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Original research article

Discourse, discursive power, and Social License to Operate: The case of bioenergy with carbon capture and storage in the United Kingdom

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ABSTRACT

BECCS, with the upscaling of domestic biomass feedstock, is envisaged to play an important role in meeting the UK's net zero commitments. However, BECCS is controversial which has implications for social acceptability. This paper aims to examine how discourse and discursive power of different groups engaged in the debates about BECCS can condition a Social License to Operate (SLO). It contributes to a growing body of critical social science studies of CSS and advances SLO scholarship by integrating the concept of discourse.

A wide constituency of actor groups active in the debate about BECCS in the UK was identified. Text analysis of position statements of 27 organisations, semi-structured interviews and a workshop were used to undertake discourse analysis, assess discursive power, and explore the implications of these for a SLO, using framing of distributional and procedural fairness, confidence in governance, and trust.

Analysis confirmed polarised discourses prevailing across organisations, but with many nuances, reflecting the multi-faceted nature of BECCS. Overcoming discourse polarisation and discursive power struggles emerges as a key need for achieving a SLO. The paper concludes with two ways to address this. First, the importance of deliberative discussions to accommodate polarised views bringing in different knowledges and values is clear. Secondly, adaptability from all groups is required, including a shared responsibility and agency for reviewing and responding to governance, political demands, evidence and societal interests. Both are in-line with the notion of SLO being intangible and non-permanent, and allow for normative complexity around achieving net zero.

1. Introduction

Bioenergy with Carbon Capture and Storage (BECCS) plays a central role in the Intergovernmental Panel on Climate Change IPCC scenario pathways that limit global warming in line with the objectives of the Paris Agreement [1]. In the UK,[1] government net zero ambitions envisage significant contributions from BECCS [2] and recent projections (Balanced Pathway) see a transition away from imported biomass towards domestically produced biomass (residues and dedicated energy crops) as feedstock [3].

As a combination of a land-based solution and CSS technology, implementing BECCS will necessitate accepting environmental, social and economic risks and costs relating to production, processing and transportation of biomass, and transport and storage options for captured CO_2 [4]. The success of policy ambitions therefore will depend on multiple socio-political factors which go beyond technical feasibility [5–9]. The BECCS concept is controversial and has been widely debated amongst different groups of actors internationally and in the UK [7,10], the new emphasis on domestically grown biomass feedstock in the UK widens the scope of this debate.

If BECCS is to be effective, improving understanding of the social acceptability or social legitimacy has been regarded as paramount. Typically, public perception and social acceptability have been articulated in social science literatures in terms of barriers to policy decisions and implementation. Public evaluation of engineered methods such as BECCS has shown the importance of building trust and support [11–13], as Bellamy [[14] p1] observes, democratic, trustworthy and socially intelligent "deployment of CDR (carbon dioxide removal) methods will be highly dependent on how different publics evaluate them, and ultimately which groups support or oppose them."

Social License to Operate (SLO) [15,16] provides a way of both conceptualising and strategically building community acceptance or

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[1] Policies refer to the UK but there is disaggregated analysis and targets for the devolved administrations (Scotland, Wales, and Northern Ireland).

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approval of an operation, project or activity from those affected [17]. In its broadest sense, the concept of SLO is indicative of societies' changing expectations towards corporate entities, namely their wider responsibility for social and environmental impacts [18]. SLO is becoming increasingly important in providing conceptual foundations for studies in energy transition [15,19]. In line with the calls for policy-making processes which consider just transition [20], energy citizenship [21], inequalities, [19], ethical governance [22], scholars are critiquing the more conventional SLO framings of social acceptance [15], and instrumental forms of public and political engagement. As well as emphasising broader implications for human needs, justice and ethics [23], they are paying attention to affected communities [6,24,25], and the diverse and geographically varying societal values and interests [26]; and deliberative approaches that pay more attention to social and political realities in [12,27], and the normative elements [28] of, Carbon Capture and Storage (CSS) studies.

Discourse and discursive power of different groups engaged in the debates about BECCS can influence social acceptability and in turn condition a SLO. To date, studies have revealed a range of discourses about BECCS across different groups including expert and public perception [10,29–31]; agenda setting and policy making communities [32,33]; informed stakeholders [12,34,35]; and environmental activists and NGOs [36]. This literature shows how CCS discourses are often embedded in power dynamics, with different groups holding disproportionate amounts of power [28].

These discourses are characterised by polarisation between advocacy and criticism, as described for geoengineering controversies [37]. Advocates frame CCS technologies as – technological optimism, political realism and catastrophe avoidance [38]. For bioenergy and BECCS, optimistic narratives are discursively produced by policy makers and industry actors [9,33], accordingly 'necessary', and an 'economic opportunity' are common BECCS storylines [39]. Conversely, critics doubt the credibility of BECCS as an untested 'technological imaginary' [40] and question its role in meeting the Paris targets [41–43]. They also raise concerns about the sustainability of the supply of biomass feedstock, the damaging impact on biodiversity and forests, and indirect effect on food production, and regard BECCS as a distraction from other mitigation efforts [27,39,44]. In the UK the normative policy position that views BECCS as both necessary and desirable is widely contested [45]. The focus for controversy and media censure has been on the largest biomass heat and power station Drax, which predominantly burns imported wood pellets [46].

The ambition for upscaling domestic biomass production for feedstocks adds a new inflection to these debates. In particular, studies of the discursive field need to encapsulate a wider range of constituencies in this new context, such as environmental NGOs and campaigners (eNGOS), as well as energy industry representatives, researchers, relevant land use stakeholders, and local decision makers [8]. Such actors are active in shaping and legitimising discourses and steering public opinion, and ultimately a SLO, about BECCS [31,47]. eNGOs are a specific constituency of the public, who scrutinise the actions of governments and business, highlighting risks and uncertainties [48], and have voiced sustained opposition to imported woody biomass [45,49]. They can strengthen their voice in advocacy coalitions [28]. Bioenergy industries drive deployment of negative emissions technology [5] and can be influential supporters [50] and lobbyists directing substantial resources towards shaping the narrative in the policy and public domain. These elites are often considered to hold disproportionate power [28]. Equally land use stakeholders at the farm [51] and landscape level [8] are important constituencies if biomass crop production is to be upscaled in the UK to the extent envisaged.

