energy Systems in Germany"),* 2nd ed. trend:research GmbH, Bremen, DE.

Treynor, J. L. (1961) 'Market Value, Time, and Risk', Unpublished Manuscript.

Treynor, J. L. (1962) 'Toward a Theory of Market Value of Risky Assets', Unpublished Manuscript.

Trigeorgis, L. (1993) 'The Nature of Option Interactions and the Valuation of Investments with Multiple Real Options', *Journal of Financial and Quantitative Analysis,* Vol. 28 No. 1, pp. 1-20.

Trigeorgis, L. (1996) *Real Options: Managerial Flexibility and Strategy in Resource Allocation,* Asco Trade Typesetting Ltd., Hong Kong.

Truong, G., Partington, G. & Peat, M. (2008) 'Cost-of-Capital Estimation and Capital-Budgeting Practice in Australia', *Australian Journal of Management,* Vol. 33 No. 1, pp. 95-121.

Turner, G., Roots, S., Wiltshire, M., Trueb, J., Brown, S., Benz, G. & Hegelbach, M. (2013) 'Profiling the Risks in Solar and Wind: a Case for New Risk Management Approaches in the Renewable Energy Sector', *Swiss Re and Bloomberg New Energy Finance*, Vol. 23, [online] https://about.bnef.com/blog/profiling-the-risks-in-solar-and-wind/ (Accessed 30 June 2017).

Tweedale, H. (1993) 'Maximising the Usefulness of Risk Assessment', *In:* Melchers, R. E. & Stewart, M. G. (eds.) *Probabilistic Risk and Hazard Assessment.* pp. 1-11, Balkema, Rotterdam, NL.

Uher, T. E. & Toakley, A. R. (1999) 'Risk Management in the Conceptual Phase of a Project', *International Journal of Project Management,* Vol. 17 No. 3, pp. 161-169.

United Nations Framework Convention on Climate Change (UNFCCC) (n.d.) *Background on the UNFCCC: The International Response to Climate Change*, [online] http://unfccc.int/essential_background/items/6031.php (Accessed 30 June 2016).

University of Gloucestershire (2008) *Research Ethics: A Handbook of Principles and Procedures*, Cheltenham, UK, [online] http://www.glos.ac.uk/docs/download/Research/handbook-of-principles-and-procedures.pdf (Accessed 30 November 2015).

Unteutsch, M. & Lindenberger, D. (2016) 'Promotion of Electricity from Renewable Energy in Europe post 2020—the Economic Benefits of Cooperation', *In:* von Weizsäcker, C. C., Lindenberger, D. & Höffler, F. (eds.) *Interdisziplinäre Aspekte der Energiewirtschaft [Translation: "Interdisciplinary Aspects of the Energy Industry"].* pp. 61-78, Springer, Heidelberg, DE.

UZH (2016a) *Methodenberatung - Einfaktorielle Varianzanalyse (ohne Messwiederholung) [Translation: "Methods Consulting - Univeriate Analysis of Variances (without Repeated Measurements)"]*, [online] http://www.methodenberatung.uzh.ch/datenanalyse/unterschiede/zentral/evarianz.html (Accessed 2 July 2016).

UZH (2016b) *Methodenberatung - Korrelation nach Bravais-Pearson [Translation: "Methods Consulting - Correlation according to Bravais-Pearson"]*, [online] http://www.methodenberatung.uzh.ch/datenanalyse/zusammenhaenge/korrelation.html (Accessed 2 July 2016).

UZH (2016c) *Methodenberatung - t-Test für unabhängige Stichproben [Translation: "Methods Consulting - t-Test for Independent samples"]*, [online] http://www.methodenberatung.uzh.ch/datenanalyse/unterschiede/zentral/ttestunabh.html (Accessed 2 July 2016).

UZH (2016d) *Methodenberatung - Pearson Chi-Quadrat-Test (Kontingenzanalyse) [Translation: "Methods Consulting - Pearson Chi-Squared Test (Contingency Analysis)"]*, [online] http://www.methodenberatung.uzh.ch/datenanalyse/unterschiede/proportionen/pearsonuntersch.html#80 (Accessed 2 July 2016).

Velez-Pareja, I. (2005) 'Cost of Capital for Non-Traded Firms', *Social Science Research Network*, [online] http://papers.ssrn.com/soL3/papers.cfm?abstract_id=366981 (Accessed 18 July 2014).

Viebig, J., Poddig, T. & Varmaz, A. (eds.) (2008) *Equity Valuation - Models from Leading Investment Banks,* Chichester, UK: John Wiley & Sons.

Villiger, R. & Bogdan, B. (2005) 'Valuing Pharma R&D: The Catch-22 of DCF', *Journal of Applied Corporate Finance,* Vol. 17 No. 2, pp. 113-116.

Vintila, N. (2007) 'Real Options in Capital Budgeting. Pricing the Option to Delay and the Option to Abandon a Project', *Theoretical and Applied Economics,* Vol. 7 No. 512, pp. 47-58.

Vogt, W. P. (1999) *Dictionary of Statistics and Methodology,* SAGE, Thousand Oaks, CA.

Wagle, B. (1967) 'A Statistical Analysis of Risk in Capital Investment Projects', *Journal of the Operational Research Society,* Vol. 18 No. 1, pp. 13-33.

Waldron, J. (1990) *The Right to Private Property,* Clarendon Paperbacks, Oxford, UK.

Wallace, R. O. & Mellor, C. (1988) 'Nonresponse Bias in Mail Accounting Surveys: A Pedagogical Note', *The British Accounting Review,* Vol. 20 No. 2, pp. 131-139.

Wallmeier, M. (1999) 'Kapitalkosten und Finanzierungsprämissen [Translation: "Capital Costs and Financial Premises"]', *Zeitschrift fur Betriebswirtschaft,* Vol. 69 No. 12, pp. 1473-1490.

Warren, B. (2014) *Chief Editor's Note*, RECAI. [online]. EY, 40, February. [online] http://www.ey.com/Publication/vwLUAssets/RECAI_40_-_February_2014/$FILE/EY_RECAI%2040_Feb%202014.pdf (Accessed 1 October 2015).

Warren, B. (2017) *EY UK Energy Blog - RECAI at 50: The Next Phase of the Renewables Revolution,* EY, 10 October, [online] https://www.ey.com/uk/en/services/specialty-services/ey-energy-blog-ben-warren-10-2017 (Accessed 30 March 2018).

Wassmann, A., Martin, F. & Ebner, M. (2016) *Market study - Investments in Renewables Survey of Institutional Investors 2015*, KGAL. [online] http://www.kgal-group.com/uploads/tx_newsdownloads/KGAL_markets_study_infrastructure_2015_01.pdf (Accessed 5 January 2016).

Watts, C. (2011) *Managing the Risk in Renewable Energy*, Economist Intelligence Unit. [online]. The Economist, sponsored by Swiss Re. [online] http://www.economistinsights.com/sites/default/files/downloads/EIU-SwissRe_ManagingRiskRenewableEnergy_Web_2.pdf (Accessed 30 March 2014).

Weber, E. U. (1997) 'The Utility of Measuring and Modeling Perceived Risk', *In:* Marley, A. A. J. (ed.) *Choice, decision, and measurement: Essays in honor of R. Duncan Luce.* pp. 45-56, Lawrence Erlbaum Associates Publishers, Mahwah, NJ.

Weber, E. U. (1998) 'Whos Afraid of a Little Risk? New Evidence for General Risk Aversion', *In:* J, S., Mellers, B. & Schum, D. (eds.) *Decision science and technology: Reflections on the contributions of Ward Edwards.* pp. 5364, Kluwer Academic Press:, Norwell, MA.

Weber, E. U., Blais, A. R. & Betz, N. E. (2002) 'A Domain-Specific Risk-Attitude Scale: Measuring Risk Perceptions and Risk Behaviors', *Journal of Behavioral Decision Making,* Vol. 15 No. 4, pp. 263-290.

Weber, E. U. & Hsee, C. (1998) 'Cross-Cultural Differences in Risk Perception, but Cross-Cultural Similarities in Attitudes Towards Perceived Risk', *Management Science,* Vol. 44 No. 9, pp. 1205-1217.

Weitmayr, H. (2017) 'Die Schwäne sind gelandet [Translations: "The Swans Are Landed"]', *Institutional Money, FONDS Professionell Multimedia GmbH*, *(*1) [online] http://www.institutional-money.com/magazin/theorie-praxis/artikel/die-schwaene-sind-gelandet-58793/ (Accessed 24 April 2018).

Welch, I. (2000) 'Views of Financial Economists on the Equity Premium and on Professional Controversies', *Journal of Business,* Vol. 73 No. 4, pp. 501-537.

Welsh, J. A., White, J. F. & Dowell, P. (1982) 'A Small Business is not a Little Big Business Harvard Business Review, Vol. 59, No. 4, July/August, 1981, pp. 18 (9 pages', *International Small Business Journal,* Vol. 1 No. 1, pp. 95-95.

Weston, J. F. (1954) 'The Profit Concept and Theory: A Restatement', *Journal of Political Economy,* Vol. 62 No. 2, pp. 152-170.

Weston, J. F. (1973) 'Investment Decisions Using the Capital Asset Pricing Model', *Financial Management,* Vol. 2 No. 2, pp. 25-33.

Whitehead, J. C., Groothuis, P. A. & Blomquist, G. C. (1993) 'Testing for Non-Response and Sample Selection Bias in Contingent Valuation: Analysis of a Combination Phone/Mail Survey', *Economics Letters,* Vol. 41 No. 2, pp. 215-220.

Wikgren, M. (2005) 'Critical Realism as a Philosophy and Social Theory in Information Science?', *Journal of Documentation,* Vol. 61 No. 1, pp. 11-22.

Wikipedia (2017) *Risk Universe*, [online] https://en.wiktionary.org/wiki/risk_universe (Accessed 23 November 2017).

Williams, J. B. (1938) *The Theory of Investment Value.,* Harvard University Press, Cambridge.

Williams, J. T. (1991) 'Real Estate Development as an Option', *The Journal of Real Estate Finance and Economics,* Vol. 4 No. 2, pp. 191-208.

Willows, R., Reynard, N., Meadowcroft, I. & Connell, R. (2003) *Climate Adaptation: Risk, Uncertainty and Decision-Making. UKCIP Technical Report,* UK Climate Impacts Programme.

Wind:Research (2012) in Neue Energie (2014) *Neue Energie,* Vol. May.

Winkler, R. L. (2003) *An Introduction to Bayesian Inference and Decision,* 2nd ed. Probabilistic Publishing, Gainesville, US.

Wolffsen, P. (2012) 'Modification of Capital Budgeting Under Uncertainty', *Taikomoji Ekonomika: Sisteminiai Tyrimai,* Vol. 6 No. 2, pp. 143-159.

Womack, K., Zhang, Y., Borchert, A., Ensz, L., Knijn, J., Pope, G. & Smith, A. (2003) *Understanding Risk and Return, the CAPM, and the Fama-French Three-Factor Model*, Tuck School of Business. [online] http://ssrn.com/abstract=481881 (Accessed 15 February 2014).

Wong, K. & So, A. T. (1995) 'A Fuzzy Expert System for Contract Decision Making', *Construction Management and Economics,* Vol. 13 No. 2, pp. 95-103.

Wood, R. A., McInish, T. H. & Lawrence, K. D. (1992) 'Estimating Divisional Betas with Diversified Firm Data', *Review of Quantitative Finance & Accounting,* Vol. 2 No. 1, pp. 89-96.

Woolley, C. M. (2008) 'Meeting the Mixed Methods Challenge of Integration in a Sociological Study of Structure and Agency', *Journal of Mixed Methods Research,* Vol. 3 No. 1, pp. 7-25.

Wuester, H., Jungmin Lee, J. & Lumijarvi, A. (2016) *Unlocking Renewable Energy Investment: The Role of Risk Mitigation and Structured Finance*, IRENA. [online] https://www.res4med.org/wp-content/uploads/2017/11/IRENA_Risk_Mitigation_and_Structured_Finance_2016.pdf.

Wüstenhagen, R. & Menichetti, E. (2012) 'Strategic Choices for Renewable Energy Investment: Conceptual Framework and Opportunities for Further Research', *Energy Policy,* Vol. 40, pp. 1-10.

Yeh, T.-H. & Wang, L. (2008) 'A Study on Generator Capacity for Wind Turbines Under Various Tower Heights and Rated Wind Speeds Using Weibull Distribution', *IEEE Transactions on Energy Conversion,* Vol. 23 No. 2, pp. 592-602.

Yescombe, E. R. (2013) *Principles of Project Finance,* 2nd ed. Elsevier, New York.

Yin, R. K. (2011) *Applications of Case Study Research,* SAGE, Thousand Oaks, CA.

Yin, R. K. (2014) *Case Study Research: Design and Methods,* SAGE, Thousand Oaks, CA.

Zachariadis, M., Scott, S. V. & Barrett, M. I. (2010) 'Exploring Critical Realism as the Theoretical Foundation of Mixed-Method Research: Evidence from the Economies for IS Innovations', [online] https://www.jbs.cam.ac.uk/fileadmin/user_upload/research/workingpapers/wp1003.pdf (Accessed 8 August 2018).

Zeckhauser, R. J. & Viscusi, W. K. (2008) 'Discounting Dilemmas: Editors' Introduction', *Journal of Risk and Uncertainty,* Vol. 37 No. 2-3, pp. 95-106.

Zimmermann, H., Bilo, S., Christophers, H. & Degosciu, M. (2005) 'Risk, Returns, and Biases of Listed Private Equity Portfolios', working paper, *WWZ/Department of Finance*, [online] https://wwz.unibas.ch/uploads/tx_x4epublication/Risk-Returns.pdf (Accessed 21 February 2014).

Zink, D. W. (1973) *The Political Risks for Multinational Enterprise in Developing Countries,* Praeger Publishers, New York.

Zou, L. (2006) 'The Best-Beta CAPM', *Applied Financial Economics Letters,* Vol. 2 No. 2, pp. 131-137.

APPENDICES

Appendix 1 Value creation methods

One of the most popular valuation methods is the EVA, developed by Stern et al. (1995). A simplified EVA approach is given by the discounted EVA technique[73]. It is computed from the net operating profit after tax (NOPAT) which corresponds to the income surplus, reduced by the cost of capital (WACC) on the capital invested (CI) in the previous year as shown in the equation 12:

$$EVA_t = NOPAT_t - WACC\ x\ CI_{t-1} \tag{12}$$

The EVA technique is applied for computing a NPV. The IRR method is not applicable when applying the EVA approach since the applied calculation of the surplus return over the cost of involved capital omits the initial expenditure when starting the valuation process (Mielcarz and Mlinarič, 2014). It is applied rather for project or company valuations with less data to plan with.

Appendix 2 Alternative CoC models to CAPM

A2.1 Multi-Beta Models

In the late 1970ies, multi-beta models were introduced as alternatives and extensions to the simple one-factor CAPM using several risk premiums instead of only one. In general, multi-beta models try to explain returns of different assets by a set of common factors in a linear model (Ericsson and Karlsson, 2004). There are in principle two strands of multi-beta models in the empirical literature which can both be described by equation (13).

$$Expected\ return = Riskfree\ Rate + \sum_{j=1}^{j=k} \beta_j (Risk\ Premiums_j) \tag{13}$$

A2.1.1 The Arbitrage Pricing Model

In the Arbitrage Pricing Model (APM)[74] advocated by Ross (1976), betas are estimated against several individual unspecified market risk factors or macro economic factors (Dash and Mahakud, 2013). The focus is on unobservable or latent factors (Ericsson and Karlsson, 2004) which should not include more than five factors (Connor and Korajczyk, 1989). The expected return is a linear function of such variables based on the assumption that pricing of assets are about preventing arbitrage (Damodaran, 2011a, Dash and Mahakud, 2013). Within this theory, it is possible to produce exact statements of expected return as showed by Connor (1984) in his APM version. The first step in the APM starts with identifying several possible macro economic factors which could affect expected returns (Brealey et al., 2011).

However, the APM comes also with certain drawbacks. It also assumes that the portfolio is completely diversified as we have already experienced for the CAPM (Fama, 1996). Moreover, there is a barrier in using it in practice since the model does not define which exact factors should be applied or to be looked for (Damodaran, 2011a). This lack is also probably one of the reasons why according to a survey performed by Gitman and Vandenberg (2000) the APM is seldom used, compared to the wide spread usage of the CAPM[75].

A2.1.2 Multifactor Models

The Multifactor models apply the same principle, but betas are estimated against specific, observable macro-economic variables in empirical studies, such as interest rates, GDP growth rate, slope of the yield curve, using historical data, sometimes up to 15 factors (Ericsson and Karlsson, 2004, Damodaran, 2011a). There are several subversions of this multifactor model.

The *intertemporal CAPM* (ICAPM) of Merton (1973) goes a step further than the standard CAPM in taking into account how investor participate in the market. Without having to assume a perfect portfolio diversification, the ICAPM predicts exact statement of expected return using a multifactor approach and utility maximization[76]. However, it comes with the cost of complexity since the used state variables cannot be easily identified which is key for doing empirical testing and for financial decision-making (Breeden, 1979). This model assumes that most investors participate in financial markets for multiple years and not only for one year. While over longer periods expectations of risk change, there might be a shift in investment opportunities. Hence investors might wish to react and hedge their portfolio against anticipated market changes (Brennan and Xia, 2003). Furthermore, the assumption that in the ICAPM, consumer expectations are assumed to be homogenous, meaning that it cannot take into account individual risk preferences have been criticised (Breeden, 1979, Cochrane, 2000).

Breeden (1979) extends the intertemporal model of Merton (1973) into a “multi-good, continuous-time model with uncertain consumption-goods prices and uncertain investment opportunities” (1979:265). This *consumption-based CAPM* (CCAPM) suggests that the expected return of stock is determined by the consumption beta or covariance of a securities return with the consumption growth risk instead of the market beta as argued by the CAPM (Breeden, 1979). The CCAPM includes the amount that an individual or firm wishes to consume in the future. In the simplest form of the CCAPM, the model differs from the CAPM only by the beta for consumption which measures the covariance between the return from a market index and an investor's ability to consume goods and services from investments (Duffie and Zame, 1989, Cochrane, 2000).[77]

The APM and the Multifactor model have the advantage to do better than CAPM in explaining return differences across investment based on historical data (Womack et al., 2003, Damodaran, 2011a), but falls also short to bring along a forward-looking estimate of the expected return (Damodaran, 2011a). They are used less frequently by practitioners than the CAPM (Gitman and Vandenberg, 2000, Graham and Harvey, 2001, Damodaran, 2011a), probably due to its complexity.

A2.2 Proxy Models

In contrast to assumptions of the conventional risk-return models, such as CAPM and multi-beta models, that markets are perfect, there are no transaction costs and taxes, all investors have the same and costless information and behave rational (Fama, 1968), proxy models do not rely on those common theoretical concepts. They are essentially built up from scratch by trying to estimate returns on stock prices with observable variables (Damodaran, 2013). In general, proxy models applied to determine expected returns can be described with equation 14.

$$Expected\ Return = a + b(Proxy\ 1) + \ c(Proxy\ 2) \tag{14}$$

Proxy 1 and 2 are firm characteristics, such as market capitalization, price to book ratios or return momentum (Damodaran, 2013). Fama and French (1992), (1995) concluded in their widely noted research that there are evidences that firm size and book-to-market ratio are two relevant proxies in estimating expected returns which the CAPM does not consider at all (Fama and French, 1992, 1996). Newer research has been looking for alternative and better proxies, for example liquidity, in order to determine expected return of lower traded companies (Damodaran, 2005a). Comparing this model to CAPM, it seems to be rather complex. Moreover, it is solely applicable for PTC due to the necessary access to market data.

A2.3 Principle Models adjusted with Additional Determinants

While the use of pure proxy models by practitioners is seldom (Gitman and Vandenberg, 2000, Damodaran, 2011b), many analysts have however included the results or some of the characteristics in conventional models, for example, by adding a small cap premium to the CAPM equation (Damodaran, 2011b), as shown in equation 15.[78]

$$\begin{gathered} Expected\ Return = Riskfree\ Rate + \beta_{market}(Equity\ Risk\ Premium) + \\ Small\ Cap\ Premium \end{gathered} \tag{15}$$

Similarly, in order to overcome the problem of looking for not known factors to be applied in the APM (Brealey et al., 2011), the model has been adjusted with proxy model characteristics with the findings of Fama and French (1992, 1995) to come up with a model commonly known as Fama-

French (FF) Three-Factor Model (Fama and French, 1993, 1997, Brealey et al., 2011) using three key factors: market factor, size factor and book-to-market factor[79], as illustrated in equation 16.

$$Expected\ Return = Riskfree\ Rate + \beta_{market}(Equity\ Risk\ Premium) + \beta_{Size}(Small\ cap\ risk) + \beta_{book\ to\ market}(Book\ to\ Market\ Premium) \quad (16)$$

This model has been supported by recent studies (Mohanty and Nandha, 2011). In addition, Carhart compared the FF-Three-Factor Model with the CAPM performance and found out that the first model is “more precise, but generally not economically different from the CAPM” (Carhart, 1997:61). He receives better estimates by adding a fourth factor, the momentum, to the FF-Three-Factor Model (Carhart, 1997). This momentum in a stock describes the inertia of the stock price, i.e. the stock price's tendency to continue rising, while increasing and to continue declining, while going down (Carhart, 1997).[80] In the empirical financial literature, this FF-Carhard Model has become a popular and widely used asset pricing model (Mohanty and Nandha, 2011) while other authors critically discuss the relevance of its applied risk factors (Cochrane, 2000, Ericsson and Karlsson, 2004).

Table 33 gives an overview of all above discussed principle models which have been developed on the basis of traded companies, while summarizing the assumptions and limitations, giving pros and cons and suggesting its applicability.

A2.4 Market-derived Capital Asset Pricing Model (MCPM)

Based on the MCPM approach, the cost of capital is calculated based on three components: national confiscation risk, corporate default risk and equity return risk. The first components governmental bonds and for the seconde component corporate bonds are used as proxies. The last component is computed by considering the implied volatility derived from the market prices of stock options (McNulty et al., 2002).

Table 33: Principle models for estimating expected returns as suggested by financial theory and according to empirical surveys among practitioners (PTC: publicly traded company, NTA: non-traded asset).