Paying closer attention to how these different kinds of actors perceive BECCS implementation can add substantial value to any attempts to understand the socio-political preconditions for deploying BECCS at scale [36]. As scholars assert, social groups play a critical role in shaping and defining the problems that arise during the deployment of technologies [52]; they give meaning to and define the problems facing that technology and influence the likelihood of achieving a SLO [5]. Such actors are important where knowledge and awareness amongst public and land use stakeholders about BECCS is limited and perceptions often negative, as in the case with BECCS in the UK [8,12,34,53].

This paper aims to examine how the discourse and discursive power of different actor groups conditions a SLO for BECCS in the UK. Specifically, the research questions are:

- Who are the actor groups active in the BECCS debate in the UK?
- What discourses do these actor groups propound and what is the meaning behind them?
- What is their respective influence and power in shaping the debate in this arena?
- What are the implications of these discourses for achieving a SLO?

We position the research in the new context of envisaged upscaling of domestic biomass feedstock production in the UK for CCS (BECCS). In doing this we address a research gap by incorporating voices from a broad range of stakeholders in an evaluation of BECCS in the UK. We contribute to a growing body of critical social science studies of CSS [28], and advance and broaden SLO scholarship by integrating the concept of discourse. Although studies of BECCS in the UK have separately explored social acceptability and SLO [13], and discourses and contested framings [27,39], the relationship between them has not been fully investigated. Furthermore, we critique the inherently normative nature of the SLO concept, in that it presupposes the existence of a consensus about desirable pathways, that can obscure underlying values and disagreements. In this paper, conscious of the issue of normative orientation of researchers in sustainability science and sustainability transitions [28,54], we adopt a neutral stance, aiming to examine the development of BECCS in the UK without endorsing or opposing its deployment.

2. UK context

The notion of BECCS is multi-faceted and includes: the technology used; the location, scales and pace of implementation; the land category used (forest, grassland, marginal lands and crop lands); the governance systems; and the business models and practices adopted, including how these integrate with or displace the existing land use [7]. All these facets need to be considered in the UK context since all engender varying public perceptions [34].

Considering the scale and pace, building on the Biomass Strategy [2], the UK's 7th carbon budget Balanced Net Zero Pathway envisages that annual planting rates (Miscanthus, short rotation coppice, and short rotation forestry) rise from 1000 ha to 38, 000 ha, which equates to almost 3 % of UK land area, by 2050 [3]. This ambition aligns with plans for CCS to provide 89 % of engineered removals in 2040. Accordingly, in 2024 Drax was granted development consent for a BECCS facility, as part of the UK's commitment to establish low carbon industrial clusters by 2030 [13].

The need nationally for governance systems that are sensitive to social and ethical concerns, as well as political, legal, economic, environmental and scientific ones, to mitigate adverse or unexpected consequences of CSS deployment, is recognised [55]. However, current arrangements for the industry to meet sustainability standards are considered inadequate by the National Audit Office [50,56]. An independent inquiry, BECCS 'Done Well', also identified a number of conditions that were needed to be able to demonstrate good practice [57]. These both largely relate to imported forest biomass.

Any upscaling ambitions for domestic biomass crop production need to be considered against a backdrop of historic and contemporary contexts. As Waller [27] notes, the governance landscape for BECCS has been somewhat uneven and patchy with large-scale fossil CCS projects and bioenergy production slow to progress due to uneven political

support [58] and political concerns about environmental impact. The government has long promoted 'sustainable bioenergy' [33], however there has been public contestation [33], industry and grower lack of confidence in policies and markets [59], and questioning of the feasibility of the supply chain for BECCS [60]. The envisaged scale of crop production needs to be reconciled with other land use priorities [7,61] with government commitments for food production, reforestation, and environment [62,63]. Typically, biomass crop cultivation is considered best restricted to marginal land (to avoid displacing food production) however, this risks encroaching on sensitive biodiversity areas and semi-natural grasslands high in carbon stocks. This is set against wider concerns about the necessary rate and extent of land use change to meet national climate pledges [64].

At farm and landscape level, land managers try to balance these different demands in the context of post-Brexit policy transition and uncertainties, low levels of confidence in government, market volatility, and agrifood supply chain dominance [8]. Bioenergy has been promoted as a diversification option for farmers [33] although continuity of support has always been a risk [65]. The growing evidence of the co-benefits of growing perennial biomass crops [66] offers new opportunities for farmers, and land managers more widely, possibly through agri-environment schemes or natural capital payments [8].

3. Conceptual framework

Given that discourse and discursive power of different groups engaged in the debates about BECCS can potentially influence social acceptability and in turn condition a SLO, we develop a conceptual framework drawing on these two interconnected concepts (Fig. 1).

3.1. Social license to operate

The concept of SLO relates to the intangible and tacit, contract with society, or a social group, which enables an activity to progress [67]. Although SLO has its origins in the mining industry and tends to be restricted to projects or activities and their relationship with affected local communities, the concept is no longer limited to a geographical grouping of people and can be applied to wider societal acceptability. This can take the form of a coalition of actors, constituent groups or institutional supporters which may include directly affected communities, local and regional authorities or agencies, eNGOs, environmental activists, investment funds, businesses, and the local media. A broader definition of 'community' that is about communities of interest, where participants are more akin to 'stakeholders', can be employed [68]. Following this logic, a successful SLO has the potential to positively influence a whole industry [15]. While SLO has been discursively used in a number of cases as a metaphor to advance industry intentions [69], the emphasis in BECCS studies to date has been more on understanding social acceptability given its influence on gaining a political mandate from society as a whole [12].

Although there is a degree of overlap between SLO and social acceptability, the latter has been less theorised [17] and tends to examine factors and drivers of social acceptance of new energy technologies [70,15], taking a "deficit" model of the public [71] and driven by narrow instrumental aims such as managing opposition [72]. The concept of SLO has been developed around a number of dimensions, frameworks and processes. The core elements of SLO are: legitimacy, which encapsulates legal, regulatory and social aspects (aligning with social norms); and credibility, which is the extent to which the economic, technical and future viability of a project are believed, and perceived to be fairly undertaken. Both these can be enhanced through the involvement of different stakeholders, which in turn cultivates trust. SLO has been conceptualised using systems thinking according to different states of acceptance [73] or maintenance [74]. Referring to community and project level, the process is framed as a 'pyramid' with three distinct boundaries or levels of perception which stakeholders need to achieve: socio-political legitimacy, credibility and transactional trust [73].