Model name	**Model**	**Assumptions/ Limitations**	**Applicability for**	**Pros (+)/Cons (-)**	**Sources of basic research**	**Empirical surveys among practitioners**
Capital Asset Pricing Model (CAPM)	$Expected\ Return = Riskfree\ Rate + \beta_{asset}\ x\ Equity\ Risk\ Premium$	- homogenous consumer expectations - perfect market - not transaction costs or transaction taxes - all investors with same, costless information and rational behaviours - no analysis of single investment in isolation - completely diversified portfolio of investor (not applicable for MCPM)	PTC and NTA	- strong assumptions - single period model + applied for PTC and NTA	Treynor (1961/62) Sharpe (1964) Lintner (1965a, b) Mossin (1966)	Gitman and Mercurio (1982), Petry and Sprow (1994), Bruner et al. (1998), Kester et al. (1999), Al-Ali and Arkwright (2000), Graham and Harvey (2001), Brounen et al. (2004), da Silva Bastos and Martins (2007), Baker et al. (2009)
CAPM plus Small Cap Premium	$Expected\ Return = Riskfree\ Rate + \beta_{market}(Equity\ Risk\ Premium) + Small\ Cap\ Premium$		PTC and NTA	+ does better than CAPM + applied for PTC and NTA	McMahon and Stanger (1995), Damodaran (2011b)	-
Arbitrage Pricing Model (APM)	$Expected\ Return = = Riskfree\ Rate + \sum_{j=1}^{j=k} \beta_j (Risk\ Premiums_j)$		PTC	- complex - only applicable for PTC + does better than CAPM	Ross (1976)	Graham and Harvey (2001), Brounen et al. (2004), Baker et al. (2009)
Market-derived Capital Pricing Model (MCPM)	$Expected\ Return = confiscation\ risk\ (governmental\ bonds) + corporate\ default\ risk\ (corporate\ bonds) + equity\ return\ risk\ (based\ on\ option\ valuation)$		PTC	+ not based on historical data as in CAPM + considers systematic and unsystematic risks - lack of theoretical support - empirical evidence is outstanding - particularly applicable for PTC	McNulty et al. (2002)	-

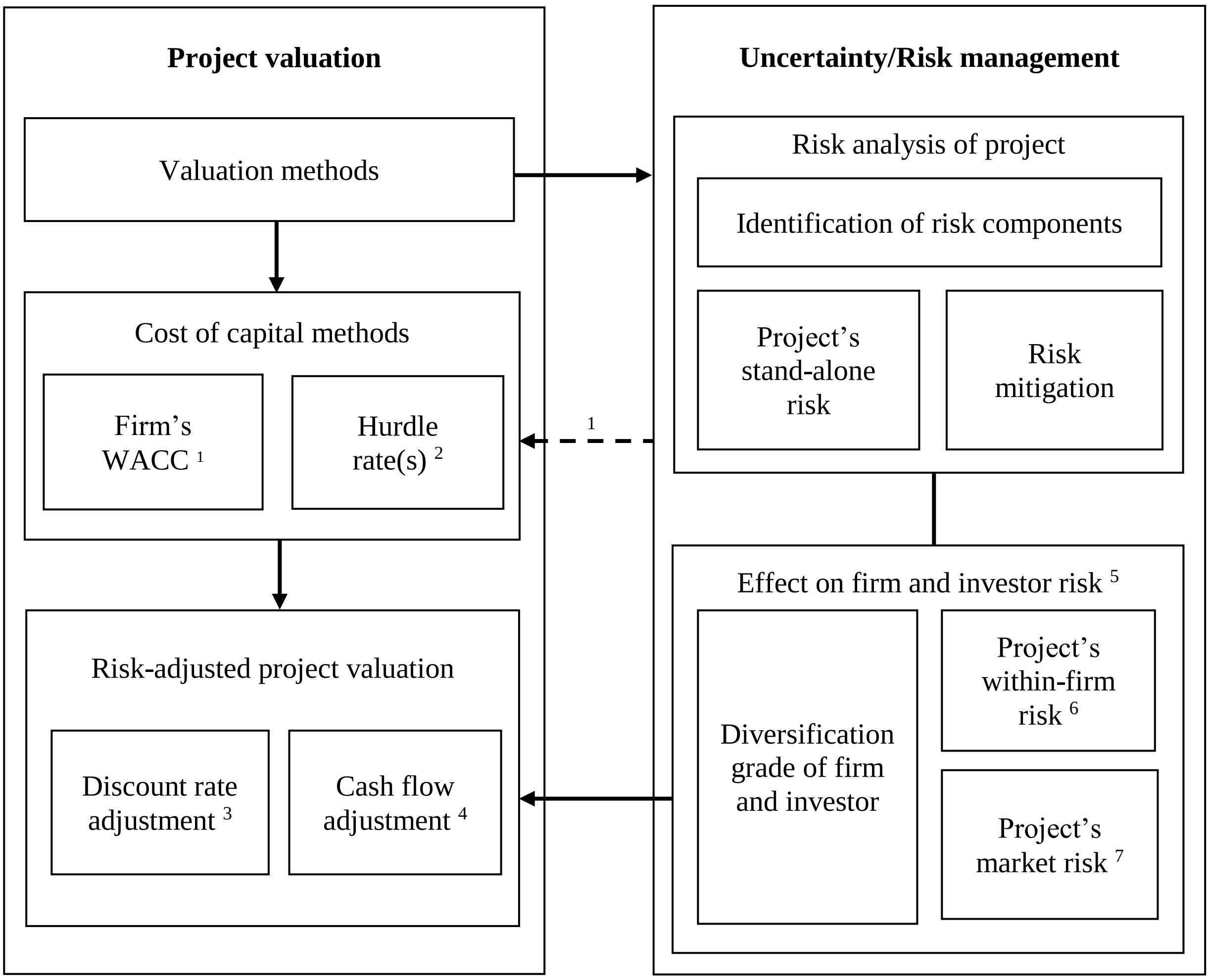
Table 33: (continued).

Model name	**Model**	**Assumptions/ Limitations**	**Applicability for**	**Pros (+)/Cons (-)**	**Sources of basic research**	**Empirical surveys among practitioners**
Multifactor model	$Expected\ Return = Risk - free\ Rate + \sum_{j=1}^{j=k} \beta_j (Risk\ Premiums_j)$	- not completely diversified portfolio of investor - investment over multiple years - no analysis of single investment in isolation	PTC	- complex - rather applicable for PTC + not completely diversified portfolios of investor necessary + multiple period model + does better than CAPM	Merton (1973) Breeden (1973) Ross (1976) Cochrane (1991)	Graham and Harvey (2001), Brounen et al. (2004), Baker et al. (2009)
Proxy models	$Expected\ Return = a + b(Proxy\ 1) + c(Proxy\ 2)$ (proxy 1 and 2 are firm characteristics, such as market capitalization, price to book ratios or return momentum)	- not based on strong assumptions	PTC	+ not based on general theoretical concepts as other models - complex - only applicable for PTC	Applied by Fama and French (1992, 1995)	-
Three-Factor Model (with features of CAPM and Proxy model)	$Expected\ Return = Riskfree\ Rate + \beta_{market}(Equity\ Risk\ Premium) + \beta_{Size}(Small\ cap\ risk) + \beta_{book\ to\ market}\ (Book\ to\ Market\ Premium)$	- no analysis of single investment in isolation	PTC	+ good empirical results (more precise than CAPM) - but economically not different than CAPM	Fama and French (1993, 1997)	-
Four-Factor Model by Carhart	$Expected\ Return = Riskfree\ Rate + \beta_{market}(Equity\ Risk\ Premium) + \beta_{Size}(Small\ cap\ risk) + \beta_{book\ to\ market}(Book\ to\ Market\ Premium) + \beta_{momentum}(momentum)$	- no analysis of single investment in isolation	PTC	+ good empirical results (better than CAPM and Three-Factor model) - only applicable for PTC	Carhart (1997)	-
Modified CAPM including additional extra risk factors	$Expected\ Return = Riskfree\ Rate + \sum_{j=1}^{j=k} \beta_j (Risk\ Premiums_j)$	- additional variables are relevant in estimating return rates	PTC and NTA	+ adjustment with additional relevant variables (e.g. illiquidity) - specific data mining necessary to validate this method and find relevant variables	Damodaran (2011b)	Graham and Harvey (2001), Brounen et al. (2004)

Appendix 3 Integrating Project Valuation and Risk/Uncertainty Management

The understanding that valuation processes in transactions are a combination of and an interaction between project valuation steps with an appropriate risk/uncertainty management before the investment decision is taken is presented in the illustration in Figure 55. This builds the basis for surveying the risk adjustment processes within valuations (section 4.3.3.5). This project valuation adjustment and uncertainty/risk management framework integrates the risk analysis of the considered project and the effect of the project's risk on firm and investor risk with RAPV processes, as presented in Hürlimann and Bengoa (2017a). After assessing the project's stand-alone risk and its type of correlation with corporate and investors' risk, while considering the firm's and investor's diversification grade and applying appropriate project risk mitigation measures, still relevant project risk components are to be considered in the subsequent RAPV processes, either with discount rate or cash flow adjustments (Sick, 1986, Arnold, 2008, Damodaran, 2011c) (section 2.4.4).

Figure 55: Project valuation adjustment and uncertainty/risk management framework (author's own illustration).



[1] Firm's risk management functions might influence the firm's WACC in general. [2] Either multiple hurdle rates—one for each division—or separate hurdle rates for each individual project. [3] Example based on the RADR concept (section 3.3). [4] Example based on the CE method (section 3.3). [5] Correlation (positively/negatively) of project's stand-alone risk with earnings of other firm's assets or investor returns. [6] Systematic plus undiversifiable unsystematic risk is relevant. [7] Only systematic risk is relevant (for well-diversified investors) (see figure 1).

Table 34: Full table of interview candidates in QUAL phase.

No.	Country	Type of candidates	Type of employer	Current position	Academic qualification	Experience (no. of acquisitions)	Experience (year)	Mode of interview	Duration of interview (hh:mm:ss)
1	Germany	Consultant	Finance advisory (previously project developer + specialized funds for retail customers)	Managing director	Master	>50	>10	Face-to-face	01:30:00
2	Switzerland	Consultant	Finance advisory (previously specialized funds)	Managing director	Master	50	10	Face-to-face	01:08:00
3	Switzerland	Industrial professional	Project developer	Director	Doctorate	20	7	Face-to-face	01:01:00
4	Switzerland	Industrial professional	Project developer	Director	Master	40	6	Face-to-face	01:11:00
5	Germany	Industrial professional	Project developer / IPP	Head of M&A	Master	40	9	Face-to-face	01:05:00
6	Germany	Industrial professional	Project developer	Manager project financing	Doctorate	20	7	Face-to-face	01:21:00
7	Switzerland	Industrial professional	Utility	Director / CFO	Doctorate	12	13	Face-to-face	00:48:00
8	Germany	Industrial professional	Specialized funds for institutional investors	Director	Master	>50	>12	Face-to-face	00:40:00
9	Switzerland	Industrial professional	Specialized funds for institutional investors	Investment manager	Master	12	5	Face-to-face	00:56:00
10	Switzerland	Consultant	Finance advisory	Managing director	Master	>10	5	Face-to-face	00:46:00
11	Germany	Consultant	Finance advisory	Managing director	Doctorate	15	6	Telephone	01:12:00
12	Germany	Consultant	Finance advisory (previously project developer)	Managing director	Master	25	11	Telephone	00:50:00
13	Germany	Industrial professional	Utility	Managing director	Master	20	10	Telephone	00:37:00
14	Germany	Industrial professional	Utility	Head of Asset Mgt	Master	>50	24	Telephone	00:34:00
15	Switzerland	Industrial professional	Utility / IPP	Head of Asset Mgt	Master	40	3.5	Face-to-face	00:56:00
16	Switzerland	Industrial professional	Utility	Head of Asset Mgt	Master	>20	5	Face-to-face	01:10:15

IPP: Independent power producer

Appendix 5 Questionnaire

Private equity investments in renewable energies

Welcome to the survey about risk and return in renewable energy investments

Thank you very much for agreeing to take part in this important survey evaluating risk and return in renewable energy investments.

This survey is done as part of a research project for a doctorate in business administration at the University of Gloucestershire, in Cheltenham, England in cooperation with Kalaidos University of Applied Sciences Switzerland, in Zurich. It is designed to gain your thoughts and opinions in order to better understand how organisations in the field of renewable energy investments manage risk and define return rates from a Swiss and German investor's perspective. This survey will take around 25 minutes to complete.

Be assured that all answers you provide will be kept strictly confidential, will not be passed on to third parties and are used solely for the agreed purpose. The survey results are only used for academic research purposes. Moreover, it is ensured that identification of the participants and companies is not possible in publications.

Prize draw: You could win a case of six bottles of good wine
You can register at the last page of this survey to enter the prize draw, if interested.

If you have any questions or uncertainties, please do not hesitate to contact **Christian Hürlimann**
[contact details redacted]

The abbreviation RE is used for renewable energy. The terms RE project, RE assets and RE power plant are used interchangeably throughout this survey. Likewise, the terms company, firm and organisation are used interchangeably.

Questions marked with asterisk * should be answered in order to enable deeper analysis.

General questions about renewable energy investments

Your data will be treated with the utmost confidentiality and will not be passed on to third parties.

Please indicate the main primary energy source of your company's current renewable energy (RE) power plant activities and/or plans?
*

Please choose **all** that apply:

- ☐ Onshore wind
- ☐ Offshore wind
- ☐ Hydro (i.e. hydroelectric)
- ☐ Bio-energy
- ☐ Photovoltaic solar
- ☐ Concentrated solar
- ☐ Geothermal energy
- ☐ Other, please specify:

RE: renewable energy

Has your company already invested in RE projects / assets? *

Please choose **only one** of the following:

- ○ Yes
- ○ No, not yet

If previous question has been answered with „Yes":

In which countries has your company invested so far in RE projects / assets?
*

Please choose **all** that apply:

- ☐ Austria
- ☐ Belgium
- ☐ Bulgaria
- ☐ Croatia
- ☐ Czech Republic
- ☐ Denmark
- ☐ England
- ☐ Estonia
- ☐ Finland
- ☐ France
- ☐ Germany
- ☐ Greece
- ☐ Ireland
- ☐ Italy
- ☐ Latvia
- ☐ Lithuania
- ☐ Netherlands
- ☐ Norway
- ☐ Poland
- ☐ Portugal
- ☐ Romania
- ☐ Scotland
- ☐ Spain
- ☐ Sweden
- ☐ Switzerland
- ☐ Other European countries (other than the above mentioned)

In which <u>non-European countries</u> has your company invested in RE projects / assets? *

Please choose **all** that apply:

- ☐ North America
- ☐ Latin America
- ☐ Asia
- ☐ Africa
- ☐ Oceania

At which stage has your company invested in and/or acquired RE projects / power plants in the last 5 years? *

Please choose **all** that apply:

- ☐ Greenfield projects (starting project from scratch)
- ☐ Brownfield projects (project based on prior work)
- ☐ Projects just before receiving building and operating permit
- ☐ Ready-to-build projects (all necessary building and operating permits available)
- ☐ Projects just starting operating phase
- ☐ Power plants with 1 to 2 years in operation
- ☐ Power plants with 3 to 5 years in operation
- ☐ Power plants with 6 to 10 years in operation
- ☐ Power plants with more than 10 years in operation
- ☐ Power plants with the focus on repowering/retrofitting

Risk assessment

Your data will be treated with the utmost confidentiality and will not be passed on to third parties.

How would you rate the significance of each of the following types of risk to your company's RE projects? (1 = low risk; 5= high risk) *

Please choose the appropriate response for each item:

	Low risk (1)	(2)	Medium risk (3)	(4)	High risk (5)	I do not know / not applicable
Financial risk (e.g. access to capital, currency changes, change in interest rates affecting profitabilty)	○	○	○	○	○	○
Business/strategic risk (e.g. technological obsolescence)	○	○	○	○	○	○
Building and testing risks (e.g. unproven technology, construction delays due to unexpected difficulties, e.g. archaeological findings)	○	○	○	○	○	○
Operational risk (e.g. plant damage/component failure or plant closure to resource unavailability)	○	○	○	○	○	○
Political/regulatory risk (e.g. change in public policy affecting profitability, excl. tax risk)	○	○	○	○	○	○
Tax risk (e.g. change in tax laws and rules affecting profitability)	○	○	○	○	○	○
Market risk (e.g. decrease in power prices or increase in commodity prices)	○	○	○	○	○	○
Weather-related volume risk (e.g. lack of wind, sunshine or water)	○	○	○	○	○	○
Environmental risk (other than weather-related volume risk, e.g. liability for environmental damage)	○	○	○	○	○	○
Risk of subsidiaries not being under corporate control (e.g. in case of minority participations)	○	○	○	○	○	○

In general, how would you assess the overall degree of risk associated with each of the following stages of planning, building and operating RE power plants?
(1 = low risk; 5= high risk) *

Please choose the appropriate response for each item:

	Low risk (1)	(2)	Medium risk (3)	(4)	High risk (5)	I do not know / not applicable
Planning/designing the power plant	○	○	○	○	○	○
Financing the power plant	○	○	○	○	○	○
Building the power plant	○	○	○	○	○	○
Commissioning the power plant	○	○	○	○	○	○
Operating the power plant	○	○	○	○	○	○
Retrofitting / repowering the power plant	○	○	○	○	○	○
Decommissioning the power plant	○	○	○	○	○	○

Valuation

Your data will be treated with the utmost confidentiality and will not be passed on to third parties.

How frequently does your company use the following techniques when deciding which RE projects / acquisitions to pursue?
*****

Please choose the appropriate response for each item:

	Never	Almost never	Sometimes	Almost always	Always	I do not know / not applicable
Cash flow projection / free cash flow to firm (FCFF) approach	○	○	○	○	○	○
Discounted cash flow (DCF)	○	○	○	○	○	○
Net present value (NPV)	○	○	○	○	○	○
Internal rate of return (IRR)	○	○	○	○	○	○
Hurdle rate of return	○	○	○	○	○	○
Estimate cost of equity capital of project (equity return rate)	○	○	○	○	○	○
Estimate total cost of capital of project (project return rate)	○	○	○	○	○	○
Multiple approach	○	○	○	○	○	○
Profitability index (PI)	○	○	○	○	○	○
Payback period	○	○	○	○	○	○
Value at risk (VaR)	○	○	○	○	○	○
Real options	○	○	○	○	○	○
Sensitivity analysis	○	○	○	○	○	○
Scenario analysis (e.g. base case, worst case, best case)	○	○	○	○	○	○
Simulations (e.g. Monte Carlo simulations)	○	○	○	○	○	○
Valuing opportunities & synergy possibilities	○	○	○	○	○	○

IRR is the return generated based on the amount of the initial outlay and the amount and timing of the subsequent cash inflows.
NPV is the present value of the project's cash inflows less the present value of its cash outflows.
Hurdle rate is the minimum rate of return that a firm expects to earn when investing in a project and/or to cover all costs.
Multiple approach assumes that a ratio comparing value to some firm-specific variable (operating margins, cash flow, etc.) is the same across similar firms (e.g. ratio between investment value divided by annual energy production)
Profitability index is the present value of future cash flow divided by the initial investment.
Payback period measures the time between project adoption and the firm's recovery of its initial outlay.
Value at risk is a statistical technique used to measure and quantify the level of financial risk (amount and probability of potential loss) within a firm or investment portfolio over a specific time frame.
Real options are rights - but not obligations - to undertake certain business initiatives, such as expand or cease projects, if certain conditions arise. They involve specific option valuation techniques (e.g. Black-Scholes-like methods, the binomial options pricing model or Monte Carlo methods).
Sensitivity analysis involves changing key variables one at a time to determine how sensitive a project's return (e.g. NPV) is to deviations from the expected values of the input variables.
Scenario analysis involves identifying key variables that are likely to affect the return on a project (e.g. NPV). However, instead of changing each variable one at a time, the variables are changed simultaneously to develop different scenarios: e.g. base, worst or best case scenario.
Simulation involves creating probability distributions that describe possible values of key variables used in the algorithm to calculate project's return. In Monte Carlo simulations, those values are selected randomly and entered in the algorithm - repeated thousands of times - to come up with a distribution of outcomes (expected NPV and standard deviation).

When valuing RE projects, does your company adjust either the discount rate or cash flows for the following risk factors?
*****

Please choose the appropriate response for each item:

	Discount rate / return rate	Cash flows	Both	Neither	I do not know / not applicable
Weather-related volume risk (e.g. lack of water, wind, sun, waves)	○	○	○	○	○
Other natural resource risk (e.g. lack of geothermal heat or biomass supplies)	○	○	○	○	○
Market risk (e.g. decrease of power or heat prices)	○	○	○	○	○
Political/regulatory risk (e.g. change in public policy affecting profitability, excl. tax risk)	○	○	○	○	○
Tax risk (e.g. change in tax laws and rules affecting profitability)	○	○	○	○	○
Operational risk (e.g. plant damage/component failure, lower technical availability, plant closure to resource unavailability or unclear cost development)	○	○	○	○	○
Project termination risk (e.g. missing permit or no acceptance to a bid in tender process)	○	○	○	○	○
Illiquidity of investment project (lack of market for asset type)	○	○	○	○	○
Debt / equity ratio of RE project	○	○	○	○	○
Interest rate risk (change of general level of interest rate)	○	○	○	○	○
Term structure risk (long-term vs. short-term interest rate)	○	○	○	○	○

In addition, does your company adjust either the discount rate or cash flows for the following risk factors?
*****

Please choose the appropriate response for each item:

	Discount rate / return rate	Cash flows	Both	Neither	I do not know / not applicable
Complexity of organisational structure of investment	○	○	○	○	○
Risk of subsidiaries not being under corporate control (e.g. in case of minority participations)	○	○	○	○	○
Credit standing of involved partners (e.g. project developer, contractor, maintenance and service companies)	○	○	○	○	○
Risk of unexpected inflation	○	○	○	○	○
Commodity price risk	○	○	○	○	○
Foreign exchange risk (currency changes)	○	○	○	○	○
Distress risk (probability of bankruptcy)	○	○	○	○	○
Size (small firms being riskier)	○	○	○	○	○
"Market-to-book" ratio (ratio of market value of firm to book value of assets)	○	○	○	○	○
Momentum (recent stock price performance)	○	○	○	○	○

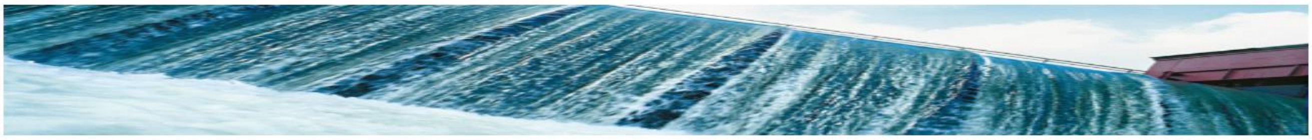
Are there any other risk factors for which your company adjusts either the discount rate or cash flows when valuing RE projects?

Please choose all that apply and provide a comment:

☐ Discount rate / return rate

☐ Cash flows

Cost of equity capital & discount rate



Your data will be treated with the utmost confidentiality and will not be passed on to third parties

How frequently does your company use the following techniques and/or approaches in determing cost of equity or discount rates when valuing RE investments? *

Please choose the appropriate response for each item:

	Never	Almost never	Sometimes	Almost always	Always	I do not know / not applicable
Formal risk analysis						
Capital Asset Pricing Model (CAPM, the beta approach)						
Modified CAPM including additional extra risk factors						
Multifactor models (e.g. arbitrage pricing models, ATP)						
Average historical returns on common stock (historical market return)						
Current market return adjusted for risk						
Discount rates set by regulatory decisions						
Dividend discount model (e.g. current/historical dividend yield plus an estimate of growth or dividend yield estimate only)						
Earnings/price ratio						
Cost of debt plus a risk premium						
Discount rates are at least as high as defined hurdle rates						
Weighted Average Cost of Capital (WACC) of our company						
Benchmarking approaches with comparable companies or comparable investments						
Whatever our investors tell us they require						
Certainty equivalents						

Hurdle rate is the minimum rate of return that a firm expects to earn when investing in a project and/or cover its costs.

Certainty equivalent is a guaranteed return that someone would accept, rather than taking a chance on a higher, but uncertain, return.

How frequently does your company use the following discount rates when valuing a new RE investment project? *

Please choose the appropriate response for each item:

	Never	Almost never	Sometimes	Almost always	Always	I do not know / not applicable
The discount rate for our entire company						
A specific discount rate for the considered country (country discount rate)						
A specific discount rate for the applied technology / concerned industry						
A specific discount rate for the concerned project stage (e.g. planning/designing, financing, building, operating...)						
A divisional discount rate						
A risk-adjusted discount rate for this particular project						
A discount rate based on our cost of financing						
A discount rate based on our past experience						
A different discount rate for each component cash flow that has a different risk characteristic (e.g. depreciation vs. operating cash flow vs debt service reserve account)						

How frequently does your company reestimate return rates requirements for investment projects? *

Please choose **only one** of the following:

- Quarterly or semiannually
- Annually
- Less frequently than one year
- Each time a major project is evaluated
- When environment conditions change sufficiently to justify it
- I do not know / not applicable

Attractiveness of RE investment opportunities

Your data will be treated with the utmost confidentiality and will not be passed on to third parties.

Which of the following factors are considered by your company when making RE investment decision? *

Please choose **all** that apply:

- ☐ Investment country
- ☐ Type of technology (e.g. hydro power, wind on-/offshore, photovoltaic roof top/land based)
- ☐ Years of experience of applied technology, incl. experience of technology provider
- ☐ Type of governmental support (e.g. feed-in tariff, FIT), market system or power purchase agreement (PPA)
- ☐ Level of regulated/contracted power purchase price (FIT or PPA) and contract duration of FIT/PPA
- ☐ Project phase (e.g. developing, financing, commissioning, operating, divestment or repowering phase)
- ☐ Uncertainty of available natural ressources (e.g. wind, sun, water, waves) relevant in investment project
- ☐ Leverage / gearing (proportion between amount of equity and debt) in investment project
- ☐ Credit standing of involved partners (e.g. project developer, contractor, maintenance and service companies)
- ☐ Corporate structure of investment project (e.g. company form)
- ☐ If other relevant factors, please specifiy: ____________

From your company's perspective, please rank the following RE investment opportunities in terms of their attractiveness.
(Most attractive = at the top; least attractive: at the bottom) *

Please number each box in order of preference from 1 to 6

- ☐ Wind offshore, in Germany, commissioning date: 2015; uncertainty of natural resource: 10%; FIT (20 years): 15 €ct/kWh; equity return rate: 11%, project return rate: 6%
- ☐ Photovoltaic, in France, commissioning date: 2011; uncertainty of natural resource: 10%; FIT (20 years): 30 €ct/kWh; equity return rate: 7.5%, project return rate: 5%
- ☐ Photovoltaic, in Germany, commissioning date: 2013; uncertainty of natural resource: 8%; FIT (20 years): 15 €ct/kWh; equity return rate: 7%, project return rate: 4%
- ☐ Hydro power, in Norway, commissioning date: 2015; uncertainty of natural resource: 8%; PPA (10 years): 7 €ct/kWh; equity return rate: 8%, project return rate: 5%
- ☐ Wind onshore, in Italy, in construction / commissioning planned in 2016; uncertainty of natural resource: 14%; FIT (20 years): 15 €ct/kWh; equity return rate: 11%, project return rate: 7%
- ☐ Wind onshore, in Germany, ready-to-build project / commissioning planned in 2016; uncertainty of natural resource: 14%; FIT (20 years): 8.5 €ct/kWh; equity return rate: 7%, project return rate: 4%

FIT (XX years): Feed-in tariff (amount of years with FIT)
PPA (XX years): Power purchase agreement (amount of contracted years)

What is your preferred amount of debt (debt ratio) used in a RE project in relation to its total assets? *

Please choose **only one** of the following:

- ○ Debt ratio: <40%
- ○ Debt ratio: 40 - 60%
- ○ Debt ratio: 60 - 70%
- ○ Debt ratio: 70 - 80%
- ○ Debt ratio: >80%
- ○ I do not know / not applicable

Debt ratio is defined as the ratio of total - long-term and short-term - debt to total assets.

Materialisation and mitigation of risk

Your data will be treated with the utmost confidentiality and will not be passed on to third parties.

In the past five years, did any risk materialise in your company's RE business? *

Please choose **only one** of the following:

○ Yes
○ No

Materialise: eintreten (in German)

If previous question has been answered with „Yes“:

Which types of risk materialised in your company's RE business in the past five years? *

☐ Financial risk (e.g. access to capital, currency changes, change in interest rates affecting profitabilty)
☐ Business/strategic risk (e.g. technological obsolescence)
☐ Building and testing risks (e.g. unproven technology, construction delays due to unexpected difficulties, e.g. archaeological findings)
☐ Operational risk (e.g. plant damage/component failure or plant closure to resource unavailability)
☐ Political/regulatory risk (e.g. change in public policy affecting profitability, excl. tax risk)
☐ Tax risk (e.g. change in tax laws and rules affecting profitability)
☐ Market risk (e.g. decrease in power prices or increase in commodity prices)
☐ Weather-related volume risk (e.g. lack of wind, sunshine or water)
☐ Environmental risk (other than weather-related volume risk, e.g. liability for environmental damage)
☐ Risk of subsidiaries not being under corporate control (e.g. in case of minority participations)
☐ Other, please specify:

Materialise: eintreten (in German)

In the past five years, which of the following <u>risk mitigation</u> measures has your company used for its RE investment business? *

Please choose **all** that apply:

☐ Internal Due Diligence of investment project
☐ External Due Diligence of investment project with external consultants
☐ Our company’s risk management function (e.g. risk management process / policy, identification of exposures, loss control)
☐ Standardisation of procedures (e.g. processes, contracts)
☐ Check type of suppliers (credit rating) and/or contractual clauses within contracts with suppliers
☐ Reduce market risks with feed-in tariffs and/or long-term power purchase agreements (PPA)
☐ Reduce operational risks (e.g. full maintenance contracts with availability guarantee, preventive maintenance procedures, periodical inspections)
☐ Making Co-investments with partners
☐ Arrange for insurance (e.g. machine failure insurance, insurance for downtime, liability insurance, directors and officers insurance)
☐ Arrange for weather protection insurance (e.g. natural resource hedging instruments)
☐ Implement emergency services
☐ Arrange for financial products (e.g. financial hedging of currency and/or interest rate changes)
☐ Other, please specifiy:

Risk mitigation: "Risikobegrenzung / Risikominimierung" (in German)

General questions about risk and return

Your data will be treated with the utmost confidentiality and will not be passed on to third parties.

How does your company understand the word "risk"?

Please choose **only one** of the following:

- Loss
- Uncertainty
- Potential
- Both loss and uncertainty
- Both uncertainty and potential
- Loss, uncertainty and potential
- Thrill
- I do not know / not applicable

How does your company understand "return rate" in case of investments? *

Please choose **only one** of the following:

- The return rate compensates investor for downside risks only.
- The return rate compensates investors for downside risks, including possible upside potentials/opportunities/synergies.
- I do not know / not applicable

In considering the risk/reward "trade-off" for an investment, what best describes your company's understanding? *

Please choose **only one** of the following:

- The potential return is the most important factor.
- The potential return must match the anticipated risk.
- The anticipated risk is the most important factor.
- I do not know / not applicable

What best describes your company's understanding what acceptable RE projects are in relation to return targets? *

Please choose **only one** of the following:

- Acceptable RE projects must promise to return the cost of capital of our company only
- Acceptable RE projects must promise to return the cost of capital of our company plus a risk premium
- RE projects must promise an attractive return independent of the cost of capital of our company
- I do not know / not applicable

Your company

Your data will be treated with the utmost confidentiality and will not be passed on to third parties.

In what type of organisation do you work?
*****

Please choose **only one** of the following:

- ○ Utility
- ○ Independent power producer (IPP)
- ○ Project developer
- ○ Bank
- ○ Insurance company
- ○ Pension fund
- ○ Fund manager
- ○ Other Asset Management Company (e.g. Hedge funds, Mutual funds)
- ○ Family office
- ○ Financial advisor
- ○ Technology provider
- ○ Authority
- ○ Other, please specify:

How many employees does your company or organisation employ?

Please choose **only one** of the following:

- ○ 1 to 50 employees
- ○ 51 to 100 employees
- ○ 101 to 500 employees
- ○ 501 to 100 employees
- ○ 1001 to 2000 employess
- ○ More than 2001 employees

Please rank the following corporate goals in terms of their importance from your organisation's perspective? (Most important = at the top; least/not important: at the bottom)

Please number each box in order of preference from 1 to 10

- [ ] Maximize profits
- [ ] Maximize sustainable growth
- [ ] Market position, service quality
- [ ] Continuity
- [ ] Maximize shareholder value
- [ ] Maximize dividends
- [ ] Optimize solvability (i.e. being solvent)
- [ ] Execute political mandate
- [ ] Execute social tasks
- [ ] Secure production units (capacities, green certificates)

Please rank the following stakeholders in terms of their importance from your organisation's perspective? (Most important = at the top; least/not important: at the bottom)

Please number each box in order of preference from 1 to 10

- [ ] Customers
- [ ] Employees
- [ ] Management
- [ ] Board of directors
- [ ] Shareholders
- [ ] Suppliers of goods/services
- [ ] Suppliers of debt
- [ ] The general public
- [ ] Politicians
- [ ] Authorities

Which attributes apply to your company or organisation?

Please choose the appropriate response for each item:

	Yes	No	I do not know / not applicable
Our company is listed on a stock exchange.	○	○	○
Our company has a debt ratio >40%.	○	○	○
In relation to RE projects, our company's investment focus is on majority shareholding (>=50% shares).	○	○	○
In relation to RE projects, our company's investment focus is on developing RE assets on our balance sheet.	○	○	○

Debt ratio is defined as the ratio of total - short-term and long-term - debt to total assets.

Your function and experience

Your data will be treated with the utmost confidentiality and will not be passed on to third parties.

What is your job title in your company or organisation?
(e.g. CFO, Asset Manager, Portfolio Manager, Head of Production, Controller or Analyst) *

Please write your answer here:

How many acquisitions/sales of companies/projects have you been involved in within the RE sector?
*****

Please choose **only one** of the following:

- 0
- 1 to 5
- 6 to 10
- 11 to 15
- 16 to 20
- 21 to 25
- More than 25

Socio-demographic questions

Your data will be treated with the utmost confidentiality and will not be passed on to third parties.

What is your gender?

Please choose **only one** of the following:

- ○ Female
- ○ Male

What is your age?

Please choose **only one** of the following:

- ○ younger than 20 years
- ○ 20-24 years old
- ○ 25-29 years old
- ○ 30-34 years old
- ○ 35-39 years old
- ○ 40-44 years old
- ○ 45-49 years old
- ○ 50-54 years old
- ○ 55-59 years old
- ○ 60-64 years old
- ○ 65-69 years old
- ○ 70 and older

Where is your place of residence?

Please choose **only one** of the following:

- ○ Switzerland
- ○ Germany
- ○ Other, please specify:

What is your highest educational qualification?

Please choose **only one** of the following:

- ○ Intermediate level / junior high school / O-levels
- ○ Training or professional school
- ○ A-levels (final secondary-school examination, university-entrance diploma) or teachers college
- ○ Higher professional / technical school / trade certificate
- ○ University of Applied Sciences / Bachelor
- ○ MBA / Executive MBA
- ○ University / Master (other than MBA / Executive MBA)
- ○ Doctorate / Phd / DBA
- ○ Compulsory school
- ○ No education

Conclusion

Your data will be treated with the utmost confidentiality and will not be passed on to third parties.

Would you like any further information?

Please choose **all** that apply:

- ☐ I would like to be informed about the results of the survey.
- ☐ Having evaluated the data of this survey, the results will be presented and discussed with a selection of survey participants. Are you interested in taking part in these discussion rounds?
- ☐ I am interested in similar studies conducted by the University of Gloucestershire and the Kalaidos University of Applied Sciences.
- ☐ I would like to participate in the prize draw to win a case of six bottles of good wine (or equivalent, if you wish).
- ☐ My e-mail address:

Please state your e-mail address if you have selected one or more of the above mentioned choices. You can be assured that your data will be treated with the utmost confidentiality and will not be shared with third parties.

Please feel free to submit any comments and notes in the text box below.

Please write your answer here:

Thank you very much for participating in this survey.

Appendix 6 Post-hoc tests

Table 35: Different post-hoc tests and its applicability for this study (adopted from Maynard, 2013, Grande, 2015b).

Post-hoc tests	Description	Applicability for this study
LSD	Does not control for type one error (liberal test)	Not ideal since liberal test
Games-Howell	No equal variances necessary	Ideal for not equal variances
Bonferroni	Good test for controlling type one error (conservative test) Rather too conservative test Good statistical power (detect a difference which is really there) when the number of comparison is low	Ideal
REGWQ	Equal n in different groups Equal variances necessary	Not ideal for this study since n are not equal
Tukey's HSD	Equal n in different groups Equal variances necessary	Not ideal for this study since n are not equal
Gabriel	Slightly different n in different groups Equal variances necessary	Ideal
Hochberg's GT2	Very different n in different groups Equal variances necessary	Ideal
Dunnett's	Compare every condition to control variables, not comparing the conditions to each other	Not ideal since control variables are not in focus

Appendix 7 Interview Protocol – 1. part of interview (semi-structured interview)

Valuation, capital budgeting methods and cost of capital:

- The performed survey about the applied capital budgeting techniques showed that the conventional methods, such IRR and NPV (both DCF methods), are the most popular ones in RES-E investments.
    - Do you also apply this methods, IRR and NPV?
    - Is this based on the flow to equity (FTE) approach?
    - Do you apply also other methods than IRR and NPV? Which ones (e.g. Multiples, payback period) and why?
    - Any methods in addition to those IRR and NPV?

- How do you and your organisation estimate discount rates in valuation process?

- Is this a constant discount rate over the whole valuation period?

- What can be improved in setting discount rates and in valuation processes in general and specifically?

- *[Maybe: What are essential points to be considered in valuation RES-E investments?]*

Uncertainty/risk, risk components, risk assessment and mitigation:

- How do you consider uncertainty/risk in RES-E investment valuations?

- Is a detailed risk assessment of the RES-E investment target performed within the valuation process?
  If yes, what methods are used to perform the risk assessment?

- The survey showed that in addition to systematic risk, several unsystematic risk components (=diversifiable risk components), such as weather-related volume risk, operational risk and interest rate risk, are relevant in RES-E investment valuation. How do you consider them in your valuation processes?

- *[Question to early stage investors (incl. project developers):*

    - *The survey shows that investors investing in early project stages (greenfield, brownfield) rate weather-related volume risk lower than the same risk in later stages. Do you have an explanation for this result? [Maybe show figure]*
    - *Or do you rate weather-related volume risk differently for greenfield or brownfield projects compared to investments at the later stage?]*

- Do you consider probabilities, i.e. distribution of input variables, in RES-E investment valuations? If yes, how?

- Do you consider the implemented or possible additional <u>risk mitigation measures</u> (mitigation = “Minderung/Entschärfung”, e.g. full maintenance contracts, insurances) in the valuation process?
  If yes, how?

- Do you consider all risks and uncertainties in the project valuation?

- How could latent uncertainties be found?

Additional influencing factors (apart from organisation type, size, leverage, stock exchange listing, project stages):

- Do you consider <u>opportunities</u> within the RES-E investments (e.g. possibility to renegotiate contracts to decrease costs) within valuations?

- Do you consider your <u>existing RES-E portfolio</u> or other ventures of your company when you perform valuations (“*within-firm risk*”)? If yes, how?

- Or do you consider other possible <u>synergies</u> in RES-E valuations? If yes, which ones and how?

- Do you <u>consider shareholder’s risk-return preference</u> in valuation instead of management’s risk-return preference (“*market risk*”)? If yes, how?

- Do <u>past experiences</u> of the involved investment team members influence the valuation and investment decision process? If yes, how? Does this <u>improve</u> the investment decision? How?

- *Maybe: Are there any other important <u>influencing factors in valuation process and decision-making</u> of RES-E investments?*

- Does a known production site has influence on valuation? Makes it the cash flows more secure? Does this influence the discount rate?

- What is the influence of leverage on the valuation?

Problems/Issues:

- Have you ever encountered <u>particular problems</u> in valuation processes? If yes, which ones?

- What would you <u>improve</u> in the valuation process?

- In case of using DCF methods, do you discount free cash flows generated in the project itself or do you discount cash flows repatriated to the investing company ,e.g. to compute an Output IRR? What would be more appropriate?

- There are critics propagating to decoupling time value of money and risk in valuation methods, e.g. as in the Certainty Equivalent method. Have you ever come across this problem? And have you ever considered such methods which address this issue?

Investment decisions:

- What data and information have to be prepared and presented for the final investment decision?

- Do you provide a final risk assessment as basis for the investment decision?

- Are judgmental ("wertend/beurteilend/qualitative Beurteilung") and/or non-mathematical components/determinants relevant in your decision-making process in case of RES-E investments? If yes, which ones and how?

Questions for the end of the interview

- Do you think that your organisation would consider additional methods in valuating RES-E investments if they are appropriate?

- What is your personal opinion about this topic?

- What do you think about this interview?

Appendix 8 Interview protocol – 2. part of interview with the investment scenarios

Assessment of investment scenarios in wind onshore in Germany and France

Approach:

- Please assume that your company for which you work pursues the objective to build a 200 MW portfolio of power plants based on renewable energies in the next 4 years (the “portfolio”). Your company starts from scratch, i.e. currently 0 MW. Your company plans to invest about 125 MEUR in equity.
- You are an investment manager working for the Renewable Energy division of this company. You are heading a team of valuation and due diligence experts in renewable energy technologies (the “valuation analysis team”). You are responsible for building this portfolio. The investment decision is taken internally by a separate decision-making body, composed of members of the board of directors of your company (including CEO and CFO).
- Your valuation analysis team presents to you following 3 investment opportunities in onshore wind. Your team provides you a summary of key figures and of the analysis results (Tables 1 and 2).
- Based on these key figures and valuation results, you have to present to your decision-making body the 3 investment opportunities and your proposal in which investment (only one of the 3), the company should try to invest. Your decision has to be justified based on the provided figures and used methods.

Additional information:

- All 3 investments are project financed by German banks.
- Your company invests in the equity portion to acquire the project while taking over the project financing without changing it.
- The Weighted Average of Cost of Capital (WACC) of the investing company (i.e. your company) is 3.0%.
- The financial department defines annually a country-specific hurdle rate (minimal return rate) for its various divisions in order to consider the specific risk of the projects of the different divisions. For this year, the hurdle rate of the concerned Renewable Energy division for Germany is 3.5% and for France is 4.1%.
- The applied risk free rate (governmental bond 10Y of concerned country) are 0.19% for Germany and 0.50% for France.

Questions:

- Are you able to present your investment proposal to your decision-making body based on the provided information (Tables 1 and 2)?
- On what basis (figures and analysis results, Tables 1 and 2) do you justify your proposal?
- Are certain key figures and analysis/used methods missing?
- Which key figures, used methods and analysis results are not necessary to make the proposal and take a decision?
- Do you consider additional circumstances which are not based on valuation and figures in your investment proposal?

Table 1: Details about the investment opportunities.

Projects	**1**	**2**	**3**
Technology	Onshore Wind	Onshore Wind	Onshore Wind
Location	Saxony-Anhalt, Germany	Mecklenburg-Western Pomerania, Germany	Picardie, France
Commissioning date	June 2016	Oct. 2014	Jan. 2016
Installed capacity	27.6 MW	14.4 MW	11.5 MW
Hub height	137 m	141 m	98 m
Rotor diameter	126 m	117 m	82 m
Annual production (@P50)	76.8 GWh/a	41.3 GWh/a	28.7 GWh/a
Full load hours (@P50)	2763 h	2868 h	2489 h
Wind assessment – average wind velocity	6.7 m/s	6.9 m/s	7.2 m/s
Wind assessment – standard deviation	12 %	13.4 %	11.5 %
Feed-in tariff (FiT) / FiT period	8.69 ct/kWh for 20 years (fixed)	8.83 ct/kWh for 20 years (fixed)	8.56 ct/kWh for 15 years (indexed)
Direct marketing fee	-0.65 ct/kWh for 10 years	-0.69 ct/kWh for 5 years	Not known yet
Power prices after FiT end (assumption)	4.0 ct/kWh, indexed with 1.5%/a (base year 2014)	4.0 ct/kWh, indexed with 1.5%/a (base year 2014)	4.0 ct/kWh, indexed with 1.5%/a (base year 2014)
Lease agreements	25 + 5 years	25 + 5 years	25 + 5 years
Project financing	78% leverage Tenor: 10 years Interest rate (first 10 years): 1.8%	70% leverage Tenor: 10 years Interest rate (first 10 years): 1.9%	68% leverage Tenor: 10 years Interest rate (first 10 years): 2.6%
Management contracts (technical and commercial)	Contract term: 20 years	Contract term: 10 years	Contract term: 5 years
O&M agreement	15 full maintenance contract (all components included)	10 full maintenance contract (all components included)	5 full maintenance contract (all components included)
Stake in target to be sold	100%	100%	100%

Table 2: Valuation results.

Projects	**1**	**2**	**3**
DCF methods			
Valuation period	25 years	23 years	25 years
Base case:			
Equity return rate (equity IRR) (incl. all tax) vs. P value	6.52% @P50 4.28% @P75 3.04% @P90	5.23% @P50 2.87% @P75 1.34% @P90	5.48% @P50 3.75% @P75 2.16% @P90
Project return rate (total/project IRR) (incl. all tax) vs. P value	3.64% @P50 2.85% @P75 2.03% @P90	3.37% @P50 2.23% @P75 1.03% @P90	3.87% @P50 3.01% @P75 2.20% @P90
Total enterprise value (@P50)	71.5 MEUR	37.2 MEUR	20.7 MEUR
Equity value (@P50)	15.9 MEUR	11.2 MEUR	6.7 MEUR
NPV @5.0% cost of equity	16.8 MEUR	11.5 MEUR	7.0 MEUR
Certainty equivalent method* (based on risk free rate = governmental bond 10Y of concerned country)	14.1 MEUR @0.19%	7.9 MEUR @0.19	4.7 MEUR @0.50%
Profitability index (PI)** (@4.0% cost of equity)	1.142	1.119	1.143
Discounted payback period	17.5 years @3.0% 18.6 years @4.0% 21.9 years @5.0%	17.9 years @3.0% 19.4 years @4.0% 23.0 years @5.0%	17.2 years @3.0% 19.2 years @4.0% 22.0 years @5.0%
Non-DCF methods			
Payback period	15.2 years	14.0 years	15.3 years
Enterprise value / capacity	2.59 EUR/MW	2.58 EUR/MW	1.80 EUR/MW
Enterprise value / annual production (P50)	0.93 EUR/GWh	0.90 EUR/GWh	0.72 EUR/GWh
Additional assessment			
Probability of investment success according to valuation team	50%	60%	70%
Risk and opportunity assessment			
Sensitivity analysis – Wind risk	(see equity IRR and total IRR above for different P values)	(see equity IRR and total IRR above for different P values)	(see equity IRR and total IRR above for different P values)
Sensitivity analysis – Market risk: -10% market prices after FiT end: (all other variables constant)	Equity IRR: 6.31% Total IRR: 3.55%	Equity IRR: 5.04% Total IRR: 3.25%	Equity IRR: 5.03% Total IRR: 3.62%
Sensitivity analysis – O&M risk: +10% O&M costs at the end of contract (all other variables constant)	Equity IRR: 6.43% Total IRR: 3.59%	Equity IRR: 5.18% Total IRR: 3.36%	Equity IRR: 5.21% Total IRR: 3.73%
Sensitivity analysis – interest rates (project financing) risk: +1% higher interest rate after 10 years (all other variables constant)	Equity IRR: 6.44% Total IRR: 3.65%	Equity IRR: 5.07% Total IRR: 3.40%	Equity IRR: 5.39% Total IRR: 3.78%
Scenario analysis*** - Worst Case:	Equity IRR: 2.21% Total IRR: 0.51%	Equity IRR: 0.10% Total IRR: -0.15%	Equity IRR: 0.51% Total IRR: 0.12%
Scenario analysis*** - Best Case:	Equity IRR: 8.76% Total IRR: 4.95%	Equity IRR: 9.57% Total IRR: 6.31%	Equity IRR: 11.82% Total IRR:8.13%
Opportunities	Almost no opportunities	New negotiation of O&M and management contract >11 years	New negotiation of O&M and manage-ment contract >5 years; maybe additional revenues for direct marketing

Description:

P value (P50, P75 etc.): It is a probability measure, e.g. P50 is defined as 50% of estimates exceed the P50 estimate, in case of P90, 90% of the estimates exceed the P90 estimate.

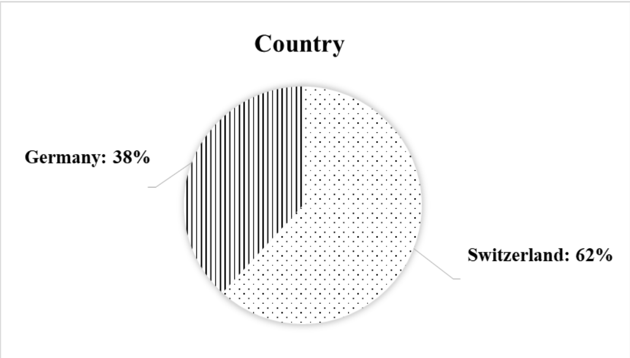
* Within the certainty equivalent method, expected cash flows are adjusted to reflect project risk and discounted by the appropriate risk-free rate to obtain project's NPV.

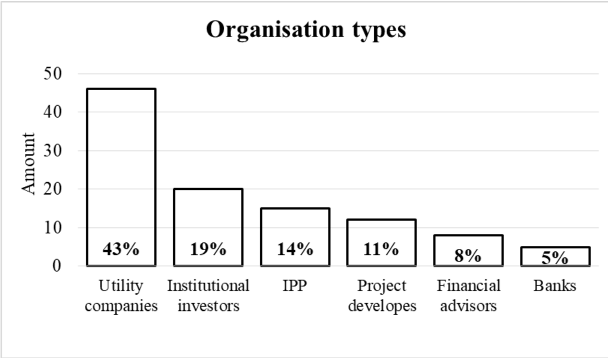
** Profitability index (PI) is the present value of the project's cash inflow per currency unit of its initial investment.

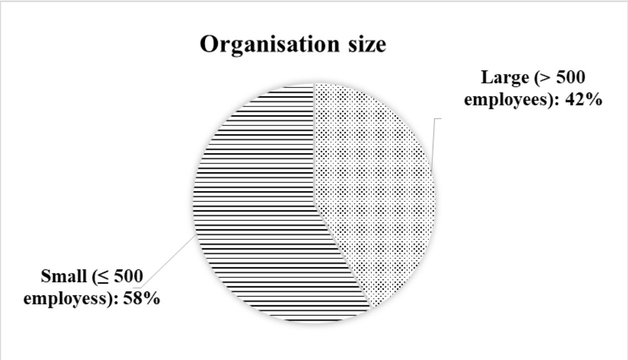
*** Worst Case and best case: Adjustment of +/- 20% production, O&M costs: +/- 30% end of contract, interest rate: +4% / -0.5%, market prices after end of FiT: + 100%/- 50%

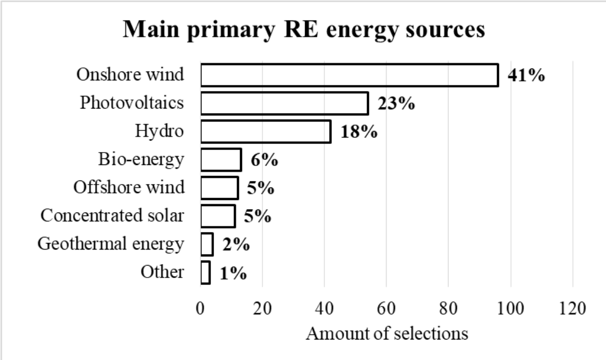
Appendix 9 QUAN result tables

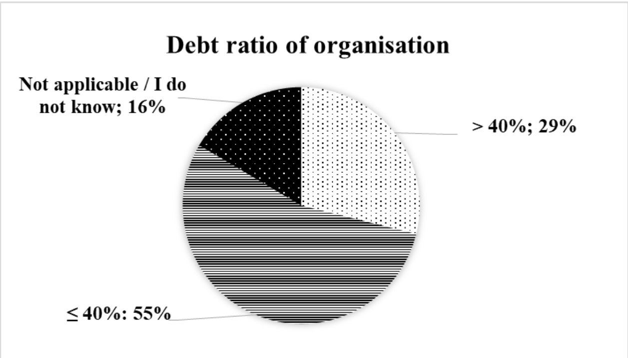
Figure 56: Organisation characteristics.