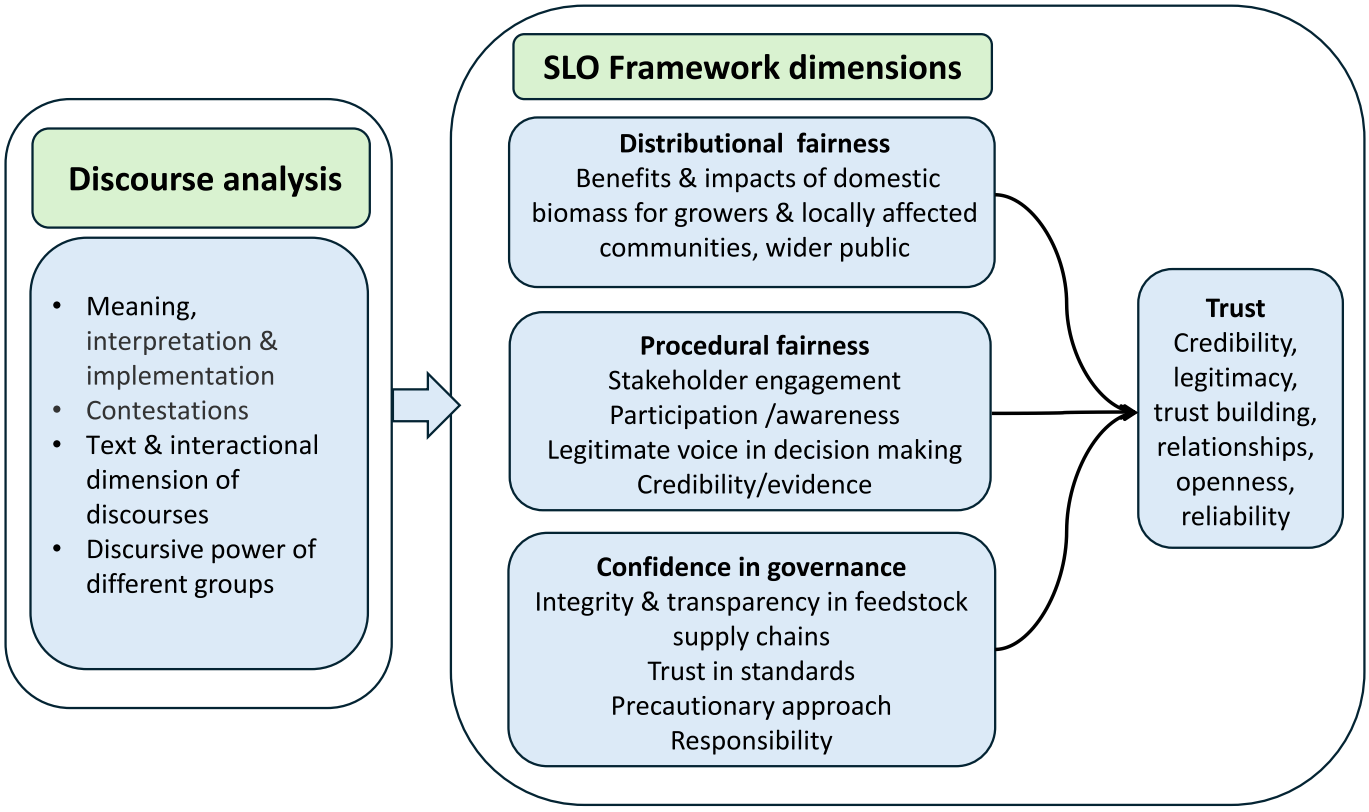

Fig. 1. Conceptual framework integrating discourse analysis and SLO dimensions (adapted from Baumber (2018)).

Interest is growing in applying the SLO concept to energy transitions applied to novel decarbonisation technologies, including direct air capture [13], seaweed farming for biofuels [75] and CSS [67,76]. However, bioenergy is a relatively new area for the application of the SLO concept [16].

In energy contexts scholars have critiqued and advanced more conventional and normative framing of SLO, incorporating fairness and justice principles [20], notions of 'energy justice' [15], differentiated and marginalised communities [19], normative complexity [77], and different visions and scales [13], identifying research gaps on topics of power dynamics and governance [28]. Building on and addressing these, we adapt the SLO framework developed by Baumber [78] for bioenergy cropping, to provide a guide for analysing how a SLO might be achieved in our research of BECCS, the key dimensions, as shown in Fig. 1, are:

- Distributional fairness - how different stakeholders are affected by positive and negative impacts of an activity; fair distribution of the benefits and burdens of the energy sector
- Procedural fairness - processes for communication, governance and ensuring community engagement in decision-making
- Confidence in governance

We incorporate trust into our framework as an overarching determinant precondition for distributional fairness, procedural fairness and confidence in governance [79]. Approaches for SLO all converge on developing meaningful, long-term, trust-based relationships with communities, and, trust in the company or the public institution [80–82]. Although SLO's reflection of social norms, legitimacy, acceptance, and trust indicates that the SLO is highly context-specific, we adapt the framework to consider BECCS at local and larger geographic scales.

3.2. Discourse analysis

Discourse analysis has been widely used to explore the discursive power and influence of groups in environmental governance and can be a helpful indicator of the conditions for a SLO. Previous studies of BECCS and CDR more widely show that actor groups discursively produce different views and these have been conceptualised as media storylines [39], expert narratives [47], issue frames [83–85], contested framings [27] and 'sociotechnical imaginaries' [32,33,86].

Discourse is defined as "an ensemble of ideas, concepts and categories through which meaning is given to social and physical phenomena, and which is produced and reproduced through an identifiable set of practices" [[87] p5]. The analysis of discourse can be placed in the interpretative or social constructionist tradition in social sciences [88]. This approach appreciates the messy and complex interactions that make up any environmental policy process. Abstract concepts cannot simply be imposed in a top-down way, but are continuously contested in a struggle about their meaning, interpretation and implementation [89]. Such struggles are ongoing with new concepts like net zero and the implementation of BECCS. In making sense of these struggles, discourse analysis can illuminate mechanisms and answer 'how questions' [90]. Given the contestations around BECCS, these 'how questions' are relevant to understanding how, and in what way, a SLO can be advanced.