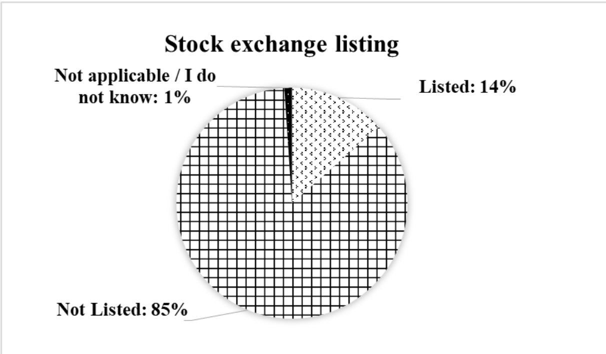












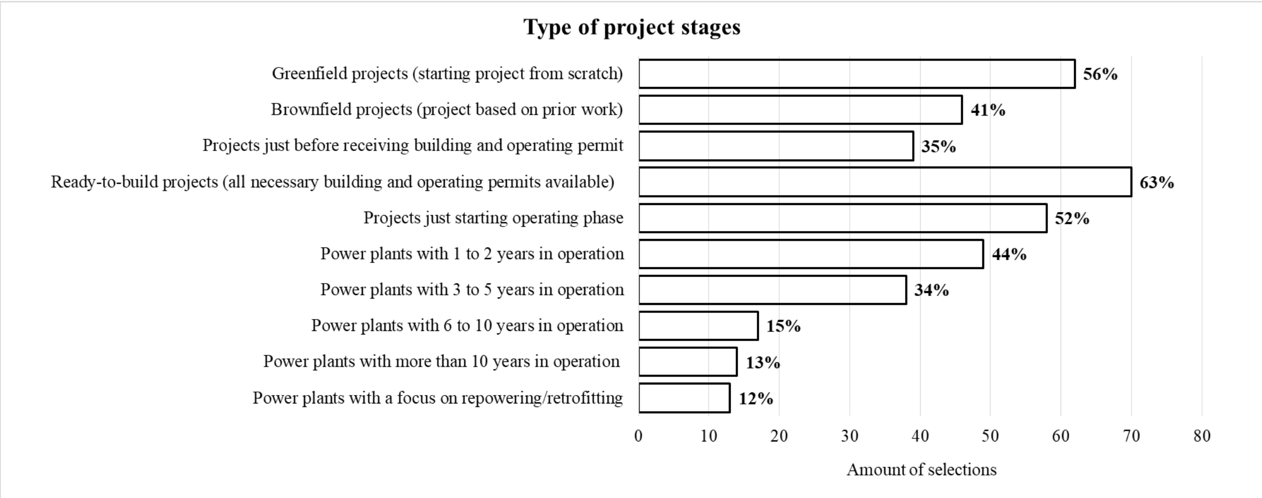


Figure 57: Characteristics of participants.

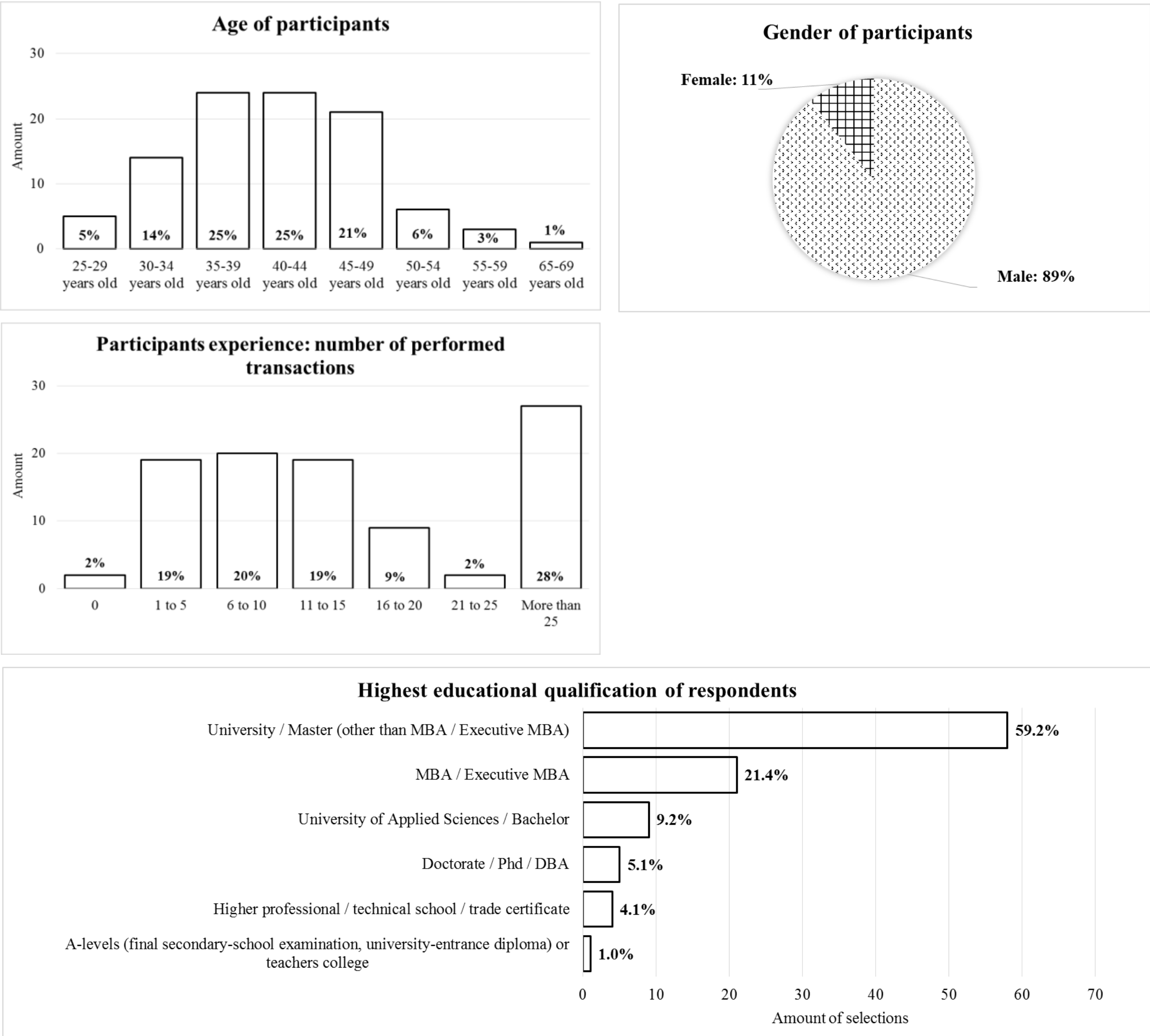


Table 36: Demographic correlations of control variables in the survey[1].

	Organisation type (energy vs. others)	Country (DE vs. CH)	Size (large vs. small firms)	Leverage (high vs. low)	Stock exchange listing (yes vs. no)	Gender (male vs. female)	Age (young vs. mature)	Education (MBA vs. others)
Country	0.036							
Size	0.308***	0.184*						
Leverage	-0.151	-0.448***	-0.169					
Stock exchange listing	0.149	0.049	0.130	0.097				
Gender	0.038[2]	0.006[2]	0.112	-0.076[2]	0.241**[2]			
Age	0.082	-0.006	-0.215**	0.084	0.001	-0.061[2]		
Education	0.049	0.369***	0.033	-0.183*	0.210*	0.047[2]	-0.061	
Experience in transactions (high vs. low)	-0.068	-0.112	0.182*	0.087	0.010	-0.169[2]	0.125	0.140

[1] Index of mean square contingency (phi coefficient). This statistic measures the correlation of ordered groups of attributes.[81]
****, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively, based on Pearson χ^2 or Fisher's exact test;*

[2] Fisher's exact test.

Table 37: Survey responses to the question ‘How would you rate the significance of each of the following types of risk to your company's RE projects?’ in relation to organisation type, country, company size, leverage of company and its stock exchange listing (arithmetic mean).

	% higher risk (4) and (5)[1]	Arithmetic mean	Organisation type[2]							Country[3]			Organisation size[3]		Leverage of company[3]			Stock exchange listing[3]		
			Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors		Germany	Switzerland		Large	Small	Low	High		Listed	Not listed	
e) Political/regulatory risk (excl. tax risk) [S]	61.5	3.74	3.78	3.83	3.36	3.55	4.20	3.75		4.02	3.58	**	3.71	3.73	3.90	3.61		3.86	3.71	
g) Market risk [S]	53.2	3.49	3.57	3.58	3.13	3.63	2.40	3.50		3.48	3.52		3.62	3.40	3.40	3.58		3.79	3.47	
h) Weather-related volume risk [U]	52.3	3.58	3.61	3.17	3.57	3.95	4.00	2.75		3.51	3.60		3.67	3.52	3.93	3.41	**[4]	3.00	3.69	*
a) Financial risk [S]	36.4	3.07	3.07	3.25	2.93	2.70	3.40	3.25		3.02	3.07		2.95	3.10	3.10	2.93		2.57	3.11	
f) Tax risk [S]	33.9	3.01	3.24[5]	2.25[5]	2.67	3.40[5]	2.80	2.75	**	2.79	3.15		3.10	2.97	3.10	3.02		3.14	3.00	
c) Building and testing risks [U]	18.3	2.42	2.43	2.58	2.13	2.16	3.40	2.13		2.66	2.30		2.36	2.32	2.37	2.42		2.50	2.31	
d) Operational risk [U]	18.2	2.66	2.83	2.17	2.53	2.85	2.40	2.38		2.48	2.78		2.67	2.67	2.63	2.78		3.29	2.56	***
j) Risk of subsidiaries not being under	15.5	2.36	2.50	2.50	2.57	2.00	2.20	2.00		2.48	2.64		2.45	2.24	2.33	2.30		2.71	2.27	
i) Environmental risk [U]	10.9	2.31[2]	2.26	2.50	2.33	2.40	2.20	2.00		2.33	2.28		2.36	2.21	2.37	2.13		2.43	2.23	
b) Business/strategic risk [U]	6.4	2.25	2.43	2.33	2.13	1.85	2.00	1.88		2.33	2.42		2.29	2.15	2.00	2.28		2.00	2.23	

[1] answer options: scale of 1 to 5 (risk rating: 1 meaning very low risk, 5 meaning very high risk);
****, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively;*
[2] ANOVA; [3] t-test; [4] Welch’s t-test; [5] post-hoc tests (Bonferroni) for detecting significant differences between the various organisation types;
S: systematic risk; U: unsystematic risk.

Table 38: Survey responses to the question 'How would you rate the significance of each of the following types of risk to your company's RE projects? (1 = low risk; 5= high risk)' in relation to investment point of time concerning the various project stages (arithmetic mean).

			Type of project stage[2]									
	% higher risk (4) and (5)[1]	Arithmetic mean	Greenfield projects (starting project from scratch)	Brownfield projects (project based on prior work)	Projects just before receiving building and operating permit	Ready-to-build projects (all necessary building and operating permits available)	Projects just starting operating phase	Power plants with 1 to 2 years in operation	Power plants with 3 to 5 years in operation	Power plants with 6 to 10 years in operation	Power plants with more than 10 years in operation	Power plants with the focus on repowering/ retrofitting
e) Political/regulatory risk (excl. tax risk) S	61.5	3.74	3.89	3.71	3.74	3.65	3.72	3.72	3.70	3.71	3.66	3.54
g) Market risk S	53.2	3.49	3.52	3.53	3.42	3.37	3.36	3.36	3.49	3.47	3.43	3.38
h) Weather-related volume risk U	52.3	3.58	3.39*	3.36*	3.59	3.72*	3.91***	3.91**[3]	3.86*	3.71	3.73	3.46
a) Financial risk S	36.4	3.07	3.10	2.96	3.03	2.96	3.09	3.09	2.95	2.47**	2.57*	2.77
f) Tax risk S	33.9	3.01	2.79**	2.78*	2.85	3.19**	3.30***	3.30***	3.51***	3.24	3.14	2.23***
c) Building and testing risks U	18.3	2.42	2.53	2.53	2.61	2.38	2.30	2.30	2.53	2.75	2.54	2.54
d) Operational risk U	18.2	2.66	2.56	2.54	2.67	2.72	2.82*[2]	2.82	2.97**[2]	2.88	2.71	2.46
j) Risk of subsidiaries not being under corporate control U	15.5	2.36	2.48	2.43	2.38	2.44	2.28	2.28	2.47	2.56	2.54	2.08
i) Environmental risk U	10.9	2.31	2.37	2.28	2.33	2.26	2.25	2.25	2.32	2.71**	2.70**	2.62
b) Business/strategic risk U	6.4	2.25	2.42**[3]	2.26	2.13	2.23	2.19	2.19*	2.05**[3]	2.12	2.00	2.15

[1] answer options: scale of 1 to 5 (risk rating: 1 meaning very low risk, 5 meaning very high risk);
****, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively;*
[2] t-test; [3] Welch's t-test; S: systematic risk; U: unsystematic risk.

Table 39: Survey responses to the question 'How would you rate the significance of each of the following types of risk to your company's RE projects? (1 = low risk; 5= high risk)' in relation to materialised risk by asking "Which types of risk materialised in your company's RE business in the past five years?" (in %).

			In case of materialised risk in general		**In case of specific materialised risk (arithmetic mean)**[2]									
	% higher risk (4) and (5)[1]	Arithmetic mean	% higher risk (4) and (5)[1]	Arithmetic mean	Financial risk	Business/strategic risk	Building and testing risks	Operational risk	Political/regulatory risk	Tax risk	Market risk	Weather-related volume risk	Environmental risk (other than weather-related volume risk)	Risk of subsidiaries not being under corporate control
e) Political/regulatory risk (excl. tax risk) [S]	61.5	3.74	61.5	3.77	3.75	3.90	4.00	3.70	**3.86**	3.80	4.00*	3.77	4.50	3.75
g) Market risk [S]	53.2	3.49	54.5	3.57	3.63	3.30	3.50	3.53	3.66	3.50	**3.82****[3]	3.45	3.50	3.50
h) Weather-related volume risk [U]	52.3	3.58	55.8	3.73	3.97*	3.30	3.43	3.70	3.68	3.91	3.57	**3.87*****	2.50***	3.50
a) Financial risk [S]	36.4	3.07	34.6	3.05	**3.63*****	2.50*	3.14	2.89	3.09	3.09	3.32	3.05	2.00	2.75
f) Tax risk [S]	33.9	3.01	40.3	3.14	3.47**	2.90	2.76	3.23	3.30**	**3.60*****	3.21	3.23	3.50	2.88
c) Building and testing risks [U]	18.3	2.42	16.9	2.36	2.23	2.50	**2.55**	2.49	2.32	2.17	2.59	2.38	3.00	2.38
d) Operational risk [U]	18.2	2.66	23.1	2.79	2.81	2.80	2.64	**2.98***	2.70	3.03	2.97	2.84	3.00	2.75
j) Risk of subsidiaries not being under corporate	15.5	2.36	17.8	2.40	2.45	2.40	2.57	2.46	2.43	2.22	2.34	2.40	1.50	**2.75**
i) Environmental risk [U]	10.9	2.31	9.0	2.24	2.16	2.50	2.36	2.18	2.25	2.14	2.29	2.31	**2.00**	2.50
b) Business/strategic risk [U]	6.4	2.25	3.8	2.22	2.19	**2.50**	2.27	2.27	2.14	2.09	2.26	2.19	2.50	2.38
% have chosen this risk category as having					32.0	10.0	22.0	44.0	57.0	35.0	38.0	62.0	2.0	8.2

[1] answer options: scale of 1 to 5 (risk rating: 1 meaning very low risk, 5 meaning very high risk); only the data of those respondents which have experienced materialised risk have been selected for the statistical analysis.
****, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively;*
*[2] t-test; [3] Welch's t-test; **Bold figures**: same risk had already materialised in their RES-E investments in the past five years.*

Table 40: Survey responses to the question 'In general, how would you assess the overall degree of risk associated with each of the following stages of planning, building and operating RE power plants? (1 = low risk; 5= high risk)' in relation to organisation type, country, company size, leverage of company and its stock exchange listing (arithmetic mean).

	% higher risk (4) and (5)[1]	Arithmetic mean	Organisation type[2]						Country[3]		Organisation size[3]		Leverage of company[3]		Stock exchange listing[3]	
			Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors	Germany	Switzerland	Large	Small	Low	High	Listed	Not listed
a) Planning/designing the power plant	70.8	3.93	3.95	3.08	4.00	4.47	4.00	3.86	3.79	4.02	3.83	4.14	4.21	3.81	3.86	4.03
f) Retrofitting / repowering the power plant	32.0	3.03	3.08	2.40	3.27	2.94	3.00	3.71	2.85	3.16	3.15	2.98	3.21	2.98	3.17	3.03
c) Building the power plant	23.1	2.74	2.82	2.33	2.67	2.58	3.40	2.63	2.57	2.83	2.76	2.63	2.62	2.74	2.79	2.67
b) Financing the power plant	15.6	2.62	2.71	3.00	2.60	2.25	2.80	2.38	2.67	2.62	2.44	2.75 *	2.57	2.64	2.79	2.64
e) Operating the power plant	12.8	2.50	2.64	2.00	2.67	2.30	2.40	2.25	2.40	2.55	2.63	2.36	2.60	2.47	2.64	2.43
g) Decommissioning the power plant	10.0	2.20	2.28	2.00	2.43	2.00	1.25	2.57	2.03	2.34	2.13	2.23	2.29	2.13	2.36	2.15
d) Commissioning the power plant	5.6	2.34[4]	2.44	2.00	2.27	2.00	2.40	2.38	2.21	2.42	2.37	2.22	2.14	2.34	2.57	2.23

[1] answer options: scale of 1 to 5 (risk rating: 1 meaning low risk, 5 meaning high risk);
** denotes a significant difference at the 10% level, respectively;*
[2] ANOVA; [3] t-test; [4] Commissioning has the lower rate in % higher risk (4) and (5) than decommissioning, but the higher arithmetic mean. This is due to the fact that decommissioning received no rating 5 in contrast to commissioning which decreases the arithmetic mean.

Table 41: Survey responses to the question 'In the past five years, which of the following risk mitigation measures has your company used for its RE investment business?' in relation to organisation type, country, company size, leverage of company and its stock exchange listing (in %).

	% applicable	Organisation type[1]							Country[1]			Organisation size[1]			Leverage of company[1]		Stock exchange listing[1]	
		Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors		Germany	Switzerland		Large	Small		Low	High	Listed	Not listed
a) Internal DD of investment project	83.0	82.6	83.3	66.7	80.0	80.0	62.5		69.0	79.4		81.0	83.1		83.6	83.3	85.7	83.5
g) Reduce operational risks (for example, full maintenance contracts with availability guarantee, preventive maintenance procedures, and periodical inspections)	81.0	69.6	75.0	80.0	95.0	80.0	62.5		73.8	73.5		71.4	86.4		76.4	90.0	64.3	83.5
b) External DD of investment project with external consultants	75.0	78.3	41.7	73.3	75.0	60.0	62.5		52.4	77.9	***	81.0	69.5	*	80.0	73.3	71.4	75.3
i) Arrange for insurance (for example, machine failure insurance, insurance for downtime, liability insurance, directors, and officers insurance)	69.0	65.2	58.3	60.0	85.0	60.0	37.5		54.8	67.6		66.7	69.5		70.9	73.3	64.3	70.6
f) Reduce market risks with FiT and/or long-term PPA	68.0	60.9	50.0	66.7	85.0	60.0	50.0		54.8	66.2		64.3	69.5		67.3	73.3	78.6	65.9
d) Standardisation of procedures (for example, processes, contracts)	62.0	63.0	58.3	60.0	70.0	40.0	12.5*[3]	*[2]	50.0	60.3		69.0	55.9		67.3	60.0	64.3	62.4
c) Our company's risk management function (for example, risk management process / policy, identification of exposures, loss control)	50.0	47.8	33.3	60.0	55.0	60.0	12.5		40.5	48.5		52.4	47.5		54.5	56.7	50.0	50.6
e) Check type of suppliers (credit rating) and/or contractual clauses within contracts with suppliers	48.0	43.5	25.0	60.0	65.0	40.0	12.5	*[2]	35.7	48.5		50.0	45.8		58.2	46.7	35.7	50.6
h) Making Co-investments with partners	48.0	63.0	41.7	46.7	35.0	0.0	0.0	***[2]	38.1	47.1		54.8	42.4		52.7	40.0	35.7	50.6
l) Arrange for financial products (for example, financial hedging of currency and/or interest rate changes)	45.0	41.3	25.0	53.3	55.0	40.0	25.0		9.5	17.6		47.6	42.4		54.5	40.0	42.9	45.9
k) Implement emergency services	16.0	13.0	16.7	20.0	25.0	0.0	0.0		9.5	17.6		14.3	16.9		20.0	13.3	7.1	17.6
j) Arrange for weather protection insurance (for example, natural resource hedging instruments)	9.0	2.2	0.0	13.3	20.0	0.0	25.0	**[2]	2.4	11.8		2.4	13.6	*[2]	3.6	6.7	0.0	10.6

****, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively;*
[1] based on Pearson χ^2 test or Fisher's exact test. [2] Fisher's exact test; [3] $\vert$standardized residual$\vert$ > 1.96;

Table 42: Survey responses to the question 'In the past five years, which of the following risk mitigation measures has your company used for its RE investment business?' in relation to materialised risk by asking 'Which types of risk materialised in your company's RE business in the past five years?' (in %).

	% applicable	In case of following materialised risk (applicable in %)[1]									
		Financial risk	Business / strategic risk	Building and testing risks	Operational risk	Political / regulatory risk	Tax risk	Market risk	Weather-related volume risk	Environmental risk (other than weather-related volume risk)	Risk of subsidiaries not being under corporate
a) Internal DD of investment project	83.0	96.9**[2]	80.0	90.9	86.4	91.2*[2]	88.6	92.1	83.9	100.0	87.5
g) Reduce operational risks (for example, full maintenance contracts with availability guarantee, preventive maintenance procedures, and periodical inspections)	81.0	87.5	90.0	90.9	88.6	87.7	82.9	84.2	87.1	100.0	75.0
b) External DD of investment project with external consultants	75.0	87.5	90.0	86.4	81.8	87.7***[2]	80.0	78.9	83.9*[2]	100.0	75.0
i) Arrange for insurance (for example, machine failure insurance, insurance for downtime, liability insurance, directors, and officers insurance)	69.0	90.4***	90.0	86.4*	75.0	80.7**	74.3	76.3	74.2	100.0	75.0
f) Reduce market risks with FiT and/or long-term PPA	68.0	87.5**	80.0	77.3	75.0	86.0***	74.3	76.3	74.2	100.0	87.5
d) Standardisation of procedures (for example, processes, contracts)	62.0	81.3**	80.0	72.7	70.5	75.4***	68.6	65.8	71.0	100.0	87.5
c) Our company's risk management function (for example, risk management process / policy, identification of exposures, loss control)	50.0	59.4	40.0	50.0	59.1	57.9*	51.4	55.3	54.8	100.0	62.5
e) Check type of suppliers (credit rating) and/or contractual clauses within contracts with suppliers	48.0	65.6**	70.0	40.9	52.3	56.1*	51.4	50	50.0	100.0	62.5
h) Making Co-investments with partners	48.0	59.4	60.0*	68.2	54.5	56.1	54.3	44.7	56.5	50.0	50.0
l) Arrange for financial products (for example, financial hedging of currency and/or interest rate changes)	45.0	59.4*	50.0	50.0	50.0	56.1**	60.0**	42.1	48.4	100.0	62.5
k) Implement emergency services	16.0	28.1**	50.0***[2]	13.6	13.6	17.5	25.7*	13.2	16.1	100.0**	12.5
j) Arrange for weather protection insurance (for example, natural resource hedging instruments)	9.0	12.5	20.0	0.0	9.1	5.3*	11.4	7.9	11.3	0.0	25.0
% have chosen this risk category as having materialised		32.0	10.0	22.0	44.0	57.0	35.0	38.0	62.0	2.0	8.2

****, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively, [1] based on Pearson χ^2 test or Fisher's exact test. [2] Fisher's exact test. Only the data of those respondents which have experienced materialised risk have been selected for the statistical analysis.*

Table 43: Survey responses to the question 'How frequently does your company use the following techniques when deciding which RE projects / acquisitions to pursue?' in relation to organisation type, country, company size, leverage of company and its stock exchange listing (arithmetic mean).