Analysis of discourse to understand how different positions are formed and communicated in the geoengineering context have been largely based on media analysis for the public sphere [39,83]; and text analysis for informed or agenda setting stakeholders [90]. Building on this work, we use the concept of discourse to capture the range of positions held by a wider constituency of social groups commenting on both engineered solutions (CSS) and land use solutions (biomass crops). We analyse the discursive power and influence of these groups, with respect to BECCS, where discursive power is defined as the power to influence the norms and values that guide behavior [91]. This discursive landscape provides insights into the drivers and processes for achieving a SLO. This is depicted in the conceptual framework (Fig. 1).

While language and analytical approaches to discourse emphasise texts and words, discourse analysis cannot be separated from its context, as discourses become embedded in social structures, institutions, and policies, shaping the way things are done and understood, and how arguments are constructed [87]. Linguistical analysis of discursive construction therefore needs to be done in the context of the conditions in which any statements are produced and received, and to understand the interplay between what is said, who is saying it, and the context in which it is said. To reflect this, we combine a more rhetorically-structured linguistics framework with a broad and contextual approach to discourse. For the former we adapt Carvalho's [92] linguistic framework. For the latter we draw on Hajer's [93] Argumentative Discourse Analysis (ADA) which examines how arguments are constructed and presented within a specific context to understand how power, persuasion, and meaning are negotiated. Both approaches allow us to understand how power is embedded in language and in dominant social structures [94] and can reveal the "discursive struggle for hegemony" (Hajer, 1995). Following this approach we identify any groups of actors or discourse coalitions that are attracted to a specific (set of) discourse [93].

4. Methods

The research design applied to address the research questions is set out in Table 1, showing the phases of the research. A mixed method approach was used combining a desk study to identify organisations,[2] their discourses and relative public influence, followed by semi-structured interviews and a workshop to understand how such discourses set the conditions for SLO, according to the dimensions of our SLO framework.

Table 1
Research design.

Topic of analysis	Methods	Analysis	Outputs
Organisations involved in debate: organisation profile (reach, analytics), relative influence	Desk study- organisations identified through expert opinion and internet search	Relative influence mapping validated through interview	Discourse-influence matrix
Organisation Discourse	Desk study - position texts identified through internet search Interviews and workshops to supplement and validate	Discourse analysis of position texts, and of interview and workshop transcripts Understanding discourse construction, arguments, discursive power, coalitions, meaning and context	Discourse characterisation
SLO dimensions: distributional fairness, procedural fairness, confidence in government, and trust	Interviews and workshops co-design SLO processes	Qualitative deductive and inductive analysis of SLO dimensions; co-designing SLO processes for BECCS	Conditions required for a SLO for BECCS

[2] We use the terms organisation and coalition of organisations, to describe actors as collective units of institutions or organisations and social groups that often share the same set of meanings attached to a particular technology [5].

4.1. Identifying organisations and their discourses

A discourse analysis of organisations' positions on BECCS was undertaken in a desk study. Information for this analysis was available as text from webpages, reports, blogs, articles, opinion pieces, policy papers, select committee hearings and responses to government consultations. Initially organisations known to have published position or policy statements or consultation responses, or to have campaigned about biomass for BECCS, were identified through project partner expert knowledge and using a Freedom of Information request to the government for the respondents to the UK Government Biomass Strategy [50]. Supplementing this, the google search engine was used with the following key words combined in different search strings: UK; perennial biomass crops; PBC; bioenergy crops; BECCS; carbon capture and storage; bioenergy with carbon capture and storage; policy position; statement; consultation; consultation response. The search was done iteratively, and aimed to be exhaustive continuing using different search strings until saturation point had been reached. The geographic scope of organisations and published material was the UK, however, texts from international organisations with UK associations were also included. The publication date range for the search was January 2010 to July 2024. The search was conducted between 1 February to 29 February 2024. Government organisations (excepting independent bodies) and mainstream media were excluded since the study focused on the role of non-governmental constituency groups, also media has been comprehensively covered by other studies.

Criteria for inclusion of organisations were: 1) they have expressed a position about biomass and or BECCS, and are active in debates; 2) they have positions that are easily accessible to the public and can potentially influence or shape public opinion; 3) they are primarily UK based organisations; and 4) they provide research, evidence and data to inform policy about biomass for BECCS. Information about 27 organisations and their associated position texts was collected in a database, and structured according to a typology of organisations (Table 2) adapted from Smith and Christie [95]. Industry associations and formal organisation coalitions are highlighted.

Table 2
Organisations represented in discourse analysis of text (bold denotes NGO coalitions or industry associations)

Typology	Organisation & jurisdiction	Sector
Industry (those with responsibility for public, stakeholder and policy relations) and sector platforms	Drax plc (UK-based power generation company with international interests) **Carbon Capture and Storage Association (CCSA)** **Association for Renewable Energy and Clean Technology (REA)** *International* International Energy Agency Shell plc	Energy
Govt funded programmes policy-research-industry partnerships	The Biomass Feedstocks Innovation Programme, DESNZ (funds Biomass Connect) Supergen Bioenergy Hub (UK research funding)	Policy
Environmental non-governmental organisations, activists and campaigners, informed commentators	*UK* Royal Society for the Protection of Birds RSPB Wildlife Trusts Greenpeace Fern Sustain DeSmog *International* Biofuelwatch WorldWide Fund for Nature WWF Cut Carbon not Forests CCNF Forest Litigation Collaborative/The Lifescape Project Feedback Global Campaign Against Climate Change MCS Charitable Foundation Ember	Environment and nature
Membership body	National Farmers Union (England) NFU	Agriculture and Horticulture
Academic/research bodies	UK Centre for Ecology & Hydrology (lead Biomass Connect), Tyndall Centre for Climate Research (some government funding)	Climate change
Statutory body (independent)	Climate Change Committee (CCC), National Audit Office (NAO)	Policy
Coalition of environmental and wildlife organisations	**Wildlife and Countryside Link**	Environment

4.2. Organisation mapping

While the texts indicate the intention of potential political influence, we also profiled each organisation and undertook an assessment of its reach in terms of type of audience, and 'relative influence' on the public ([95]. There is no objective measure of 'influence' or a unifying unit of measurement across organisational types, so we relied on a degree of subjective value judgement informed by combinations of metrics including: audience, revenue, website and social media accessibility, membership/readership. At this stage, the organisations were categorised broadly into supportive and unsupportive discourses. These categories were mapped together with the organisations' relative influence on the public on a 'discourse influence matrix'. This was validated with expert opinion where interviewees were largely in agreement with the researchers' relative positioning of organisations but made some 'in quadrat' adjustments. The final adjusted matrix is shown in Supplementary Fig. S1.