	% almost always (4) and always (5)[1]	Arithmetic mean	Organisation type[2]							Country[3]			Organisation size[3]		Leverage of company[3]			Stock exchange listing[3]		
			Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors		Germany	Switzerland		Large	Small	High	Low		Listed	Not listed	
d) Internal rate of return	92.4	4.70	4.89	4.40	4.33	4.80	4.00	4.88		4.48	4.83	*[4]	4.85	4.61	4.37	4.90	**[4]	4.86	4.68	
c) Net present value	79.8	4.35	4.64	4.67	4.00	4.11	3.40	4.00		4.21	4.42		4.45	4.25	3.80	4.53	**[4]	4.29	4.32	
n) Scenario analysis (for example, base case, worst case, and best case)	79.4	4.26	4.30	4.11	4.07	4.50	5.00	3.75		4.32	4.22		4.23	4.28	4.17	4.46		4.77	4.21	**[4]
m) Sensitivity analysis	75.7	4.04	4.12	3.60	3.60	4.42	4.80	3.63		3.92	4.10		4.13	3.97	3.83	4.20		4.43	3.95	
f) Estimate cost of equity capital of project (equity return rate)	65.0	3,82	3.65	3.75	3.87	4.05	3.25	4.25		3.70	3.87		3.68	3.88	3.57	3.94		4.15	3.74	
e) Hurdle rate of return	63.9	3,79	4.22	3.13	3.86	3.63	2.75	3.00		3.54	3.93		4.03	3.62	3.64	4.02		4.27	3.72	
g) Estimate total cost of capital of project (project return rate)	62.7	3,78	3.81	3.00	3.60	4.16	3.60	3.88		3.26	4.10	***[4]	3.83	3.72	3.40	3.94		4.14	3.68	
j) Payback period	44.4	3,10	3.43	2.67	2.47	3.22	4.00	2.13	*	3.03	3.16		3.38	2.91	2.64	3.38	**	3.15	3.10	
h) Multiple approach	39.4	3,00	2.93	2.44	2.71	2.94	4.67	3.75		2.79	3.13		3.00	2.93	2.74	2.96		3.46	2.83	
p) Valuing opportunities and synergy possibilities	24.0	2,64	2.55	3.00	2.40	3.06	1.75	2.43		2.44	2.77		2.57	2.69	2.29	2.73		2.92	2.58	
o) Simulations (for example, Monte Carlo simulations)	12.2	1,94	1.70*[5]	1.89	2.27	2.00	3.40*[5]	1.38	*[(6)]	2.37	1.64	***[4]	1.84	1.95	2.07	1.86		1.92	1.87	
i) Profitability index	10.9	1,90	1.85	1.78	2.07	1.88	2.00	1.63		1.94	1.90		1.79	1.87	1.65	1.89		1.73	1.83	
l) Real options	10.8	1,76	1.60	1.88	2.00	2.00	1.50	1.25		1.91	1.69		1.51	1.83	1.68	1.74		1.75	1.67	
k) Value at risk	8.2	1,90	1.80	1.67	2.20	1.88	2.25	1.63		2.03	1.83		1.78	1.88	1.88	1.89		1.83	1.83	

[1] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always;
****, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively;*
[2] ANOVA; [3] t-test; [4] Welch's t-tests,; [5] post-hoc tests (Bonferroni) to detect significant differences between the various organisation types; [(6)] Result with low reliability due to robustness check for non-size characteristics.
The results regarding DCF (in survey question at position b) and cash flow projection / free cash flow to firm (FCFF) approach (in survey question at position a) are shown in Table 53 in Appendix 10.

Table 44: Survey responses to the question 'How frequently does your company use the following techniques when deciding which RE projects / acquisitions to pursue?' in relation to the investment focus concerning project stages (arithmetic mean).

	% almost always (4) and always (5)[1]	Arithmetic mean	Type of project stages[2]									
			Greenfield projects (starting project from scratch)	Brownfield projects (project based on prior work)	Projects just before receiving building and operating permit	Ready-to-build projects (all necessary building and operating permits available)	Projects just starting operating phase	Power plants with 1 to 2 years in operation	Power plants with 3 to 5 years in operation	Power plants with 6 to 10 years in operation	Power plants with more than 10 years in operation	Power plants with the focus on repowering / retrofitting
d) Internal rate of return	92.4	4.70	4.63	4.70	4.68	4.70	4.82	4.91***[3]	4.74	4.86	4.83	4.91*[4]
c) Net present value	79.8	4.35	4.42	4.51	4.39	4.33	4.27	4.41	4.50	4.43	4.50	4.36
n) Scenario analysis (for example, base case, and worst case, best case)	79.4	4.26	4.25	4.37	4.36	4.23	4.28	4.31	4.33	4.36	4.00	4.10
m) Sensitivity analysis	75.7	4.04	3.98	4.26*	4.28	4.17	4.19	4.29**	4.38**	4.79***[3]	4.42	4.27
f) Estimate cost of equity capital of project (equity return rate)	65.0	3.82	3.76	4.03	3.86	3.90	3.96	4.07	4.12	4.31*[3]	4.50**[3]	3.89
e) Hurdle rate of return	63.9	3.79	3.67	3.79	3.71	4.05**	4.10**	4.05	4.36***[3]	4.08	3.90	2.38***
g) Estimate total cost of capital of project (project return rate)	62.7	3.78	3.71	4.02	3.94	3.89	4.08**[3]	4.18**[4]	4.15*[3]	4.29	3.83	3.18
j) Payback period	44.4	3.10	2.94	2.95	3.03	3.26	3.33	3.28	3.39	3.23	2.60	3.22
h) Multiple approach	39.4	3.00	2.75*	3.00	3.12	3.12	3.31**	3.37	3.60***	3.73*	3.00	3.00
p) Valuing opportunities and synergy possibilities	24.0	2.64	2.44*	2.79	2.62	2.58	2.64	2.77	2.84	3.42**	3.13	2.88
o) Simulations (for example, Monte Carlo simulations)	12.2	1.94	1.87	2.12	1.94	1.94	1.88	1.98	2.15	2.62**	2.64**	2.10
i) Profitability index	10.9	1.90	1.83	2.05	1.88	1.91	2.10*[3]	2.10	2.03	2.55*	2.22	1.89
l) Real options	10.8	1.76	1.75	1.83	1.69	1.70	1.81	1.83	2.03	2.55**	2.13	2.13
k) Value at risk	8.2	1.90	1.78	2.00	1.77	1.85	1.90	2.05	2.25**	2.58**	2.40	1.78

[1] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always;

****, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively.*

[2] t-test; [3] Welch-test. The results regarding DCF (in survey question at position b) and cash flow projection / free cash flow to firm (FCFF) approach (in survey question at position a) are shown in Table 53 in Appendix 10.

Table 45: Survey responses to the question 'How frequently does your company use the following techniques and/or approaches in determining cost of equity or discount rates when valuing RE investments?' in relation to organisation type, country, company size, leverage of company and its stock exchange listing (arithmetic mean).

	% almost always (4) and always (5)[1]	Arith-metic mean	Organisation type[2]							Country[3]			Organisation size[3]			Leverage of company[3]			Stock exchange listing[3]		
			Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors		Germany	Switzerland		Large	Small		High	Low		Listed	Not listed	
l) Weighted average cost of capital of our company	67.0	3.74	4.60	2.33	3.69	3.24	1.00	3.25	***[5] [(7)]	2.90	4.15	***	4.22	3.44	***[4]	3.18	4.22	***[4]	3.71	3.77	
k) Discount rates are at least as high as defined hurdle rates	59.0	3.49	4.06	3.11	3.70	3.18	2.75	2.14		3.27	3.62		3.82	3.31		3.54	3.73		4.11	3.44	
a) Formal risk analysis	57.3	3.63	3.87	3.38	3.25	3.53	5.00	2.71		3.63	3.63		4.00	3.39	**	3.67	3.90		4.75	3.47	***[4] [(7)]
m) Benchmarking approaches with comparable companies or comparable investments	43.2	3.30	3.38	2.88	3.36	3.53	3.25	2.75		3.14	3.37		3.33	3.30		3.14	3.63		3.92	3.22	*
b) Capital asset pricing model	35.3	2.85	3.08	2.13	2.92	3.13	1.00	2.88		2.29	3.12	**	3.23	2.60	*	2.37	3.34	***	3.75	2.72	**[(7)]
f) Current market return adjusted for risk	31.0	2.50	2.34	2.50	3.00	2.47	1.00	3.13		2.30	2.61		2.32	2.60		2.07	2.64		2.80	2.44	
g) Discount rates set by regulatory decisions	29.4	2.51	2.39	2.50	2.92	2.63	1.50	2.63		2.43	2.55		2.24	2.69		2.19	2.71		2.64	2.49	
j) Cost of debt plus a risk premium	27.6	2.72	2.76	2.63	3.15	2.75	1.50	2.50		2.84	2.66		2.77	2.70		2.86	2.60		3.64	2.59	**
i) Earnings/price ratio	25.9	2.46	2.49	2.50	3.00	2.06	2.00	2.50		2.32	2.53		2.53	2.41		2.39	2.58		3.33	2.30	*[4]
n) Whatever our investors tell us they require	23.3	2.63	2.10	3.29	2.50	3.13	2.33	3.60	*	3.00	2.44		1.86	3.05	***[4]	2.67	2.49		3.00	2.46	
c) Modified CAPM including additional extra risk factors	20.3	2.20	2.38	1.50	2.00	2.67	1.00	2.25		1.79	2.43	**[4]	2.47	2.02		1.93	2.51	*[4]	3.22	2.07	**
e) Average historical returns on common stock (historical market return)	17.3	2.15	2.31	2.00	2.36	1.71	1.00	2.38		1.79	2.34	*[4]	2.15	2.11		1.78	2.45	**[4]	2.80	2.03	
h) Dividend discount model (e.g. current/historical dividend yield plus an estimate of growth or dividend yield estimate only)	8.6	1.88	1.82	2.13	2.00	1.63	1.50	2.29		1.79	1.92		1.75	1.94		1.59	2.02		2.30	1.80	
o) Certainty equivalent method	9.2	1.77	1.42	2.43	2.50	1.81	1.33	1.20	*[6]	2.00	1.64		1.37	2.05	**[4]	1.83	1.79		2.14	1.72	
d) Multifactor models (for example, ATP)	0.0	1.48	1.47	1.38	1.55	1.56	1.00	1.50		1.50	1.46		1.53	1.42		1.52	1.51		1.67	1.44	

[1]answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always;
****, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively;*
[2] ANOVA; [3] t-test; [4] Welch's t-test; [5] Welch- and Brown-Forsythe-Test (without variances of Zero); [6] Brown-Forsythe-Test;[(7)] Not reliable for non-size characteristics (i.e. mean difference is dependent on size).

Table 46: Survey responses to the question 'How frequently does your company use the following techniques and/or approaches in determining cost of equity or discount rates when valuing RE investments?' in relation to the various project stages (arithmetic mean).

	% almost always (4) and always (5)[1]	Arithmetic mean	**Type of project stage**[2] Greenfield projects (starting project from scratch)	Brownfield projects (project based on prior work)	Projects just before receiving building and operating permit	Ready-to-build projects (all necessary building and operating permits available)	Projects just starting operating phase	Power plants with 1 to 2 years in operation	Power plants with 3 to 5 years in operation	Power plants with 6 to 10 years in operation	Power plants with more than 10 years in operation	Power plants with the focus on repowering/ retrofitting
l) Weighted average cost of capital of our company	67.0	3.74	3.92	3.53	3.40	3.60	3.77	3.86	3.90	4.08	3.36	3.11
k) Discount rates are at least as high as defined hurdle rates	59.0	3.49	3.57	3.35	3.47	3.57	3.62	3.69	3.84*[3]	3.33	3.73	2.89
a) Formal risk analysis	57.3	3.63	3.66	3.58	3.83	3.88**	3.74	3.88	3.81	4.15	4.10	3.38
m) Benchmarking approaches with comparable companies or comparable investments	43.2	3.30	3.39	3.22	3.41	3.25	3.17	3.39	3.38	3.38	3.20	2.88
b) Capital asset pricing model	35.3	2.85	2.76	2.64	2.83	2.83	2.93	3.00	2.90	3.08	2.70	1.88*
f) Current market return adjusted for risk	31.0	2.50	2.28	2.62	2.56	2.45	2.35	2.54	2.42	2.50	2.11	1.75*[3]
g) Discount rates set by regulatory decisions	29.4	2.51	2.49	2.35	2.37	2.29	2.38	2.58	2.73	3.17**	3.33*	2.50
j) Cost of debt plus a risk premium	27.6	2.72	2.77	2.85	2.93	2.56	2.57	2.87	2.71	3.33	3.67**	2.63
i) Earnings/price ratio	25.9	2.46	2.52	2.41	2.54	2.35	2.45	2.51	2.29	2.58	2.44	2.50
n) Whatever our investors tell us they require	23.3	2.63	2.71	2.90	2.83	2.49	2.51	2.28	2.46	2.30	2.43	2.33
c) Modified CAPM including additional extra risk factors	20.3	2.20	2.07	2.24	2.19	2.29	2.39	2.50	2.43	2.36	2.22	1.63*[3]
e) Average historical returns on common stock (historical market return)	17.3	2.15	2.00	1.88	1.78*	2.16	1.95	2.11	2.14	2.00	1.89	1.63
h) Dividend discount model (for example, current/historical dividend yield plus an estimate of growth or dividend yield estimate only)	8.6	1.88	2.05	1.97	1.81	1.78	1.76	1.92	2.00	2.36*	2.11	1.50
o) Certainty equivalent method	9.2	1.77	1.88	1.77	1.82	1.65	1.65	1.71	1.67	2.11	2.56*	1.88
d) Multifactor models (for example, ATP)	0.0	1.48	1.42	1.47	1.41	1.39	1.48	1.50	1.48	1.90*	1.50	1.63

[1]answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always;

***, * denotes a significant difference at the 5% and 10% level, respectively;*

[2] t-test; [3] Welch's t-Test.

Table 47: Survey responses to the question 'How frequently does your company use the following discount rates when valuing a new RE investment project?' in relation to organisation type, country, company size, leverage of company and its stock exchange listing (arithmetic mean).

	% almost always (4) and always (5)[1]	Arithmetic mean	Organisation type[3]							Country[4]			Organisation size[4]			Leverage of company[4]			Stock exchange listing[4]		
			Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors		Germany	Switzerland		Large	Small		High	Low		Listed	Not listed	
b) A specific discount rate for the considered country (country discount rate)	65.9	3.86	4.21	3.11	4.00	4.22	-	3.38		3.45	4.05	*[5]	4.26	3.60	**[5]	3.57	4.25	**[5]	4.69	3.73	***[5]
c) A specific discount rate for the applied technology/ concerned industry	60.0	3.59	4.05	2.67	3.62	3.71	-	3.13	* [(7)]	3.20	3.76		3.89	3.40		3.21	3.88	*	4.57	3.41	***[5]
d) A specific discount rate for the concerned project stage (e.g. planning/designing, financing, building, operating)	52.2	3.26	3.23	3.40	3.62	3.61	-	2.75		3.38	3.17		3.14	3.37		2.93	3.58	*	4.00	3.13	**
f) A RADR for this particular project	44.4	3.01	2.89	2.89	3.08	3.29	-	2.63		3.28	2.82		2.81	3.14		2.83	3.25		3.17	2.95	
g) A discount rate based on our cost of financing	34.1	2.73	2.90	2.67	2.92	2.18	-	2.38		2.87	2.61		2.87	2.63		2.45	2.80		2.92	2.68	
h) A discount rate based on our past experience	31.5	2.75	2.49	3.33	3.15	2.94	-	2.50		2.94	2.61		2.28	3.10	**[5]	2.38	2.96	*	2.67	2.75	
a) The discount rate for our entire company	23.5	2.44	2.82	1.78	2.08	2.47	-	2.63		2.09	2.64		2.73	2.25		2.07	2.62		2.25	2.49	
e) A divisional discount rate	15.6	1.95	2.42	1.63	1.64	1.79	-	1.43	*[6] [(7)]	1.65	2.10		2.30	1.67	*[5]	1.63	2.21	*[5]	2.20	1.91	
i) A different discount rate for each component cash flow that has a different risk characteristic (for example, depreciation vs. operating cash flow vs debt service reserve account)	14.6	1.89	1.63	2.44	2.33	2.20	-	1.50		2.30	1.69	*[5]	1.76	1.98		1.84	1.84		2.30	1.83	

[1] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always; [2] The results of the banks are not considered in this analysis;
****, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively;*
[3] ANOVA; [4] t-test; [5] Welch's t-test; [6] Welch- and Brown-Forsythe-Test;[(7)] Not reliable for non-size characteristics (i.e. mean difference is dependent on size.

Table 48: Survey responses to the question 'When valuing RE projects, does your company adjust either the discount rate or cash flows for the following risk factors?' in relation to organisation type, country, company size, leverage of company and its stock exchange listing.

	Overall[1]			
	% Discount / return rate	% Cash flow	% Both	% Neither
c) Market risk	25.5	44.7	23.4	6.4
a) Weather-related volume risk	12.1	57.6	23.2	7.1
f) Operational risk	13.3	59.2	19.4	8.2
j) Interest rate risk	26.1	39.1	23.9	10.9
d) Political/regulatory risk [4]	45.8	25.0	16.7	12.5
i) Debt/equity ratio of RE project	29.4	34.1	18.8	17.6
e) Tax risk	31.5	29.2	14.6	24.7
q) Foreign exchange risk	33.7	26.7	14.0	25.6
k) Term structure risk	18.8	35.3	18.8	27.1
p) Commodity price risk	10.5	40.7	16.3	32.6
b) Other natural resource risk	10.0	43.3	11.7	35.0
g) Project termination risk	14.3	31.0	15.5	39.3
o) Risk of unexpected inflation	22.3	27.7	9.6	40.4
l) Complexity of organisational structure of investment	22.8	22.8	8.7	45.7
n) Credit standing of involved partners	26.1	16.3	10.9	46.7
m) Risk of subsidiaries not being under corporate control	18.1	18.1	9.6	54.2
h) Illiquidity of investment project	25.0	18.1	6.9	50.0
s) Size	31.8	10.6	4.7	52.9
r) Distress risk	27.9	10.5	8.1	53.5
t) 'Market-to-book' ratio	9.5	8.1	5.4	77.0
u) Momentum	5.6	4.2	8.5	81.7

[1] answer options: 1 = Discount rate / return rate; 2=Cash flow; 3= Both; 4= Neither;

***, * denotes a significant difference at the 5%, and 10% level, respectively,*

[2] based on Pearson χ^2 test or Fisher's exact test; [3] $|$standardized residual$|$ > 1.96; [4]excluding tax risk.

Table 48: (continued).

	Organisation type[1, 2]																								
	% Discount / return rate						% Cash flow						% Both						% Neither						
	Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors	Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors	Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors	Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors	
c) Market risk	30.0	33.3	25.0	27.8	0.0	14.3	40.0	33.3	58.3	38.9	60.0	57.1	27.5	22.2	8.3	16.7	4.0	28.6	2.5	11.1	8.3	16.7	0.0	0.0	
a) Weather-related volume risk	14.6	0.0	15.4	5.3	0.0	37.5	48.8	55.6	69.2	63.2	100.0	37.5	26.8	33.3	15.4	26.3	0.0	12.5	9.8	11.1	0.0	5.3	0.0	12.5	
f) Operational risk	20.0	0.0	16.7	5.3	0.0	25.0	50.0	50.0	75.0	73.7	80.0	50.0	20.0	30.0	8.3	21.1	20.0	12.5	10.0	20.0	0.0	0.0	0.0	12.5	
j) Interest rate risk	30.8	0.0	36.4	17.6	0.0	37.5	28.2	62.5	45.5	52.9	100.0[3]	12.5	20.5	37.5	18.2	29.4	0.0	25.0	20.5	0.0	0.0	0.0	0.0	25.0	**
d) Political/regulatory risk [4]	51.2	40.0	27.3	57.9	25.0	37.5	22.0	20.0	54.5	15.8	50.0	25.0	14.6	20.0	18.2	15.8	0.0	25.0	12.2	20.0	0.0	10.5	25.0	12.5	
i) Debt/equity ratio of RE project	24.3	0.0	36.4	50.0	25.0	37.5	29.7	57.1	45.5	35.7	75.0	12.5	21.6	28.6	0.0	7.1	0.0	37.5	24.3	14.3	18.2	7.1	0.0	12.5	
e) Tax risk	38.9	0.0	27.3	31.6	25.0	37.5	25.0	42.9	54.5	26.3	50.0	12.5	11.1	14.3	0.0	21.1	0.0	25.0	25.0	42.9	18.2	21.1	25.0	25.0	
q) Foreign exchange risk	34.2	33.3	20.0	37.5	33.3	42.9	26.3	22.2	50.0	25.0	33.3	14.3	13.2	33.3	10.0	6.3	0.0	14.3	26.3	11.1	20.0	31.3	33.3	28.6	
k) Term structure risk	19.4	0.0	20.0	12.5	0.0	50.0	27.8	37.5	60.0	31.3	100.0	25.0	16.7	37.5	0.0	31.3	0.0	12.5	36.1	25.0	20.0	25.0	0.0	12.5	
p) Commodity price risk	11.1	20.0	0.0	7.1	20.0	14.3	41.7	10.0	58.3	42.9	80.0	28.6	13.9	40.0	8.3	7.1	0.0	28.6	33.3	30.0	33.3	42.9	0.0	28.6	
b) Other natural resource risk	14.3	0.0	0.0	11.1	0.0	20.0	35.7	50.0	71.4	33.3	100.0	40.0	17.9	0.0	0.0	11.1	0.0	0.0	32.1	50.0	28.6	44.4	0.0	40.0	
g) Project termination risk	18.9	0.0	30.0	5.6	33.3	0.0	29.7	25.0	20.0	38.9	33.3	60.0	16.2	25.0	10.0	11.1	0.0	20.0	35.1	50.0	40.0	44.4	33.3	20.0	
o) Risk of unexpected inflation	25.0	22.2	25.0	11.1	20.0	28.6	22.5	22.2	50.0	22.2	60.0	28.6	7.5	22.2	0.0	16.7	0.0	0.0	45.0	33.3	25.0	50.0	20.0	42.9	
l) Complexity of organisational structure of investment	25.0	12.5	20.0	22.2	40.0	14.3	25.0	12.5	30.0	27.8	0.0	28.6	7.5	25.0	0.0	5.6	0.0	0.0	42.5	50.0	50.0	44.4	60.0	57.1	
n) Credit standing of involved partners	25.6	20.0	20.0	22.2	40.0	42.9	12.8	10.0	30.0	22.2	20.0	14.3	7.7	20.0	10.0	16.7	0.0	0.0	53.8	50.0	40.0	38.9	40.0	42.9	
m) Risk of subsidiaries not being under corporate control	13.9	10.0	10.0	28.6	20.0	40.0	19.4	10.0	40.0	7.1	20.0	20.0	13.9	10.0	0.0	7.1	0.0	0.0	52.8	70.0	50.0	57.1	60.0	40.0	
h) Illiquidity of investment project	19.4	0.0	37.5	40.0	33.3	40.0	16.1	37.5	37.5	0.0	33.3	20.0	6.5	12.5	0.0	6.7	0.0	0.0	58.1	50.0	25.0	53.3	33.3	40.0	
s) Size	40.0	0.0	22.2	20.0	50.0	42.9	7.5	14.3	33.3	13.3	0.0	0.0	5.0	0.0	0.0	6.7	0.0	0.0	47.5	85.7	44.4	60.0	50.0	57.1	
r) Distress risk	27.8	11.1	36.4	20.0	40.0	42.9	8.3	11.1	27.3	13.3	0.0	0.0	5.6	11.1	0.0	6.7	0.0	28.6	58.3	66.7	36.4	60.0	60.0	28.6	
t) 'Market-to-book' ratio	6.5	0.0	10.0	23.1	33.3	0.0	3.2	25.0	30.0[2]	0.0	0.0	0.0	3.2	12.5	0.0	7.7	0.0	0.0	87.1	62.5	60.0	69.2	66.7	100.0	*
u) Momentum	6.5	0.0	0.0	8.3	33.3	0.0	0.0	12.5	25.0	0.0	0.0	0.0	6.5	12.5	12.5	8.3	0.0	0.0	87.1	75.0	62.5	83.3	66.7	100.0	

[1] answer options: 1 = Discount rate / return rate; 2=Cash flow; 3= Both; 4= Neither;

***, * denotes a significant difference at the 5%, and 10% level, respectively,*

[2] based on Pearson χ^2 test or Fisher's exact test; [3] │standardized residual│ > 1.96; [4] excluding tax risk.