4.3. Interviews and workshop

Discourse analysis is best employed as part of a broader approach to allow analysis of the more interactional dimension of discourses through discussion with participants in the field about how they understand texts as part of everyday practice [32,96]. This allows an appreciation for the more profound role of discourse by looking at social relations, institutions, materialities and imaginaries [69,94,97]. To capture this, in-depth semi-structured interviews were conducted with 11 actors, representing 12 of the 27 organisations listed; actors from the other organisations were unavailable (Table 2). The interview schedule was structured around seeking feedback on the list of organisations (this led to additional participants being included in the research), analysis of the organisations' discourse, the discourse influence matrix, and the dimensions of our SLO framework.

A workshop followed, this aimed to co-design the conditions required to establish a SLO with respect to BECCS with sustainable biomass crops in the UK. All 27 organisations, and additional ones suggested by interviewees, were invited and 8 participated. The programme was structured to facilitate a discussion around the SLO dimensions: distributional fairness, procedural fairness, confidence in government, and trust. Table 3 shows that the interview and workshop participants represented a range of organisations. However, NGOs and campaigners were under-represented, this is attributed to their limited capacity to attend.

4.4. Discourse analysis of texts and qualitative data

A combination of deductive and inductive analysis of the texts and

Table 3
Organisations represented in the interviews and workshops.

Type	Organisation	Sector	Jurisdiction	Interview	Workshop
Academic/research bodies	Tyndall Centre for Climate Change Research	Climate change	UK/Global	y	n
Industry (those with responsibility for public, stakeholder and policy relations)	Drax	Energy	UK/Global	y	n
Membership body (farming)	National Farmers Union (NFU)	Agriculture and Horticulture	England and Wales	y	y
Researcher within project funded by Biomass Feedstocks Innovation Programme (Industry and DESNZ)	UKCEH partner in: Biomass Connect Project	Environmental science	UK	y	y
Environmental NGO/land manager	Wildlife Trusts	Wildlife	UK	y	y
Industry (those with responsibility for public, stakeholder and policy relations)	The Association for Renewable Energy and Clean Technology (REA)	Energy	UK	y	y
UK funded research and innovation centre Academic/ research bodies	Industrial Decarbonisation Research and Innovation Centre and academia	Research Climate and energy	UK/Global	y	y
Commentators/specialist journalism	DeSmog	Media	UK/Global	y	n
Environmental NGO/land manager/campaigner	RSPB	Wildlife	UK	y	n
Additional participants from organisations not represented in the text analysis					
Environmental NGO/membership body/land-owner	National Trust	Environment, heritage	UK	y	n
Environmental NGO, land manager	Woodland Trust	Nature	UK	y	n
Environmental NGO, birds, wildlife and nature	British Trust for Ornithology	Nature	UK	n	Y
UK independent scientific institution	Royal Society	Academic	UK	n	Y
Research Institute for forestry and tree related research, in England, Scotland and Wales.	Forest Research	Research	UK	n	Y

Important organisations such as the Natural Resources Defense Council (NRDC) and Forum for the Future were identified after the text analysis but no people were available for interview.

qualitative data was undertaken. Discourse analysis identifies "the sets of ideas, or discourses, used to make sense of the world within particular social and temporal contexts" [[98] p217]. It involves the analysis of texts to understand different accounts and the meanings behind those accounts. An inductive approach was used to identify common discourses expressed in the position texts and a coding structure was iteratively developed by the research team. These discourses suggest dominant ways of "seeing" the issue. Each report was read by the researchers and discourses were identified and coded accordingly, starting with recurring words and phrases. A discourse was confirmed if it met the following criteria (adapted from [83,87]): 1) identifiable ideological and linguistic features, 2) that it was commonly observed, 3) that it could be easily distinguished from other discourses, and 4) it is recognisable by others. These discourses were then analysed using the following framework, adapting linguistic and ADA approaches [52,92]: Lexical Choices, Argumentation Styles and language (ethos, logic, pathos), Social and Ideological Contexts, Power Dynamics, Stakeholder Positioning, Underlying Ideologies. Supplementary data Table S1 sets out the full discourse description.

Interview and workshop transcripts were analysed deductively with a coding structure designed around the discourses identified in the text analysis, and attention was paid to 1) discourse construction and argument, 2) discursive power, the discursive field and coalitions, 3) the context in which discourse are articulated (including contemporary and historic dynamic political context and relevant media coverage), and 4) the three SLO dimensions. For SLO, emerging themes were also identified inductively and coded, with a focus on how the discourses can set the conditions for a SLO. Groups of organisations with similar discourses were identified, and the institutional settings where these discourses gain traction were traced showing how certain ideas and framings come to dominate certain arenas.

5. Results

Results from the discourse analysis are presented first, analysis of their relation to the dimensions of the SLO framework then follows.

5.1. Discourse analysis

The text analysis is presented together with the interview analysis, followed by insights into discursive power, and discourse development across and within organisations.

The text discourse analysis framework is set out in Fig. 2. It identifies the organisation and its type, the assigned discourse, alongside text quotes from the position documents that characterise the discourse. Three unsupportive and three supportive discourses were identified in the document analysis. A 'neutral' discourse was also identified but not described here. A summary of the discourses is presented below, see Supplementary data for further descriptions. The interview analysis reveals more nuanced considerations of the issues within and across the discourses, illustrating the need to understand the many facets of the debate by differentiating biomass feedstock sources, and the supply chain actors, particularly with respect to UK produced biomass. This illustrates the importance of using interviews for a better understanding of the meaning behind what is said and who said it. All quotes with numbered participants are from interviews, unnumbered quotes are from workshop participants.

5.1.1. Unsupportive discourses

Three discourses, largely expressed in NGO and campaigning organisation texts, focus on the unproven BECCS technology, the unsustainable practices along the supply chain and negative impacts, and argue that BECCS is a distraction from alternative decarbonising approaches and mitigation in general.