Table 48: (continued).

	Overall[1]				Country[1, 2]									Organisation size[1, 2]							
					% Discount / return rate		% Cash flow		% Both		% Neither			% Discount / return rate		% Cash flow		% Both		% Neither	
	% Discount / return rate	% Cash flow	% Both	% Neither	Switzer-land	Germany	Switzer-land	Germany	Switzer-land	Germany	Switzer-land	Germany		Large	Small	Large	Small	Large	Small	Large	Small
c) Market risk	25.5	44.7	23.4	6.4	29.3	20.0	41.4	48.6	22.4	25.7	6.9	5.7		31.6	23.5	47.4	41.2	18.4	25.5	2.6	9.8
a) Weather-related volume risk	12.1	57.6	23.2	7.1	16.7	5.3	51.7	65.8	23.3	23.7	8.3	5.3		17.9	9.1	56.4	56.4	17.9	27.3	7.7	7.3
f) Operational risk	13.3	59.2	19.4	8.2	16.7	8.1	58.3	59.5	18.3	21.6	6.7	10.8		15.4	13.0	56.4	61.1	17.9	20.4	10.3	5.6
j) Interest rate risk	26.1	39.1	23.9	10.9	31.6	14.7	31.6	52.9	21.1	29.4	15.8	2.9	**	25.0	27.5	38.9	37.3	22.2	25.5	13.9	9.8
d) Political/regulatory risk [4]	45.8	25.0	16.7	12.5	49.2	38.2	24.6	26.5	14.8	20.6	11.5	14.7		47.4	47.2	26.3	24.5	15.8	17.0	10.5	11.3
i) Debt/equity ratio of RE project	29.4	34.1	18.8	17.6	28.8	28.1	30.8	40.6	21.2	15.6	19.2	15.6		21.9	37.5	37.5	29.2	21.9	16.7	18.8	16.7
e) Tax risk	31.5	29.2	14.6	24.7	34.5	23.3	25.9	36.7	13.8	16.7	25.9	23.3		29.0	34.0	32.3	28.3	16.1	13.2	22.6	24.5
q) Foreign exchange risk	33.7	26.7	14.0	25.6	37.5	24.1	21.4	37.9	10.7	20.7	30.4	17.2		35.3	34.0	32.4	23.4	8.8	17.0	23.5	25.5
k) Term structure risk	18.8	35.3	18.8	27.1	20.0	13.8	30.9	44.8	16.4	24.1	32.7	17.2		14.7	23.9	41.2	28.3	17.6	19.6	26.5	28.3
p) Commodity price risk	10.5	40.7	16.3	32.6	9.4	12.1	39.6	42.4	15.1	18.2	35.8	27.3		8.8	10.6	50.0	36.2	11.8	19.1	29.4	34.0
b) Other natural resource risk	10.0	43.3	11.7	35.0	11.4	8.0	40.0	48.0	8.6	16.0	40.0	28.0		4.3	15.2	52.2	36.4	17.4	6.1	26.1	42.4
g) Project termination risk	14.3	31.0	15.5	39.3	13.5	15.6	30.8	31.3	17.3	12.5	38.5	40.6		13.8	14.0	34.5	30.0	17.2	14.0	34.5	42.0
o) Risk of unexpected inflation	22.3	27.7	9.6	40.4	23.7	17.6	23.7	35.3	8.5	11.8	44.1	35.3		22.2	22.6	33.3	24.5	5.6	11.3	38.9	41.5
l) Complexity of organisational structure of investment	22.8	22.8	8.7	45.7	25.9	15.2	24.1	21.2	5.2	15.2	44.8	48.5		22.2	23.5	22.2	23.5	5.6	9.8	50.0	43.1
n) Credit standing of involved partners	26.1	16.3	10.9	46.7	26.8	22.9	14.3	20.0	5.4	20.0	53.6	37.1		27.8	25.5	11.1	19.6	5.6	13.7	55.6	41.2
m) Risk of subsidiaries not being under corporate control	18.1	18.1	9.6	54.2	20.4	12.1	18.4	18.2	8.2	12.1	53.1	57.6		17.6	18.2	20.6	15.9	11.8	6.8	50.0	59.1
h) Illiquidity of investment project	25.0	18.1	6.9	50.0	24.4	25.9	15.6	22.2	4.4	11.1	55.6	40.7		16.7	30.2	16.7	18.6	8.3	4.7	58.3	46.5
s) Size	31.8	10.6	4.7	52.9	33.9	25.0	8.9	14.3	3.6	7.1	53.6	53.6		41.7	25.0	8.3	11.4	5.6	2.3	44.4	61.4
r) Distress risk	27.9	10.5	8.1	53.5	30.2	21.9	5.7	18.8	7.5	9.4	56.6	50.0		22.9	32.6	8.6	10.9	2.9	10.9	65.7	45.7
t) 'Market-to-book' ratio	9.5	8.1	5.4	77.0	8.5	11.1	6.4	11.1	2.1	11.1	83.0	66.7		6.7	10.3	6.7	7.7	3.3	5.1	83.3	76.9
u) Momentum	5.6	4.2	8.5	81.7	4.3	8.3	0.0	12.5[3]	6.4	12.5	89.4	66.7	**	6.9	2.7	0.0	5.4	6.9	8.1	86.2	83.8

[1] answer options: 1 = Discount rate / return rate; 2=Cash flow; 3= Both; 4= Neither;
*** denotes a significant difference at the 5%, level,*
[2] based on Pearson χ^2 test or Fisher's exact test; [3] │standardized residual│ > 1.96; [4]excluding tax risk.

Table 48: (continued).

	Overall[1]				Leverage of company[1, 2]									Stock exchange listing[1, 2]							
					% Discount / return rate		% Cash flow		% Both		% Neither			% Discount / return rate		% Cash flow		% Both		% Neither	
	% Discount / return rate	% Cash flow	% Both	% Neither	High	Low	High	Low	High	Low	High	Low		Listed	Not listed	Listed	Not listed	Listed	Not listed	Listed	Not listed
c) Market risk	25.5	44.7	23.4	6.4	31.0	29.8	34.5	44.7	20.7	23.4	13.8	2.1		46.2	24.7	30.8	45.2	23.1	21.9	0.0	8.2
a) Weather-related volume risk	12.1	57.6	23.2	7.1	13.8	14.6	55.2	56.3	20.7	25.0	10.3	4.2		23.1	11.7	61.5	54.5	7.7	26.0	7.7	7.8
f) Operational risk	13.3	59.2	19.4	8.2	10.7	18.8	67.9	56.3	14.3	20.8	7.1	4.2		30.8	11.8	46.2	60.5	15.4	19.7	7.7	7.9
j) Interest rate risk	26.1	39.1	23.9	10.9	29.6	25.5	40.7	34.0	18.5	25.5	11.1	14.9		41.7	23.6	25.0	40.3	16.7	25.0	16.7	11.1
d) Political/regulatory risk [4]	45.8	25.0	16.7	12.5	44.4	57.1	25.9	18.4	14.8	18.4	14.8	6.1		61.5	44.0	23.1	25.3	15.4	17.3	0.0	13.3
i) Debt/equity ratio of RE project	29.4	34.1	18.8	17.6	29.2	33.3	50.0	16.7	8.3	23.8	12.5	26.2	**	36.4	30.3	27.3	33.3	18.2	18.2	18.2	18.2
e) Tax risk	31.5	29.2	14.6	24.7	32.0	35.6	36.0	26.7	4.0	17.8	28.0	20.0		50.0	27.9	33.3	30.9	8.3	13.2	8.3	27.9
q) Foreign exchange risk	33.7	26.7	14.0	25.6	22.7	43.5	31.8	23.9	9.1	15.2	36.4	17.4		36.4	33.8	45.5	23.5	9.1	14.7	9.1	27.9
k) Term structure risk	18.8	35.3	18.8	27.1	12.5	25.0	33.3	36.4	16.7	18.2	37.5	20.5		27.3	17.9	18.2	35.8	18.2	19.4	36.4	26.9
p) Commodity price risk	10.5	40.7	16.3	32.6	7.1	14.6	50.0	36.6	10.7	17.1	32.1	31.7		7.7	10.4	30.8	43.3	15.4	16.4	46.2	29.9
b) Other natural resource risk	10.0	43.3	11.7	35.0	5.3	17.2	36.8	48.3	21.1	6.9	36.8	27.6		25.0	8.7	62.5	39.1	0.0	13.0	12.5	39.1
g) Project termination risk	14.3	31.0	15.5	39.3	25.0	12.2	25.0	29.3	4.2	24.4	45.8	34.1		25.0	12.5	25.0	31.3	16.7	15.6	33.3	40.6
o) Risk of unexpected inflation	22.3	27.7	9.6	40.4	11.1	31.3	33.3	20.8	11.1	8.3	44.4	39.6		33.3	20.0	25.0	28.0	0.0	10.7	41.7	41.3
l) Complexity of organisational structure of investment	22.8	22.8	8.7	45.7	16.0	27.7	20.0	25.5	8.0	6.4	56.0	40.4		25.0	22.5	16.7	22.5	8.3	7.0	50.0	47.9
n) Credit standing of involved partners	26.1	16.3	10.9	46.7	22.2	29.5	14.8	13.6	11.1	11.4	51.9	45.5		33.3	25.0	16.7	13.9	8.3	11.1	41.7	50.0
m) Risk of subsidiaries not being under corporate control	18.1	18.1	9.6	54.2	8.0	23.7	16.0	18.4	12.0	10.5	64.0	47.4		23.1	16.1	15.4	17.7	7.7	9.7	53.8	56.5
h) Illiquidity of investment project	25.0	18.1	6.9	50.0	33.3	28.6	19.0	14.3	4.8	8.6	42.9	48.6		33.3	24.1	16.7	16.7	16.7	3.7	33.3	55.6
s) Size	31.8	10.6	4.7	52.9	26.1	40.0	4.3	8.9	4.3	4.4	65.2	46.7		50.0	28.8	8.3	9.1	8.3	3.0	33.3	59.1
r) Distress risk	27.9	10.5	8.1	53.5	28.0	34.9	12.0	4.7	4.0	9.3	56.0	51.2		38.5	26.2	7.7	7.7	7.7	7.7	46.2	58.5
t) 'Market-to-book' ratio	9.5	8.1	5.4	77.0	5.0	13.2	0.0	7.9	5.0	5.3	90.0	73.7		20.0	6.9	10.0	5.2	0.0	5.2	70.0	82.8
u) Momentum	5.6	4.2	8.5	81.7	0.0	8.1	0.0	0.0	11.1	8.1	88.9	83.8		9.1	3.7	0.0	1.9	9.1	7.4	81.8	87.0

[1] answer options: 1 = Discount rate / return rate; 2=Cash flow; 3= Both; 4= Neither;
*** denotes a significant difference at the 5% level,*
[2] based on Pearson χ^2 test or Fisher's exact test. [3] $|$standardized residual$|$ > 1.96; [4]excluding tax risk.

Table 49: Survey responses to the question 'When valuing RE projects, does your company adjust either the discount rate or cash flows for the following risk factors?' in relation to materialised risk.

	Overall[1]				**Materialised risk[1, 2]**								
	% Discount / return rate	% Cash flow	% Both	% Neither	% Discount / return rate		% Cash flow		% Both		% Neither		
					Yes	No	Yes	No	Yes	No	Yes	No	
c) Market risk	25.5	44.7	23.4	6.4	25.7	33.3	45.7	33.3	21.4	27.8	7.1	5.6	
a) Weather-related volume risk	12.1	57.6	23.2	7.1	9.6	26.3	60.3	42.1	21.9	26.3	8.2	5.3	
f) Operational risk	13.3	59.2	19.4	8.2	11.0	27.8	61.6	44.4	19.2	22.2	8.2	5.6	
j) Interest rate risk	26.1	39.1	23.9	10.9	22.1	47.1	41.2	23.5	26.5	11.8	10.3	17.6	*
d) Political/regulatory risk [4]	45.8	25.0	16.7	12.5	46.5	52.6	25.4	21.1	15.5	21.1	12.7	5.3	
i) Debt/equity ratio of RE project	29.4	34.1	18.8	17.6	26.2	52.9	34.4	23.5	21.3	5.9	18.0	17.6	
e) Tax risk	31.5	29.2	14.6	24.7	28.1	44.4	35.9	11.1	12.5	16.7	23.4	27.8	
q) Foreign exchange risk	33.7	26.7	14.0	25.6	30.6	50.0	32.3	5.6	12.9	16.7	24.2	27.8	
k) Term structure risk	18.8	35.3	18.8	27.1	14.5	41.2	37.1	17.6	21.0	11.8	27.4	29.4	*
p) Commodity price risk	10.5	40.7	16.3	32.6	8.1	16.7	45.2	27.8	14.5	22.2	32.3	33.3	
b) Other natural resource risk	10.0	43.3	11.7	35.0	2.3	41.7[3]	46.5	25.0	11.6	8.3	39.5	25.0	***
g) Project termination risk	14.3	31.0	15.5	39.3	13.1	18.8	32.8	25.0	14.8	18.8	39.3	37.5	
o) Risk of unexpected inflation	22.3	27.7	9.6	40.4	20.3	31.6	30.4	15.8	8.7	10.5	40.6	42.1	
l) Complexity of organisational structure of investment	22.8	22.8	8.7	45.7	19.7	36.8	25.8	10.5	6.1	10.5	48.5	42.1	
n) Credit standing of involved partners	26.1	16.3	10.9	46.7	24.6	35.3	14.5	17.6	10.1	11.8	50.7	35.3	
m) Risk of subsidiaries not being under corporate control	18.1	18.1	9.6	54.2	13.3	35.3	18.3	11.8	10.0	5.9	58.3	47.1	
h) Illiquidity of investment project	25.0	18.1	6.9	50.0	21.2	42.9	19.2	7.1	7.7	0.0	51.9	50.0	
s) Size	31.8	10.6	4.7	52.9	28.8	45.0	8.5	10.0	3.4	5.0	59.3	40.0	
r) Distress risk	27.9	10.5	8.1	53.5	23.8	47.1	11.1	0.0	7.9	5.9	57.1	47.1	
t) 'Market-to-book' ratio	9.5	8.1	5.4	77.0	7.3	15.4	7.3	0.0	5.5	0.0	80.0	84.6	
u) Momentum	5.6	4.2	8.5	81.7	3.8	7.7	1.9	0.0	9.6	0.0	84.6	92.3	

[1] *answer options: 1 = Discount rate / return rate; 2=Cash flow; 3= Both; 4= Neither;*
****, * denotes a significant difference at the 1%, and 10% level, respectively,*
[2] *based on Pearson χ^2 test or Fisher's exact test;* [3] *|standardized residual| > 1.96;* [4]*excluding tax risk.*

Appendix 10 Details of Validity Check in QUAN Phase

A10.1 Non-Response Bias

The results of the test suggested by Wallace and Mellor (1988) show that mean answers between on time and late respondents are statistically only different for 4 (12 or 18) of those 118 questions at a 1.0% (5% or 10%) level. In addition, non-response bias is tested by comparing the results of respondents who finalised the survey or who failed to complete the survey, according to Whitehead et al. (1993), but still providing relevant data for analysis. This analysis includes 96 questions to be compared of which only 4 (7 or 21) differ at 1.0% (5% or 10%) significant level. Since there are only a few significant differences, we conclude that our sample is representative of the researched population.

Based on χ^2 goodness-of-fit analysis in line with the recommendation of Moore and Reichert (1983), it has been found that the sample is in total representative for the overall universe of firms German and Swiss population involved in RES-E investments. However, there are some restrictions, comparing the subsample Germany with the population, due to the fact that the group of utility companies has not been adequately represented in the survey. This can be explained by the low response rate (12.5%) from German utility companies in this study, showing either less interest in the topic, no interest in benchmarking their methods with others or withholding their experiences from being shared for academic purposes.

A10.2 Non-Size Characteristics

A one-way ANOVA is applied to check the reliability for non-size characteristics, including organisation types, leverage, stock exchange listing and country. Size of organisations can be correlated with those factors, by splitting the sample into large versus small firms and checking each of those factors separately. If the reliability of the factors is not confirmed, i.e. organisation size has a strong influence on the considered factors and accordingly, the mean differences of non-size IV are significantly influenced by the size, it is correspondingly marked in the tables for those data with mean differences at 10% significance level and lower and not reported in writing within the paper.

A10.3 Robustness in Relation to Education and Experience

The robustness of the answers are checked in relation to the participants' understanding of the topic and professional experience. This robustness check is passed if the methods suggested by finance theory are applied significantly more often by MBA-educated and/or high M&A-experienced participants.

In general, the results in Table 50 confirm the reliability of the capital budgeting technique results based on this performed robustness check. All, except a few methods (e.g. PB, PI and VaR), show a higher rate for participants with MBA degree and higher experience. However, only a few of them are significant. Scenario analysis shows a low significant dependency with a medium strength for the subgroups MBA based educations while the application of equity and project return rate present a low to medium significant strength in relation to experienced participants. These results confirm the robustness of the performed survey in respect to the participant's understanding of the topic, i.e. the respondents understand the surveyed topic. Less experienced participants show a tendency to apply PB more frequently than more experienced participants, but not significantly. However, the method PI seems not be understood by low experienced participants since it is significantly more applied by this group within the sample. Similarly peculiar, VaR shows a significantly higher application rate by low experienced participants. These results cannot be explained and is regarded as less reliable, although their low application rate is probably valid.

The robustness check for general CoC methods (Table 51) shows only one significant results for CAPM, confirming that participants' with a profound business administration education apply more frequently this method, propagated by financial theory. The extensive us of CAPM by respondents who went through an MBA is also supported by the finds of Jagannathan and Meier (2002) who suspects that MBA graduates might be biased in favour of taught methods, such as CAPM, used in investment decisions. In contrast to this results, the method "whatever our investor tell us they require" as cost of capital is more often applied by non-MBA-educated and low experienced participants, although not significantly, still indicating the tendency of those two subgroups to rely on predefined return rates.

The robustness check for the application of discount rates (Table 52) can also be regarded as passed since the more appropriated methods according to theory, such as RADR concept, and country and technology specific discount, are applied more often by MBA-educated and more experienced participants, but not always significantly. On the other hand, the less appropriate methods according to theory, such as discount rate based on cost of finance or based on past experience are applied significantly more frequently by non-MBA-educated and less experienced participants. The latter results is quite particular since less experienced participants apply discount rates only on few past experiences. Although not significant, the results for the application of "The discount rate for our entire company" in RES-E investment valuation show higher frequency for MBA-educated and M&A-experienced respondents are rather surprising.

In Table 53, the robustness for dependency between the DCF techniques in terms of understanding the topic is checked. Investing the results in section 5.2.2.3 in relation to the set educational criteria, the MBA-educated participants show a tendency to use DCF more often as underlying techniques (Table 2.1) while only DCF in relation to IRR and NPV shows higher application rates, significant however only for IRR (Table 2.4). This shows again the better understanding of MBA-educated participants for the surveyed topic, as anticipated and confirming the liability of the survey.

Table 50: Robustness check of capital budgeting techniques in terms of education and experience.[1]

	% almost always (4) and always (5)[2]	Arithmetic mean	Education (% almost always (4) and always (5)[2])			Experience in M&A (% almost always (4) and always (5)[2])		
			MBA-educated participants	Non-MBA-educated participants	[1, 3]	High [5]	Low [5]	[1, 3]
d) Internal rate of return	92.4	4.70	95.2	91.9		94.6	89.7	
b) Discounted cash flow	88.3	4.56	95.0	86.3		89.3	86.5	
c) Net present value	79.8	4.35	81.0	78.1		80.4	76.3	
n) Scenario analysis (for example, base case, worst case, and best case)	79.4	4.26	90.5	77.5	0.316*	83.9	75.0	
m) Sensitivity analysis	75.7	4.04	81.0	75.0		83.6	65.8	
a) Cash flow projection/FCFF approach	73.3	4.17	71.4	75.3		76.8	71.1	
f) Estimate cost of equity capital of project (equity return rate)	65.0	3.82	71.4	65.2		74.5	54.3	0.210**
e) Hurdle rate of return	63.9	3.79	70.0	62.7		66.7	60.6	
g) Estimate total cost of capital of project (project return rate)	62.7	3.78	76.2	60.6		75.0	47.2	0.283***
j) Payback period	44.4	3.10	33.3	47.1		37.7	52.8	
h) Multiple approach	39.4	3.00	52.5	33.3		38.8	37.1	0.206**
p) Valuing opportunities and synergy possibilities	24.0	2.64	20.0	24.2		25.5	20.0	
o) Simulations (for example, Monte Carlo simulations)	12.2	1.94	9.5	11.9		10.7	12.5	
i) Profitability index	10.9	1.90	9.5	8.2		4.1	15.2	-0.194*
l) Real options	10.8	1.76	14.3	8.1		12.0	6.1	
k) Value at risk	8.2	1.90	9.5	4.5		1.9	11.8	-0.207*

*[1] Index of mean square contingency (phi coefficient). [2] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always; ***, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively; [3] Pearson χ^2 test [4] Fisher's exact test. [5] High: participants performed ≥ 10 transactions, low: participants performed < 10 transactions.*

Table 51: Robustness checks in relation to CoC methods in terms of education and experience.[1]

	% almost always (4) and always (5)[2]	Arithmetic mean	Education (% almost always (4) and always (5)[2])			Experience in M&A (% almost always (4) and always (5)[2])		
			MBA-educated participants	Non-MBA-educated participants	1, 3	High [5]	Low [5]	1, 3
l) Weighted average cost of capital of our company	67.0	3.74	70.0	69.1		67.9	71.4	
k) Discount rates are at least as high as defined hurdle rates	59.0	3.49	62.5	60.9		64.0	56.7	
a) Formal risk analysis	57.3	3.63	68.4	53.7		63.5	47.1	
m) Benchmarking approaches with comparable companies or comparable investments	43.2	3.30	52.6	42.4		46.2	42.4	
b) Capital asset pricing model	35.3	2.85	52.6	31.7	0.183*	40.0	31.2	
f) Current market return adjusted for risk	31.0	2.50	35.3	28.1		26.5	34.4	
g) Discount rates set by regulatory decisions	29.4	2.51	29.4	30.8		32.0	28.1	
j) Cost of debt plus a risk premium	27.6	2.72	23.5	29.9		33.3	21.2	
i) Earnings/price ratio	25.9	2.46	31.6	25.4		26.5	27.3	
n) Whatever our investors tell us they require	23.3	2.63	14.3	23.2		16.7	28.6	
c) Modified CAPM including additional extra risk factors	20.3	2.20	35.3	16.9		25.0	14.3	
e) Average historical returns on common stock (historical market return)	17.3	2.15	17.6	16.4		14.6	20.0	
h) Dividend discount model (for example, current/historical dividend yield plus an estimate of growth or dividend yield estimate only)	8.6	1.88	11.1	8,3		8.3	10.0	
o) Certainty equivalent method	9.2	1.77	9.1	9,4		9.5	9.1	
d) Multifactor models (for example, ATP)	0.0	1.48	0.0	0.0		0.0	0.0	

*[1] Index of mean square contingency (phi coefficient). [2] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always; ***, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively; [3] Pearson χ^2 test [4] Fisher's exact test. [5] High: participants performed ≥ 10 transactions, low: participants performed < 10 transactions.*

Table 52: Robustness checks in relation to CoC methods, in particular about the application of discount rates, in terms of education and experience.[1]

	% almost always (4) and always (5)[2]	Arithmetic mean	Education (% almost always (4) and always (5)[2])			Experience in M&A (% almost always (4) and always (5)[2])		
			MBA-educated participants	Non-MBA-educated participants	[1, 3]	High [5]	Low [5]	[1, 3]
b) A specific discount rate for the considered country (country discount rate)	65.9	3.86	78.9	64.3		77.4	52.8	0.257**
c) A specific discount rate for the applied technology / concerned industry	60.0	3.59	61.9	59.1		62.3	55.9	
d) A specific discount rate for the concerned project stage (for example, planning/designing, financing, building, and operating)	52.2	3.26	50.0	54.3		57.4	47.2	
f) A RADR for this particular project	44.4	3.01	52.6	42.6		49.1	38.2	
g) A discount rate based on our cost of financing	34.1	2.73	15.8	40.0	-0.208**	33.3	37.1	
h) A discount rate based on our past experience	31.5	2.75	26.3	33.8		23.1	45.7	-0.237**
a) The discount rate for our entire company	23.5	2.44	38.9	22.9		32.0	18.4	
e) A divisional discount rate	15.6	1.95	18.8	15.3		15.2	17.2	
i) A different discount rate for each component cash flow that has a different risk characteristic (for example, depreciation vs. operating cash flow vs debt service reserve account)	14.6	1.89	16.7	12.9		16.3	9.7	

*[1] Index of mean square contingency (phi coefficient). [2] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always; ***, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively; [3] Pearson χ^2 test [4] Fisher's exact test. [5] High: participants performed ≥ 10 transactions, low: participants performed < 10 transactions.*

Table 53: Robustness check for dependency between the DCF techniques in terms of understanding the topic.