Unproven, credibility questioned

This discourse brings together concerns about technological uncertainty of BECCS and insufficient evidence. It is risk focused and characterised by scepticism towards BECCS, emphasising that it is a technology "unproven" at scale. Credibility is questioned about the claims made. The language implies distrust in industries and governments, embodies precautionary environmentalism and advocates for accountability and transparency.

Damaging, unsustainable

This discourse views biomass feedstock, particularly large-scale wood pellet imports and burning for energy, as fundamentally unsustainable. BECCS is criticised as environmentally damaging, a "new

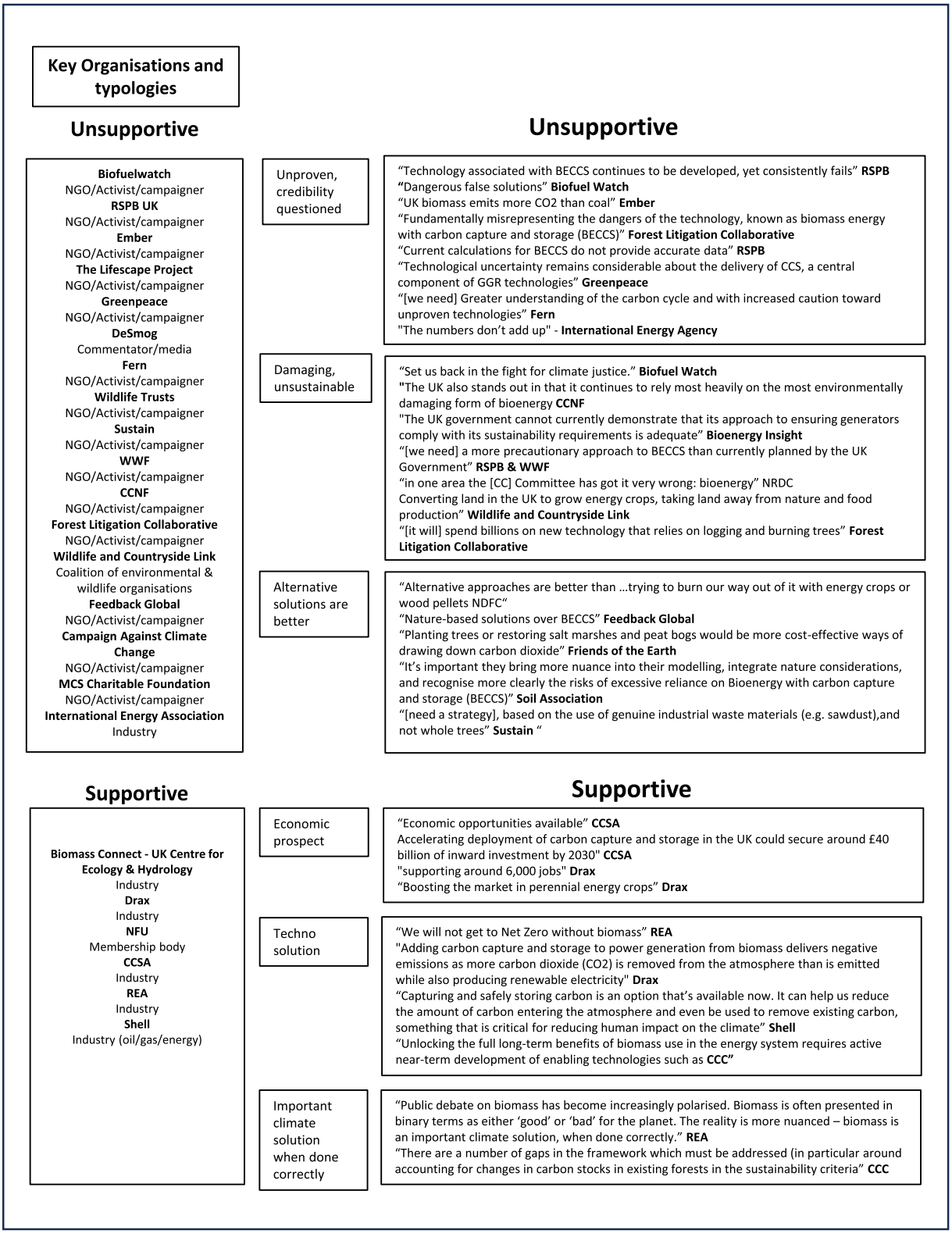

Fig. 2. Organisations and their respective discourses.

technology that relies on logging and burning trees" with an emphasis on imported wood, which undermines genuine decarbonisation efforts; or in the UK "taking land away from nature and food production". Positions itself as a counterbalance to dominant industrial and governmental narratives.

Alternative solutions are better

This discourse argues that nature-based solutions are a better approach and more cost effective than "trying to burn our way out of it with energy crops or wood pellets". It builds on the need to integrate nature considerations and argues that BECCS is incompatible with the Government's policy objectives for biodiversity and net zero.

The argumentation style leverages institutional credibility through

trusted environmental and advocacy groups and coalitions (e.g., Greenpeace, RSPB). Logical arguments are built on comparative analyses of BECCS versus alternatives. Proponents position themselves as defenders of ecological sustainability, and challenge the dominant narratives and power structures of industry.

Interviewees who expressed unsupportive views repeated and elaborated the discourses identified in the text analysis. They had concerns about unproven, risky and expensive technology and were fundamentally opposed to BECCS, seeing it as a distraction from alternative actions, exemplified here:

> "*I think we should try to limit the role of BECCS as greatly as we can in part because in our view it's a risky technology, with risks that come not from the feedstock but from the fact that it's technology that's still in development. That's incredibly expensive, and that can risk deterring real mitigation action today.*"
>
> NGO, participant 8

Others raised the issues of unsustainable supply and burning of imported forest biomass and the environmental harm to native forests across North America and Europe, in line with the discourse '*Damaging, unsustainable*'.