	% almost always (4) and always (5)[1]	Arithmetic mean	**In case of % almost always (4) and always (5) for following methods[2]** d) Internal rate of return	c) Net present value	i) Profitability index	j) Payback period	g) Estimate total cost of capital of project (project return rate)	f) Estimate cost of equity capital of project (equity return rate)	l) Real options	k) Value at Risk	h) Multiple approach	e) Hurdle rate
b) Discounted cash flow	88.3	4.56	89.5	93.8***[3]	88.9	85.4	90.3	92.1	88.9	100.0	86.1	90.3
Subgroup 'MBA-educated'			95.0***	100.0	100.0	100.0	93.3	92.9	100.0	100.0	100.0	92.9
Subgroup 'non-MBA-educated'			87.9	92.7***[3]	80.0	88.3	88.1	90.9	80.0	100.0	76.2	90.5

*[1] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always; ***, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively; [2] Pearson χ^2 test [3] Fisher's exact test.*

A10.4 Robustness for Discount Rate Definition

In respect how to apply WACC according to finance theory (Ehrhardt and Brigham, 2016), the robustness of the results in relation to applying WACC and a single discount rate for the entire company are confirmed, showing a quite strong and significant correlation (r= 0.449, p=0.000, n= 84) between the two outcomes (Table 54), while applying WACC and divisional discount rates has a medium to strong and significant correlation (r= 0.404, p=0.000, n= 74), applying WACC and a discount rate based on the company's cost of financing has a medium correlation strength (r=0.285, p=0.007, n=87) and applying WACC to the other provided discount rate definitions in the table show only weak correlation strengths. Based on the fact that a WACC is applied in connection with setting a discount rate for the entire company or less strong also for separated divisional discount rates, the robustness of the survey in relation to discount rate definition is confirmed. Interestingly are the medium correlation strength results between applying WACC and country-specific and technology-/industry-specific discount rates. This indicates that certain firms might apply WACC specifically for certain countries and technologies/industries.

Table 54: Robustness check of discount rates answers in relation to application of WACC.

	Results of analysis	**Results of correlation analysis**[1]			
	% almost always (4) and always (5)[2]	r	p	n	Effect
Weighted average cost of capital of our company [3]	67.0	-	-	-	-
A specific discount rate for the considered country (country discount rate) [4]	65.9	0.281	0.009	86	medium
A specific discount rate for the applied technology / concerned industry [4]	60.0	0.358	0.001	86	medium
A specific discount rate for the concerned project stage (for example, planning/designing, financing, building, and operating) [4]	52.2	0.076	0.485	86	weak
A RADR for this particular project [4]	44.4	0.137	0.208	86	weak
A discount rate based on our cost of financing [4]	34.1	0.285	0.007	87	medium
A discount rate based on our past experience [4]	31.5	0.125	0.258	84	weak
The discount rate for our entire company [4]	23.5	0.449	0.000	84	quite strong
A divisional discount rate [4]	15.6	0.404	0.000	74	medium to strong
A different discount rate for each component cash flow that has a different risk characteristic (for example, depreciation vs. operating cash flow vs debt service reserve account) [4]	14.6	0.111	0.328	80	weak

[1] Correlation according to Pearson's product-momentum correlation and Spearman's rank order correlation (r: correlation coefficient, p: significance level, n: sample size), lower of both coefficients is shown; [2] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always; [3] Survey response to the question "How frequently does your company use the following techniques and/or approaches in determining cost of equity or discount rates when valuing RE investments?"; [4] Survey response to the question "How frequently does your company use the following discount rates when valuing a new RE investment project?"

A10.5 Reliability Analysis with Cronbach's Alpha

Reliability analysis are carried out to check the internal consistency of items, i.e. to check whether a group of questions in the survey reliably measure the same latent variable. In order to use the measurement scales it is important that the reliability as well as the validity needs to be demonstrated (Cronbach, 1951, how2stats, 2011a, Tavakol and Dennick, 2011, Copur, 2015). Cronbach's alpha is a popular test if Likert-type scales are applied (Grande, 2014a). It is about understanding whether the questions in a group of questions in the survey all reliably measure the same latent variable, i.e. risk awareness or application frequency of methods in practice (Laerd Statistics, 2013). Nunnally (1978) recommends the value of Cronbach's alpha to be at least 0.7 to show internal consistency. Cronbach's alpha is higher if the data normally distributed. (Grande, 2014a). Table 55 summaries the results showing that only those questions in the group of questions about assessing the general risk cannot be regarded as internally reliable.

Table 55: Internal reliability test with Cronbach's Alpha.

Items to be tested for following question group	Cronbach's Alpha	Number of items	Internal reliability
How frequently does your company use the following techniques when deciding which RE projects / acquisitions to pursue?	0.850	16	good
How would you rate the significance of each of the following types of risk to your company's RE projects?	0.696	10	acceptable
In general, how would you assess the overall degree of risk associated with each of the following stages of planning, building and operating RE power plants?	0.535	7	poor
How frequently does your company use the following techniques and/or approaches in determining cost of equity or discount rates when valuing RE investments?	0.830	15	good
How frequently does your company use the following discount rates when valuing a new RE investment project?	0.744	9	acceptable

A10.6 Other Issues Related to Survey Data

As control variables for capital budgeting techniques, the usage of cash flow projection/FCFF and DCF—both underlying techniques for various other methods, including IRR and NPV—are evaluated, finding several dependencies between the underlying technique of certain methods (e.g. DCF in case of NPV, Table 56). Table 57 and Table 58 illustrate the same results in relation to the firm's characteristics, domicile and project stages. Only for cash flow projection/FCFF in relation to project stages could significant mean differences be found.

In addition, Table 59 puts applying past experience for defining discount rates in relation to the alternative approaches, applying the above introduced Pearson's correlation.

Table 56: Dependency between various capital budgeting techniques.

	% almost always (4) and always (5)[1]	Arithmetic mean	In case of % almost always (4) and always (5) for following methods[2]: d) Internal rate of return	c) Net present value	i) Profitability index	j) Payback period	g) Estimate total cost of capital of project (project return rate)	f) Estimate cost of equity capital of project (equity return rate)	l) Real options	k) Value at Risk	h) Multiple approach	e) Hurdle rate
b) Discounted cash flow	88.3	4.56	89.5	93.8***[3]	88.9	85.4	90.3	92.1	88.9	100.0	86.1	90.3
a) Cash flow projection / FCFF approach	73.3	4.17	75.0	74.1	80.0	74.4	85.9***[2]	84.6***[2]	80.0	87.5	83.8	79.0*[2]
f) Estimate cost of equity capital of project (equity return rate)	65.0	3.82	69.6***[3]	69.2	100.0**[3]	64.3	93.7***[2]	-	90.0*[3]	100.0**[3]	78.4**[2]	75.4***[2]

*[1] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always; ***, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively; [2]* Pearson χ^2 test *[3] Fisher's exact test.*

Table 57: Survey responses to the question "How frequently does your company use the following techniques when deciding which RE projects / acquisitions to pursue?" in relation to organisation type, country, company size, leverage of company and its stock exchange listing (arithmetic mean).

	% almost always (4) and always (5)[1]	Arithmetic mean	Organisation type[2]						Country[3]		Company size[3]		Leverage of company[3]		Stock exchange listing[3]	
			Utility	Project developer	IPP	Institutional investors	Banks	Financial advisors	Germany	Switzerland	Large	Small	High	Low	Listed	Not listed
b) Discounted cash flow	88.3	4.56	4.68	4.60	4.36	4.58	3.80	4.50	4.53	4.58	4.70	4.45	4.47	4.67	4.67	4.52
a) Cash flow projection / FCFF approach	73.3	4.17	3.98	4.18	4.13	4.63	5.00	3.75	4.15	4.17	4.12	4.24	4.23	4.21	4.14	4.21

*[1] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always; ***, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively; [2] ANOVA; [3] t-test.*

Table 58: Survey responses to the question "How frequently does your company use the following techniques when deciding which RE projects / acquisitions to pursue?" in relation to the investment focus concerning project stages (arithmetic mean).

	% almost always (4) and always (5)[1]	Arithmetic mean	Type of project stages[2]									
			Greenfield projects (starting project from scratch)	Brownfield projects (project based on prior work)	Projects just before receiving building and operating permit	Ready-to-build projects (all necessary building and operating permits available)	Projects just starting operating phase	Power plants with 1 to 2 years in operation	Power plants with 3 to 5 years in operation	Power plants with 6 to 10 years in operation	Power plants with more than 10 years in operation	Power plants with the focus on repowering / retrofitting
b) Discounted cash flow	88.3	4.56	4.49	4.61	4.46	4.64	4.65	4.64	4.71	4.69	4.75	4.45
a) Cash flow projection / FCFF approach	73.3	4.17	3.97*[3]	4.18	4.16	4.27	4.37	4.49***[3]	4.41	4.80***[3]	4.69**[3]	4.50

*[1] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always; ***, **, * denotes a significant difference at the 1%, 5%, and 10% level, respectively. [2] t-test; [3] Welch-test*

Table 59: Application of discount rates in relation to applying past experiences in discount rate definition.

	Results of analysis	Results of correlation analysis[1]			
	% almost always (4) and always (5)[2]	r	p	n	Effect
A discount rate based on our past experience [4]	31.5	-	-	-	-
Weighted average cost of capital of our company [3]	67.0	0.125	0.258	84	weak
A specific discount rate for the considered country (country discount rate) [4]	65.9	0.007	0.953	86	weak
A specific discount rate for the applied technology / concerned industry [4]	60.0	0.163	0.133	86	weak
A specific discount rate for the concerned project stage (for example, planning/designing, financing, building, and operating) [4]	52.2	0.322	0.002	87	medium
A RADR for this particular project [4]	44.4	0.386	0.000	88	medium
A discount rate based on our cost of financing [4]	34.1	0.424	0.000	88	medium to strong
The discount rate for our entire company [4]	23.5	0.158	0.147	86	weak
A divisional discount rate [4]	15.6	0.187	0.107	75	weak
A different discount rate for each component cash flow that has a different risk characteristic (for example, depreciation vs. operating cash flow vs debt service reserve account) [4]	14.6	0.328	0.003	80	medium

[1] Correlation according to Bravais-Pearson (r: correlation coefficient, p: significance level, n: sample size); [2] answer options: 1 = never; 2=Almost never; 3= Sometimes; 4= Almost always; 5=Always; [3] Survey response to the question "How frequently does your company use the following techniques and/or approaches in determining cost of equity or discount rates when valuing RE investments?"; [4] Survey response to the question "How frequently does your company use the following discount rates when valuing a new RE investment project?"

Appendix 11 QUAL result tables

Table 60: Categorised code matrix indicating the findings about missing or inadequate as well as key information for valuing RES-E investment projects, based on the discussion of the provided investment scenario (FiT: Feed-in tariff, OPEX: operational expenditures).

No.	Themes/categories	Participant no.																#
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
01	Missing or inadequate information																	
01.1	Resource assessments and data				■	■		■							■			4
01.2	Market value of electricity production																■	1
01.3	Supplier/manufacturer of technology and type of engine	■	■	■	■	■	■	■		■		■		■		■	■	12
01.4	OPEX details, influences, and compensation measurements	■	■	■	■	■		■	■	■		■		■			■	11
01.5	Details about service agreement, service suppliers, and credit rating			■		■		■			■	■		■			■	7
01.6	Stakeholder information		■												■		■	3
01.7	Grid situation				■							■					■	3
01.8	Financing details, including name of bank		■	■						■								3
01.9	Project structuring details (including company form)									■								1
01.10	Cash flow model			■						■			■		■			4
01.11	Scenario description details					■					■							2
01.12	Purchase price (vs. value), price negotiation scope, and SPA details						■				■		■					3
01.13	Details about existing portfolio and investment strategy						■			■								2
01.14	Developer's/seller's name and counterpart risk				■	■	■	■		■			■					6
01.15	Due diligence process, including involved parties							■										1
02	Key information for valuing projects																	
02.1	Resource: volatility, distribution, and power		■			■		■	■	■			■		■	■	■	9
02.2	Annual production	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	15
02.3	Hub height								■								■	2
02.4	Full load hours								■							■		1
02.5	Stake in project/SPV vs. its size		■						■								■	3
02.6	FiT / PPA price in relation to credit rating (country/counterpart) and FiT/ PPA period		■		■	■	■		■	■	■						■	8
02.7	Power price assumption after FiT/ PPA period					■			■								■	3
02.8	Length of project and valuation period		■			■									■		■	4
02.9	Maintenance and management service concepts (including contract length)	■	■		■				■			■	■	■			■	8
02.10	Market value of produced electricity (site attractiveness)	■										■				■	■	4
02.11	Financial information (leverage/ gearing, DSCR, and DSRA)	■	■	■				■		■				■				6
02.12	Summary of performed DD outcomes							■						■				2
02.13	Installed capacity in relation to set objectives					■		■	■					■				4
02.14	Transaction probability (deal certainty)		■				■			■		■	■	■				6
03	Less relevant information																	
03.1	Full load hours		■											■			■	3
03.2	Average wind speed		■														■	2
03.3	Hub height and rotor diameter		■															1
03.4	Transaction probability (deal certainty)					■									■			2
03.5	The WACC of investing company									■								1

Table 61: Categorised code matrix regarding general findings about valuation.

No.	Themes/categories	Participant no.																#
		1		3	4	5	6	7	8	9	10	11	12	13	14	15	16	
01	Suitability of method with regard to the investor's objectives and perspectives	■		■		■												3
02	Suitability of method for market communication while still appro-priately considering the main risks			■								■						2
03	Comprehensibility of applied methods for both transaction parties (sellers and buyers)			■					■									2
04	Existence of project-specific characteristics and different interests/perspectives between seller and acquirers					■			■									2
05	Comprehensibility of applied method for decision makers										■						■	2
06	Deduce a price from the valuation procedure	■		■														2
07	Consistency in method application to ensure comparison with historical projects																■	1
08	Sophisticated methods are mostly too complicated in practice										■	■						2
09	Risk of applying spurious accuracy within valuations									■		■						2
19	Different perspectives about optimal methods in theory and practice									■								1
11	Most appropriate and correct method is defined by the market									■	■			■				3
12	Risk of concentrating on valuation techniques while neglecting focus on essential negotiation process										■							1
13	Standardisation of valuation input data necessary to compare projects and compared to set hurdle rate	■																1

*Table 62: Categorised code matrix regarding the application of numerical capital budgeting techniques for the valuation of RES-E investments (*encountered while discussing the investment scenarios; grey cells: applied / agreed with).*

No.	Themes/categories	Participant no.																#
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
01	The DCF-based approaches																	
01.1	The DCF as a state-of-the-art approach for RES-E project investment valuation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	16
01.2	The DCF as an established method based on agreement between valuation and accounting domain										■							1
01.3	The DCF applied for project-specific valuation and known project details					■					■							2
01.4	Different DCF-based approaches available and applied	■	■	■			■		■	■		■				■	■	9
01.5	Ex-ante vs. ex-post valuation	■				■											■	3
02	Suitability of the IRR																	
02.1	The IRR as main valuation method	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	16
02.2	Awareness of restrictions of the IRR method										■							1
02.3	The IRR not appropriate for project developers					■												1
02.4	The IRR optimal for market communication					■			■		■	■						4
02.5	The IRR suitable to compare with the hurdle rate	■		■						■			■	■	■	■		7
02.6	The IRR as optimal tool to compare investments												■	■				2
02.7	Transparency of assumption within valuation									■								1
03	Suitability of the NPV																	
03.1	The NPV applied by project developers					■	■											2
03.2	The NPV suitable for value contribution to investing firm and impairment tests																■	1
04	Relevant cash flow levels																	1
04.1	Focus on the FTE approach	■			■	■			■	■	■		■	■	■	■	■	11
04.2	Entity approach, such as the WACC approach, not optimal	■		■														2
04.3	Combination of equity and entity approaches		■	■		■					■							4
04.4	Valuating an entity approach with an artificial all-equity project								■									1
04.5	Focus on entity approach before equity approach											■						1
05	Distribution potential to equity investors																	1
05.1	Distribution potential considered as relevant		■	■		■	■		■	■	■	■	■	■		■	■	12
05.2	Output IRR already applied								■									1
05.3	Output IRR calculation is not relevant					■												1
05.4	Output IRR implementation is planned													■		■	■	3
06	Certainty equivalent method																	
06.1	Known concept	■			■	■			■			■						5
06.2	Critical view		■						■		■		■					4
06.3	Regarded as interesting concept	■			■	■	■		■	■								6
07	Profitability index																	
07.1	Known concept	■											■					2
07.2	Regarded as interesting concept			■	■													2

Table 62: (continued).

08	The RES-E-specific multiples																	
08.1	Known concept																	16
08.2	Not applied as a single method, only as a complementary method																	9
08.3	Applied for benchmarking/screening purposes													*	*	*		9
09	The PB																	
09.1	Known concept																	16
09.2	Applied as risk measurement							*										7

*Table 63: Categorised code matrix regarding the application of judgmental assessments (i.e., applied methods and factors considered) in the valuation of RES-E project investments; *encountered while discussing the investment scenarios, grey cells: applied / agreed with).*

No.	Themes/categories	Participant no.																#
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
01	Evidence for qualitative assessments in RE valuation																	
01.1	Judgement assessment applied					*	*					*			*			15
01.2	No explicit application of qualitative assessment methodology reported																	2
01.3	Assessment method for risk and qualitative factors developed						*											3
02	Due diligence and transaction process																	
02.1	Due diligence results must be available to grasp the investment challenges qualitatively											*						1
02.2	What-if method applied for assessing DD results qualitatively																	1
02.3	Probability of investment success is valuable qualitative information in transactions			*	*	*	*		*	*		*	*					8
02.4	Past experience of sellers and acquirers									*								4
03	Key characteristics of RES-E projects																	
03.1	Quality of resource assessment																	2
03.2	Attractiveness of production site and applied technology																	3
03.3	Experience at production site and with type of technology																	2
03.4	Quality of contracts and quality and reliability of partners					*												6
03.5	Assessment approach of country and regulatory risks																	3
03.6	Assessment of return rates in relation to leverage																	1
04	Synergies, upside potential, existing portfolio, and diversification																	
04.1	Assessment of synergies mainly in the investment screening process																	2
04.2	Assessment of synergies is possible in the detailed valuation process																	5
04.3	Assessment of upside potentials (opportunities)															*		7
04.4	Experience/influence of existing portfolio																	3
04.5	Influence of diversification																	1

*Table 64: Categorised code matrix regarding the application of CoC approaches for the valuation of RES-E project investments (*encountered while discussing the investment scenarios; **reports observation, i.e., not applied by participant; grey cells: applied / agreed with).*

No.	Themes/categories	Participant no.																#
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
01	Discount rate																	
01.1	Discount rates indicate what can be earned in the market for comparable projects																	1
01.2	Discount rates as indicators of compensation for taking risks																	2
01.3	Discount rates are market price indicators																	1
01.4	Necessity of matching discount rate with certainty level of cash flow streams																	2
02	Equity and/or total CoC																	
02.1	Leveraged equity return rate																	15
02.2	Equity-only return rate or unleveraged equity return rate												**					2
02.3	Project return rate / total CoC	*	*	*	*							*				*		6
02.4	The WACC of the investing company is not relevant for the discount rate setting of RES-E investments																	4
03	Setting discount rates																	
03.1	Setting discount rates based on theoretical concepts (CAPM, beta factors, and pure-plays)																	1
03.2	Setting discount rates based on theoretical concepts (CAPM, beta factors, and indirect approach)																	1
03.3	The CAPM is not regarded as applicable for RES-E investments, since it ignores relevant unsystematic risks																	2
03.4	Setting discount rates with market sounding																	7
04	Hurdle rate																	
04.1	Hurdle rate as hard cut-off line																	6
04.2	Hurdle rate as reference value									**		**						5
04.3	Hurdle rates by country, technology and/or project stages, and/or business units																	3
04.4	Only one single hurdle rate																	3
04.5	Hurdle rate application: equity IRR must be greater than hurdle rate									**								5
04.6	Hurdle rate application: hurdle rate plus buffer																	1
04.7	Hurdle rate set by corporate bond																	
5	Risk-adjusted discount rates																	
05.1	The RADR as a supplementary approach to hurdle rates																	2
05.2	Application of RADRs instead of hurdle rates																	2
05.3	Necessity to define appropriate RADRs for relevant unsystematic risks																	1
05.4	Base with market sounding plus certain risk premiums																	1
06	Static to dynamic discount rates																	
06.1	Static discount rate as predominantly applied approach																	2

Table 65: Categorised code matrix about risk considerations in valuation (grey cells: applied / agreed with).

No.	Themes/categories	Participant no.																#
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
01	Risk mitigation in valuation																	
01.1	Risk mitigation according to project structure standardisation																	5
01.2	Risk mitigation measures implemented																	16
01.3	Risk mitigation is regarded as beneficial for valuation processes																	2
01.4	Specific issues with risk mitigation measures within valuations																	2
02	Valuation adjustments for risk																	
02.1	Focus on quality of cash flows																	2
02.2	Risk is predominantly considered in cash flow streams																	4
03	Risk components																	
03.1	Natural resources considered as some of the main value drivers	*	*	*		*		*	*	*			*	*	*	*	*	15
03.2	Time component of risk																	3
03.3	Differentiation between systematic and unsystematic risks																	8
03.4	Diversification potential of unsystematic risk																	3
03.5	Portfolio diversification applied																	5
04	Risk assessment																	
04.1	Scenario and sensitivity analyses and simulations																	16
04.2	Repayment potential (for example, distribution profile, PB)																	9
04.3	Benchmarking																	1
04.4	Formal risk analysis																	6
05	Understanding risk and risk preferences																	
05.1	Risk-averse investor and focus mainly on downside risk																	2
05.2	Defining risk appetite in executive committees																	2
05.2	Different risk considerations between seller and acquirer																	1
05.3	Discount rates compensated for taking risk, but only the ones still available																	1
06	Explanation for puzzling QUAN results																	
06.1	Explanation regarding difference in component risks in relation to project stages																	4

Table 66: Categorised code matrix about influence factors in valuation processes (grey cells: applied / agreed with).

No.	Themes/categories	Participant no.																#
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
01	Risk and return																	
01.1	Risk attitude																	3
01.2	Risk appetite																	2
01.3	Favourability of risk-return profile																	2
01.4	Risk diversification																	10
02	Investment pressure																	
02.1	High liquidity																	2
02.2	Entrance of young investment vehicle																	4
02.3	Search for higher/high return rates																	1
03	Market forces																	
03.1	Balance of supply and demand																	3
03.2	Attractiveness of investment area																	2
03.3	Valuating too optimistically																	2
03.4	Checking market with periodic binding offers																	2
03.5	Rethinking return rates and certain cash flow streams																	1
03.6	Regulation affecting supply area/chain and supply/demand balance																	1
04	Involved parties																	
04.1	Experiences of transaction parties																	7
04.2	Transaction security																	2
04.3	Acting persons behind contracts																	2
04.4	Communication process in transaction (information asymmetry between sellers and acquirers)																	1
04.5	Investment team composition																	1
05	Personal interests, incentives, and bias																	
05.1	Incentives and benefits (personal interest)																	1
05.2	Conflict of interest																	1
05.3	Mandate bias																	2
06	Investor and investment strategy																	
06.1	Investor's motive for investment																	5
06.2	Target characteristics																	16
06.3	Diversification grade of firm/investor																	12
06.4	Diversification requirements/strategy																	1
06.5	Investor's risk management processes																	3

Figure 58: Results from the inferences process (screenshot from nVivo10™).

Inferences

	A : Inference type	B : Additional explanatio...
1 : APV approach	Complementary	-
2 : 01 Applied capital budgeting approaches	-	-
3 : 01.1 Numererical capital budgeting techniques	-	-
4 : 01.11 DCF is the main method applied for RE investments since it is the accepted method in transaction by sellers and acquirers	Complementary	Additional explanation
5 : 01.12 More specifically, the simplified DCF approach is the main DCF method applied for RE investments accepted by the transaction market	Convergence	Additional explanation
6 : 01.13 Flow to equity_FTE_method is the preferred DCF method for RE investments	Convergence	-
7 : 01.14 A virtual all-equity case is applied for testing project attractiveness	Complementary	-
8 : 01.15 Within the FTE method, IRR is more frequently applied compared to NPV	Convergence	-
9 : 01.16 Both equity IRR and project IRR are relevant, but in variation of their priority	Convergence	-
10 : 01.18 APV approach is suggested as an optimal and complementary method for impairment test	Complementary	-
11 : 01.19 Multiples are applied for initial investment screening and_or second opinion	Complementary	-
12 : 01.20 Certainty equivalent method is almost unknown_not used	Convergence	-
13 : 01.21 Certainty equivalent method might be a complementary, valuable concept in valuation	Complementary	Additional explanation
14 : 01.22 Payback period method is only relevant for investment in risky countries	Complementary	-
15 : 01.2 Judgmental considerations in capital budgeting techniques	-	-
16 : 01.21 Judgemental assessments are widely applied in valuation of RE investments_in addition to numerical approaches	Complementary	-
17 : 01.22 Quality of partners, including their ability and credit rating particularly those with long terms, is a relevant qualitative factor in valuation	Complementary	-
18 : 02 Cost of capital approaches_required return rates	-	-
19 : 02.01 CAPM applied as basic concept for defining the expected return rates	Convergence	-
20 : 02.02 Using CAPM with a pure-play Beta factor might become interesting in the future as soon as more RE portfolios_technology wise would be preferred_are traded on stock exchanges	Complementary	Additional explanation
21 : 02.03 WACC is still a principle technique to determine cost of capital requirements	Divergence	Additional explanation
22 : 02.04 Unsystematic risk are relevant in setting required return rates	Convergence	-
23 : 02.05 Hurdle rates are widely applied in cost of capital processes	Convergence	-
24 : 02.06 Required return rates are compared to the market	Convergence	-
25 : 02.07 Return rate requirements_hurdle rates_are often distinguished between countries, technologies_industries and sometimes also project stages	Convergence	-
26 : 02.08 Sellers often set discount rates depending previous transactions and_or information from a market sounding to maximise profit	Convergence	-
27 : 02.09 Required discount rates are set in relation to exit strategies in case of investors with a defined investment period	Complementary	Additional explanation
28 : 02.10 Setting required return rates_hurdle rates are predefined by central organisation	Complementary	Additional explanation
29 : 02.11 Both equity return rates and project return rates are applied, but in different frequency in DE and CH	Convergence	-
30 : 02.12 Application of project specific risk-adjusted-return rates	Nicht zugewiesen	-
31 : 03 Risk assessment, risk mitigation and adjustment for risk	-	-
32 : 03.01 Political_regulatory, market and weather-related risk are the key risk components in RE investments	Convergence	-
33 : 03.02 Risk assessment of different risk components in relation to project stages	Complementary	Additional explanation

Figure 58: (continued).

34 : 03.03 Risk mitigation measures are widely applied and have to be considered in valuation	Convergence	-
35 : 03.04 Adjustment for risk in valuation processes is widely applied, considering systematic and unsystematic risk components	Convergence	-
36 : 03.06 Scenario and sensitivity analysis are mostly applied, simulations less frequently, but more often by DE	Convergence	-
37 : 04 Influencing factors in valuation processes	-	-
38 : 04.01 Portfolio effects are not necessarily considered in valuation	Complementary	-
39 : 04.02 Possible opportunities of investment project are interesting to be known, but are not directly considered in valuation within transactions	Divergence	Additional explanation
40 : 04.03 Possible synergies of investment project are interesting to be known, but are not directly considered in valuation within transactions	Divergence	Additional explanation
41 : 04.04 Market forces are key influencing factors in the transactions and correspondingly in valuation	Complementary	-
42 : 04.05 Internal investment pressure are key influencing factors in the transactions and correspondingly in valuation	Complementary	-
43 : 04.06 Incentives and biases influence valuation processes	Complementary	-
44 : 04.07 Company charactistics_e.g. size, leverage, and domicile	Not examined in QUAL	-
45 : 04.08 Necessity to distinguish value or value range and setting the price	Complementary	-
46 : 05 Research gap between theory and practice	-	-
47 : 05.1 A considerable gap for a complete exploitation of the possibilities in computational valuation methods exists	Nicht zugewiesen	Nicht zugewiesen
48 : 05.2 RE investor do not consistently consider the value of opportunities and_or synergy effects with the valuation process	Nicht zugewiesen	Nicht zugewiesen
49 : 05.3 WACC based techniques are still widely applied even if other concepts, such RADR concepts, are propogated	Nicht zugewiesen	Nicht zugewiesen

ENDNOTES:

[1] During the course of the thesis, the abbreviation for renewable energy projects has been adjusted and made more precise to be *RES-E*, instead of just *RE* for renewable energy or *RES* for renewable energy sources, emphasising the focus of the investigated objects on power plants producing *electricity (E)* from renewable energy sources. The abbreviation RE has been used in the questions of the questionnaire. Therefore, the QUAN results still refer to RE instead of RES-E in the titles of the corresponding table of results.

[2] Subsidies can either be feed-in tariffs (FiTs, section 2.1.1) (Lipp, 2007, Bürer and Wüstenhagen, 2009, Couture, 2010), a fixed or semi-fixed revenue in currency per amount of production for a certain period of time, or production tax credits (mainly in the US) used by equity investors for their benefits in taxes (Liebreich, 2005).

[3] The group of non-traded assets (or: non-marketable assets or perfectly non-liquid assets) consists of assets that are not traded on the (public) market, such as human capital and private businesses (Bodie et al. 2014).

[4] Private equity refers to an asset class that consists of equity securities and debt in an operating company that is privately owned and hence not publicly traded on a stock exchange (Jegadeesh et al. 2009). These investments are considered to be illiquid and long term (Zimmermann et al. 2005, Sorensen, 2013, 2014). Market data for private equity are not directly accessible (Nielsen, 2011, Driessen et al., 2012), only if securities that are investing in private equity companies are publicly traded (Ljungqvist and Richardson, M, 2003). Such securities could be funds (Ljungqvist & Richardson, 2003) or specific companies (Zimmermann et al., 2005; Jegadeesh et al., 2009). Private equity can, for example, be categorised in private equity investment trusts, venture capital trusts, public to private, management buy-outs or management buy-ins, venture capital or business angels (Arnold 2010), or SPVs for operating specific projects.

[5] i.e. the ‘conference best and highly commended student paper award’ for the best student paper at the EuroMed Academy of Business (EMAB) conference 2017.

[6] Valuation must always be considered in the context of its purpose. There is no one right value for a company, a project, or an asset. There are different values that can each serve a different purpose (Moxter, 1983:4). In the past, various valuation concepts based on different methods have been in focus in practice. For example, in Germany, the substantial value method was used in the majority of cases until the 1960s, followed by the German income approach, which valued an asset based on the future streams of earnings or profits, before the discounted cash flow method became the main approach in practice in the mid 1980s (Drukarczyk and Schüler, 2009:9).

[7] Renewable energy sources (RES) projects are enterprises that transform a replenishable primary natural resource, such as biomass, hydro power, wind power, solar radiation, gravitation, isotope decay and residual heat in the earth's interior into secondary energy forms, such as electricity, heat or fuel (BMU 2006, cited in Peter and Fischedick, 2007). The abbreviation RES-E stands power plants producing electricity from renewable energy sources (Unteutsch, 2016); these could be hydro power plants, wind farms, photovoltaic plants or geothermal power plants. Newer RES-E technologies include wind farms, photovoltaic, concentrated solar, biomass or geothermal power plants. They are all characterized by long-term investments from 20 to 30 years for wind and photovoltaic (Kost et al. 2018) and up to 80 years and more for hydro power plants (IRENA, 2012). They are typically private equity investments, either structured as completely private investments of a company on their own balance sheets or as special purpose vehicles (SPVs) with project financing (Steffen, 2018). An SPV is a business entity that is initialised by a firm for the purpose of conducting a clearly-specified activity (Gorton and Souleles, 2007; Böttcher, 2009, Chang, Wang, and Liao, 2009), such as developing, building and operating RES-E projects.

[8] Possible improve options of RES-E are for instance: i) revenue improvements with the implementation of technological retrofit measurements and software upgrades in production control system and with the access to new markets, such as the ancillary market to stabilized the grid; and/or ii) decrease of costs be renegociating improved operating contracts, such as the operation and maintence contract, commercial and technological management contracts, merging of SPV to eliminate corporate specific cost components, such as accouting, performing financial statements, and auditor’s reports.

[9] This limited scope for action in the operating phase has implication on the chosen valuation method, as discussed in section for 2.4.2.4 about active decision making in projects with higher uncertainties.

[10] Hanson summarised alternative risk definitions from a technical point of view: i) "the unwanted event which may or may not occur [, ii)] the probability of an unwanted event which may or may not occur [, or iii)] the statistical expectation value of an unwanted event which may or may not occur" (2011:1). According to Hanson (2011), these definitions fall short of describing risk appropriately.

[11] In addition to distinguishing risk from uncertainty, risk must be differentiated from the terms peril and hazard. *Peril* is a probable cause, such as an earthquake, fire, or theft, that exposes a person or property to the risk of damage, injury, or loss. Perils can be covered with appropriate insurance policies. In contrast, *hazard* exists within a particular situation that poses a threat to human health and life, a threat to animals, and damage to property and the environment. In other words, a hazard is something that makes the occurrence of a peril more likely or more severe. It can be dormant/potential or active. In contrast to peril and hazard, the term risk only describes the chance of an adverse effect occurring (Sutton, 2014, Bitaraf and Shahriari, 2015).

[12] The state of uncertainty describes situations that are also described in the literature as so-called black swans or extreme tail events, which are highly improbable, unpredictable, or unforeseen events that, at an earlier stage, are not identified as potentially hazardous, but later emerge, often with extreme consequences (Taleb, 2010, Weitmayr, H. (2017).
[13] *t* is common to use for the standard deviation, the square root of the variance, as a measurement of the risk (Loderer et al., 2010).

[14] This view on risk is defined as risk in the narrow sense. In the wide sense of the term, risk is understood as peril that an actual, realised incident diverges from the expected incident in either a positive direction (also known as opportunity) or a negative direction (also known as risk in the narrow sense), based on the work of Hupe (1995, cited in Böttcher, 2009).

[15] Or as Brealey et al. (2011) explain in their words, "Wise investors don't take risks just for fun. They are playing with real money. Therefore, they require a higher return from the market portfolio than from Treasury bills" (297).

[16] Based on the given explanations, the terms *expected return* and *risk premium* as well as *cost of equity* are used interchangeably within this thesis.

[17] Kahneman and Tversky's prospect theory (1979) describes a reference-depending nature of individuals' risk preferences, and it points out a risk aversion for decisions in a stage of gains and risk seeking for decisions in a stage of losses.

[18] Unsystematic risk may also be called specific risk, firm-specific risk, residual risk, unique risk, idiosyncratic risk, or diversified risk (Brealey et al., 2011, Damodaran, 2013, Espinoza, 2014).

[19] Systematic risk may also be called market risk or undiversified risk (Brealey et al., 2011).

[20] Here is the wider sense of financial risk meant. It includes credit risk, liquidity risk,currency risk, foreign investment risk and equity risk. The narrower sense only includes risk of leverage (credit risk), see Table 4 (Investopedia, n.d.-a).

[21] In further explanations, the term *risk mitigation* is used, although it means both risk and uncertainty mitigation.

[22] The risk premium approach can also be applied for a time-invariant risk premium for a multi-period case based on equation 3.

[23] The going concern principle is translated from the German expression 'Fortführungsprinzip', adopted from §252 Abs. 1 Nr. 2 HGB (German 'Handelsgesetzbuch', English 'commercial law').

[24] Project financing is defined as the financing of a project in which a lender first places the focus of the credit check on the project's cash flows as the sole source of funds used to service the loans (Nevitt and Fabozzi, 2000, Yescombe, 2013, Morrison, 2016).

[25] Compared to the EVA, DCF-based methods are more appropriate for handling projected cash flows over the whole project period without applying a determination value (section 2.4.1.2) and for significant distributions to equity holders in later project years.

[26] It is common praxis define *net cash inflow* (i.e. the difference between the present value of cash inflows and the present value of cash outflows) as relevant cash flow for the NPV and IRR calculations (section 2.4.2.2) while the relevant cash flow for DCF-based methods (section 2.4.2.1) is usually expressed as *free cash flow* to equity or firm (i.e. the cash flow available to only equity or to all investors, respectively) (Investopedia, n.d. –b, -c, -d).

[27] Those circulation issues in DCF-based valuation are also described as roll-back approach in literature (Casey, 2004).

[28] Expected net present value models are also called "risk-adjusted NPV models" (Villiger & Bogdan, 2005:113) or rNPV (Stewart et al., 2001).

[29] Moxter (1983) proposed the term 'valuing means comparing' (in German: "bewerten heisst vergleichen" [Moxter, 1983:123]) as basic concept for applying multiple approaches.

[30] In case of leverage firms with corporate loans, Myers (1977) and Barnea et al. (1980) argue that shareholders have a call option claim on assets and are incentivized to undertake riskier projects due to the increase of the call option value the riskier the project is (greater variance). As such, the call option is particularly attractive for high leveraged firms. Since in typically RES-E investments however, the structure of the applied project financing does not provide incentives that a potential call option value on the equity is greater in case of greater variances of the assets.

[31] The difference between real option and financial option is not discussed in this thesis. Brach (2003), for instance, gives valuable details about real option valuation in practice, including an outline of the differences between the two option approaches.

[32] The volatility as an input variable in ROV describes the uncertainty of the underlying asset over time (Brealey et al., 2011). Derived from the discussion in chapter 2.2.1, the volatility and the corresponding probability distribution are its measurements of risk.

33 The use of the CoC and the WACC leads to confusion in some circumstances. For example, the WACC described in this section should not be mistaken for the WACC of the targeted investment; the project-based WACC (see section 2.4.2.1), which is the total CoC of the investment project (Mielcarz & Mlinarič, 2014); and the DCF-based WACC approach (section 2.4.2.1).

[34] There is a third WACC concept, called vanilla WACC. It takes into account the average of both post- and pre-tax WACC Arnold, G. (2013) *Corporate Financial Management,* 5th ed. Pearson Education, Harlow, UK..

[35] According to Ehrhardt and Birgham (2016), the divisional WACC is typically calculated using the pure-play technique or the accounting beta method.

[36] Empirical surveys among practitioners demonstrate that the WACC and a single company-wide discount are predominantly applied in DCF analyses, although many practitioners also apply the hurdle rate and RADR concepts (e.g. Gitman and Mercurio, 1982, Bruner et al., 1998, Graham and Harvey, 2001).

[37] The principle of the RADR concept illustration for an all-equity financed company can also be applied and correspondingly adjusted for companies with different capital structures Arnold, G. (2013) *Corporate Financial Management,* 5th ed. Pearson Education, Harlow, UK.

[38] Since the risk-free rate does not consider the tax advantage of debt, as within the WACC calculation, it must be examined whether the potential advantages of a tax shield are appropriately considered in the CE cash flows or in the discount rates (Ehrhardt and Brigham, 2016). However, the cash flow projections for RES-E investments do typically correctly consider this benefit; therefore, cash flow adjustments on the CE level do correctly incorporate these circumstances.

[39] In this study: CFO, asset managers, and other financial experts.

[40] Similarly to private equity companies, estimating expected returns for *investment projects* is challenging, since the cost of assets can normally not directly be monitored. Loderer et al. (2010) provide an approach to estimate the RADR for investment projects, using again the CAPM. This approach is based on the assumption that the operative risk of the project has the same risk as the whole company that is investing in this project, although each project has a different risk profile.

[41] Professor Aswath Damodoran periodically publishes his industry beta calculations on the following web page: http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/Betas.html

[42] They are described elsewhere, for example, in Aharoni (1966) and Arnold (2013), p. 141ff.

[43] These three fictive examples are realistic cases, applied in the qualitative interviews in section 4.4.1.2. Detailed figures are found in Appendix 8 (2. part of interview with the investment scenarios).

[44] In the following course, the expressions research philosophy, philosophical stance, and paradigms are used interchangeably.

[45] The role of the researcher's values is studied by axiology, which is a separate philosophical branch about the theory of values (Hart, 1971).

[46] These frictions are known as the paradigm war between quantitative and qualitative approaches (Datta, 1994).

[47] It is, however, not necessarily that the chosen paradigm within this research is always applied by the author, for example, for other studies, since the selected paradigm must always match the performed research.

[48] Social conditioning is explained and discussed in detail by Maki (1992): it is a sociological process of training individuals in a society to respond in a manner generally approved by society and peer groups within society.

[49] During an unstructured or in-depth interview, the interviewer does not have a list of themes and questions to choose from, although he or she does have a clear focus on the area to be explored. It is a completely informal conversation in which the interviewee can talk freely to explore a certain area in depth (Saunders et al. 2009).

[50] A selection of seminal MMR books: SAGA Handbook of Mixed Methods in Social & Behavioural Research by Tashakkori and Teddlie (2010), The SAGE Handbook of Qualitative Research by Denzin and Lincoln (2011), Mixed Methods Research: A Guide to the Field by Plano Clark and Ivankova (2016), and Designing and Conducting Mixed Methods Research by Creswell and Plano Clark (2018).

[51] This term 'multiple approach' with research methodologies should not confused with the same term in valuation. Only the latter is abbreviated in this thesis with MA.

[52] Independent power producers are defined as those companies with electricity generating units that are not public utilities, do not have an own grid, and are therefore dependent on the grids of others (mainly utilities) (STROM.info, n.d., EnergyVortex.com, n.d.).They have often arisen from project developers of RES-E units.

[53] The access to the group of industrial companies which also invest in RES-E projects is time-consuming, difficult and therefore costly. It could be covered in a separate research project (section 6.5).

[54] The questionnaire was composed of additional sections about the attractiveness of RES-E investment opportunities, general questions about risk and return, and several additional detailed questions that were not evaluated within this research and in the subsequent QUAL phase due to resource and time restrictions.

[55] The open source software survey tool, run on the server of the Kalaidos University of Applied Sciences (see http://www.kalaidos-fh.ch/Forschung/Kalaidos-Befragungsserver), could be used.

[56] Conferences on RES-E, such as the 'New Energy Investor Summit' in Switzerland, 2016, and the 'Handelsblatt Tagung in Erneuerbare Energien' in Berlin 2015.

[57] Test re-tests to check the reliability of the questionnaire are planned within the additional interview phases with the same and similar questions.

[58] In the *greenfield* stage, power plant projects are only composed of a few rights (for example, land rights), and almost no opportunities and synergies can be used due to the typically unique nature of the project. In this paper, the term *brownfield* relates to sites for potential development that have had previous development on them.

[59] In general, having experienced weather-related volume risk to materialise does not increase the need for more risk mitigation measures, except the need for more external DD (83.9% vs. 75.0%), probably in relation to wind assessment.

This might be due to the fact that weather-related volume is considered anyhow as one of the most important risks (see section3.2) without having to materialise it in the first place. Likewise, materialised weather-related volume risk does not increase the demand for appropriate risk mitigation measures with weather protection insurances. This is probably because other risk mitigation is conducted, including portfolio diversification for sites in relation to the available natural resource conditions and for different energy transformation technologies, and because appropriate insurances are costly in relation to their benefits.

[60] This indicates that, in the project stage of a power plant with six to 10 years in operation, the possibility to adjust and improve certain essential contracts is considered, including renegotiating long-term operating and maintenance agreements, as well as refinancing loan agreements with interest rates, which are often fixed for up to 10 years in project financing agreements.

[61] Measured as a percentage of the respondents who answered ‘cash flow adjustment’, ‘discount rate adjustment’, and ‘both’.

[62] Measured as a percentage of the respondents who answered ‘cash flow adjustment’ and ‘both’.

[63] Measured as a percentage of the respondents who answered ‘discount rate’ and ‘both’.

[64] *Other natural resources* means all natural resources, except weather-related volume risk.

[65] Direct marketing in the power sector is a scheme to transform the rigid FiT system into a market-oriented subsidy system in which an energy off-taker trades the power generation at the power exchange.

[66] Market integration of RES-E, for instance, within a so-called direct market scheme.

[67] The discussed topics during the interviews regarding the challenges and issues included the following:

- The appropriateness and suitability of the IRR and NPV approaches (see section 5.3.3.2)
- The discount rate, typically incorporating both the time value of money and risk (see section 5.3.3.1)
- Methods to consider risk, either in the discount rate or the cash flows (see section 5.3.6.2)
- The selection of the appropriate cash flow streams for DCF-based valuation (see section 5.3.3.3) and matching them with the appropriate CoC approach (see section 5.3.5.1)
- The application of a constant or dynamic discount rate in relation to the involved financing policy of the valuated project (see section 5.3.5.1)
- The volatility of considered cash flow streams from period to period within the considered valuation period (see section 5.3.3.1)
- Debate about ex-ante vs. ex-post valuations (see section 5.3.5.1)

[68] *Ex-post* valuation means a retrospective valuation that considers certain later-known circumstances, in contrast to *ex-ante* valuation, which performs valuation without considering later circumstances that are not known at that point in time.

[69] Definition of *P* value: it is a probability measure; for example, P50 is defined as 50% of estimates exceeding the P50 estimate, and in the case of P90, it is 90% of the estimates exceeding the P90 estimate.

[70] The DNPV method of Espinoza and Morris (2013) and Espinoza and Rojo (2015) provides possible answers to the question of how to decrease the subjective assumptions for defining the certainty levels of the relevant input parameters (see section 2.4.4.4).

[71] Earn-out is a provision written in the financial transaction document (for example, share purchase agreement) whereby the seller of the business will receive additional payments after a defined earn-out period based on the future performance (for example, the actual production data, compared to forecasted production data) of the business sold. In a reverse earn-out provision, a certain amount is paid back to the acquirer.

[72] Likewise, values (NPV versus DNPV) can be plotted (section 2.6.3) to reduce the inherit weakness of IRR calculations, outlined in section 2.4.2.2. Despite the known weakness of the IRR, this measure has been chosen herein, since projects of different sizes (which is often the case in investment processes) can be better compared.

[73] For clarity reasons, the simplified EVA calculation is presented here to omit the issue of corrections to EBIT and CI calculations, proposed by Stern Stewart & Co. The majority of the corrections affect the EBIT calculation and CI symmetrically. Therefore, they should not have a significant impact on the final conclusions concerning the discussed issue as far as the same corrections would be applied in the process of FCF calculation (Mielcarz and Mlinarič, 2014

[74] The APM is also known as the arbitrage pricing theory (APT) (Ross, 1976).

[75] According to the study of Gitman and Vandenberg (2001), nearly 93% of the all survey participants using the DCF apply the CAPM, compared to approximately 1% who apply the APM.

[76] Utility maximisation is an economic concept that describes a consumer attempting to obtain the greatest value possible from the expenditure of the least amount of money when making a purchase decision. The objective is to maximise the total value derived from the available money (Kahneman & Thaler, 2006).

[77] Moreover, with the production-based CAPM, Cochrane (1991) developed an additional version of this model.

[78] There is a recent working paper (Chong, Jin, & Philipps, 2013) that discusses alternative CAPM adjustments based on a build-up methodology.

[79] The market factor is measured by the return on market index minus the risk-free interest rate; the size factor is measured by the return on small-firm stocks less the return on large-firm stocks; and the book-to-market factor is measured by the return on high book-to-market-ratio stock less the return on low book-to-market-ratio stocks (Brealey et al., 2011).

[80] The momentum can be calculated by subtracting the equal weighted average of the highest performing firms from the equal weighted average of the lowest performing firms, lagging by one month (Carhart, 1997).

[81] Cross tabulations are conducted by organisation type (energy-related companies, i.e., firms with energy as a core competence: utility, IPP, and project developers, versus others), country (DE: Germany, CH: Switzerland), size (large firms have more than 500 employees), leverage (firms with high leverage are defined as having a debt ratio of 40%, the ratio of total—short-term and long-term—debt to total assets), whether a firm is stock exchange listed (yes vs. no), gender (male vs. female), age (older than 40 vs. younger than 41), education (participants having an MBA vs. other qualifications), and experience (having performed more than 10 transactions is defined as having high experience). According to Cohen (1988), the phi coefficient (effect size) strength is small for a value of 0.1, moderate for 0.3, and large for 0.5.