The legacy of previous bioenergy debates and how it influences views about UK biomass production for energy is apparent. Many of the proponents of unsupportive discourses do not differentiate between sources, markets and impacts, and arguments are often premised on imported woody biomass feedstock. Although BECCS is a new concept, people's perception of BECCS are heavily informed by previous energy debates, as an industry representative (Participant 2) explained: "*So yes, it's* [*BECCS*] *a new debate, but it's, being heavily informed by previous presuppositions and other debates that are going on within the public sphere.*"

An NGO/Commentator participant (6) concurred suggesting that opinions about biomass sources are often conflated, saying: "*I imagine that the NGOs who are critical of biomass and BECCS in general would also be naturally critical of upscaling of Miscanthus.*" Similarly, Drax, which has been at the centre of controversies, continues to dominate debates. For example, an NGO interviewee (Participant 7) remarked: "*I think* [*if we're*] *talking about Drax then we're talking about BECCS*", while a researcher noted that discussions about the potential of community scale projects are "*often lost in some of these discussions, which seems to always go back to discussions around the Drax project and biomass imports*" (Participant 11).

Similarly another environmental NGO participant (4) noted that reliance on BECCS in the UK Net Zero Strategy would require significant additional biomass supply, and if all done through domestic production could lead to "*thousands of hectares of biomass crops being needed*". In support of this, another remarked:

> "*Our concern is if you look at the pathways put forward by the CCC for example then they obviously require very significant increases in land take which we would question whether that is the best way to use that land.*"
>
> NGO, participant 7

While opposing large scale planting, some NGO interviewees concerned more with land management than campaigning, can see a role for small scale locally sourced feedstock, as an NGO participant explained:

> "*We want to see an end to large scale unabated biomass in the UK, significant narrowing of its contribution to the country's net zero targets and a much more cautious approach that heeds the uncertainty in the trade-offs, particularly the trade-offs for nature… but we do see a role, particularly for kind of local scale locally sourced bioenergy that may or may not be going into BECCS.*"
>
> NGO, participant 4

They went on to explain that their position about biomass would depend on how biodiversity demands were managed: "*If we were seeing high nature value land being taken and being used for this, we'd have a huge problem with that. If goals for biodiversity were being met and you were allocating some land for biomass crops, I don't think we'd have a problem with that.*" A number of them referred to the competing demands on land and the pending government Land Use Framework for England.

One NGO participant, although largely concerned about the feasibility of the technology, not the source of the feedstock, acknowledged that risks could be lower and more manageable for domestically produced feedstocks:

> "*So I don't think that position would necessarily change very much irrespective of what the feedstock is. However, for any specs that we do use, I think I would agree that the risks are lower for domestically produced feedstocks, but not necessarily zero. And they're not necessarily acceptable risks, but it's easier to manage them.*"
>
> NGO, participant 8

5.1.2. Supportive discourses

Three discourses from text analysis focus on the argument that biomass combined with carbon capture and storage (BECCS) is necessary, critical to meeting net zero targets and available now, that it offers economic benefits and, if managed sustainably, can contribute positively to climate goals. Proponents are largely from the energy industry and to some extent research and farming.

Techno-solution

This discourse emphasises the role of biomass combined with carbon capture and storage (BECCS) as a critical technology for achieving net-zero emissions. Proponents argue that BECCS can achieve "negative emissions" and is a technology "available now" and has a critical role, "we will not get to Net Zero without biomass".

Economic prospects

This discourse focuses on the economic benefits of investing in carbon capture and bioenergy technologies, emphasising job creation. It positions itself as aligned with economic growth and energy security priorities and focuses on quantifiable benefits.

Important climate solution when done correctly

This perspective supports a role for biomass with CCS technologies in achieving long-term climate goals, provided it is managed sustainably. It highlights the need for responsible biomass sourcing to ensure it contributes positively to climate goals without compromising biodiversity or food security. The discourse acknowledges polarisation in the debate but seeks to position BECCS as a viable middle ground.

The argumentation style draws on industry and research bodies for credibility, and positions BECCS as a logical and essential step for addressing climate change. They align with institutional and industrial power structures, drawing authority from quantifiable benefits and scientific evidence.

Interviewees (industry, farmer and to some extent research representatives) supportive of biomass for BECCS expressed views that corresponded to these discourses. While industry interviewees emphasised the necessity and economic benefits of BECCS, researchers referred to meeting targets as well as co-benefits of biomass crops to the environment, while farming representatives noted the impact on farm resilience. They emphasise the critical role that BECCS will play in the UK's decarbonisation plans, although recognising that the extent of BECCS's role is still to be determined:

> "*I strongly think that resources for BECCS technologies may be a way forward if we are going to meet our carbon and net zero emissions targets.*"
>
> Researcher, participant 11

However, proponents also question the scale and sufficiency of biomass planting in the UK pointing out that imports will still be needed:

> "*We know that BECCS is required. We know we need this technology… we know that in order for the UK to meet its demands and requirements, we are going to need imports of biomass feedstocks.*"
>
> Industry, participant 5

In this respect, they call for a reorientation of the argument, saying "*We need biomass. We need BECCS. Let's make sure however we do it wherever the feedstock is coming from it is being done correctly.*" Industry, participant 2.

They also emphasised the local benefits for rural economies and jobs:

> "*Within all bits of renewable energy, these are distributed assets. They operate right across the country. They're not based in urban areas, which is a great benefit to them, and they are bringing jobs, money investment into rural areas and rural communities*."
>
> Industry, workshop participant

From a farming perspective, new jobs in managing these crops are envisaged and a "*more diverse resilient agricultural sector*" (Membership body, workshop participant).

However, the discourse that BECCS is an *Important climate solution when done correctly* emerged as the dominant one amongst industry representatives in the interviews and the workshop. This is premised on the normative assumption that biomass and BECCS are necessary and inevitable, but need to be delivered responsibly.

Considering domestic biomass perspectives, supportive discourse proponents call for disaggregation of the different dimensions and nuances in discussions about upscaling biomass crops in the UK. They question the competing demands on land and this industry interviewee identified some tensions between the claims that biomass crops can be competitive and grow on poor land:

> "*You put the crop on, poorer lands, poorer soil. You get poor yields. And so, you know, a farmer. If we're wanting to mainstream energy crops into a farming business plan, you know, it's got to be able to compete with the other crops and or livestock systems that that are. There's a complex balance to be undertaken.*"
>
> Industry, participant 2

As with unsupportive proponents, they anticipated the government's proposed Land Use Framework would help reconcile the many demands on land. In this discussion the point that biomass crops can offer ecosystem benefits was noted by those who are supportive, although this point was not prominent in the position statements reviewed.

5.1.3. Discursive power, spectrum of views and coalitions

With respect to public influence, the discourse influence matrix (Fig. S1) analysis indicates that that most of the organisations have some influence on the public, with a balance between the supportive (industry, research, farming) and unsupportive (NGOs) in terms of organisation numbers and relative influence. Although it should be noted that many of the NGOs are international campaign organisations. The matrix was a useful prompt for interviewees to discuss discursive power across the organisations in terms of their ability to shape public opinion. They noted, however, the difficulty in disentangling the influence of organisations' discourse on public, policy or practice. One NGO participant explored the different nature and extent of this influence highlighting the importance of trust and public perception:

> "*You'd probably get quite a different pattern if you split out public influence from government influence, for example I don't think Drax has a lot of public influence, but it has strong influence with the government… they absolutely have the ear of ministers and have powerful PR… whereas I think the NGO community generally is quite high on the trust scales that you see in terms of public engagement.*"
>
> NGO, participant 4

NGO campaigners are considered influential in shaping public negative attitudes towards bioenergy, and this is important as "*public perception has a direct influence on policy, because public perception influences government*" (Research, participant 3). One NGO/commentator participant remarked that the media needs to be mentioned as an interim channel between NGOs and public as "*That's what the public will actually read*".

Regarding political influence, NGOs join forces to support certain campaigns or respond to consultation responses, issue joint statements or protest again government plans, coalescing around a shared opposition to imported feedstock and the continued government financial support of Drax. However, although they refer to themselves loosely as 'the bioenergy group', these arrangements seem to be temporary and reactive. The land manager NGOs in the UK are often led by campaigning NGOs. An NGO interviewee (participant 7) referred to aligning their positions with other more active organisations, and the role of coalitions saying "*We work with the organisations there who are probably more active in this space than we are, but I think we probably completely aligned with them*" (referring to campaigning NGOs such as WWF, Ember, the Natural Resources Defence Council, Friends of the Earth and Greenpeace) "*they tend to be the most vocal* […]. *They are well aligned in concerns but the difference is probably in the way we advocate or campaign for change*".

Another participant explained how they tended to work more closely with similar UK based organisations:

> "*I think pretty much all the environmental NGOs share our position. We tend to work closest with the NGOs that are most similar to us. So the major land holding NGOs in the UK, so those are RSPB, National Trust and Woodland Trust. The position talks about the enormous amount of import of woody biomass that's coming in particularly for Drax.*"
>
> NGO, participant 4

For supportive proponent coalitions, Drax and the NFU have worked in partnership and both are founding members of the Coalition for Negative Emissions and considered relatively more influential on public opinion than some industry associations (REA, CCSA) that may be influential in policy circles.

One researcher felt there was not much discursive dominance and no 'number one narrative' dominating everything else, describing it as it being split across actors: "*I think it is really hard to determine who has high influence, partly because it is just very fragmented, as a landscape.*" Research, participant 1.

This fragmentation is illustrated by a range of views across and within the constituent organisations. For example, an NGO interviewee remarked on the difficulty of differentiating their own personal view, and the organisation's view from the view of the NGO bioenergy group.

> "*I'm just being slightly careful here because there's my personal view, the position that we have actually written, and then there's also a kind of cross NGO view because we have an NGO's bioenergy group*".
>
> NGO, participant 4

Some participants also described a spectrum of viewpoints with some organisations characterised by a combination of discourses:

> "*You get organisations like the Climate Change Committee that are kind of aware that there are risks, but also feel very strongly that we need to have a really big role from BECCS meeting net zero targets. So that's the sort of spectrum.*"
>
> NGO, participant 4

Similarly, although researchers tend to identify as having a neutral position, the research community itself spans a wide set of organisations and opinions, even within one organisation views can vary. A researcher remarked, for example "*We have people such as myself and other colleagues who are very supportive of bioenergy. But we also have other colleagues who champion other technologies and genuinely don't like BECCS*" (Research participant 11). These comments all illustrate the fragmentation of views.

This diversity reflects an evolving debate. Furthermore, a number of interviewees acknowledged that their organisations had not updated their positions about BECCS given the plans for domestic feedstock upscaling, accepting that "*they have probably moved on*"; and that "*we've*

not really been pressed hard on what our official stance is on BECCS".

The supportive and unsupportive discourses identified in the text analysis, when unpacked in the interviews provide an in-depth understanding from the viewpoint of UK biomass production for CSS, and questions of SLO become more pertinent and specific. These are addressed in the next section.

5.2. Social license to operate

Discourse analysis has shown the dominant discourses, the discursive power and influence and range of actors' positions which can potentially influence the conditions for SLO for BECCS in the UK. This analysis also reveals the nuance and ambiguity that leads BECCS to be a contested concept. The results presented next are drawn from the interviews and the workshop and connect the discourses to the three intersecting dimensions of the SLO framework.

5.2.1. Distributional fairness

A number of positive aspects of distributional fairness were identified by supportive interview and workshops participants. They considered that most benefits and impact will be localised, felt at the community level, close to power plants and biomass planting, where rural jobs are created as a result of producing local biomass feedstock for BECCS (*economic prospects* discourse). However, ensuring fair distribution amongst this community was acknowledged as important:

> "*So a big part of I think the social license to operate is identifying how those jobs are being shared out, what are the kind of returns that are coming back and making sure that some of those returns are coming back to the community directly, not just to the landowner or not just to the operator of an energy site. And those kind of community benefits that are coming from economic activities.*"
>
> Industry, workshop participant

The need for governments to recognise and plan for equity across more vulnerable farming communities was identified by many participants, including fairly rewarding farmers for growing biomass:

> "*The transition for some farming communities will be more challenging than others in terms of transition to a net zero future. Some farming communities will also have a greater burden of climate impact.* [*We*] *need to ensure that they get most support for transitioning and that those growing bioenergy crops are actually the ones that do get that benefit.*"
>
> Industry, workshop participant

Discussions considered the role of farmers as biomass feedstock suppliers arguing that any upscaling ambition should be supported by consistent and coordinated government policy, guaranteed markets and development of a robust supply chain, as historically: "*Inconsistency in policy is really unhelpful and has caused distrust in communities*" (Membership organisation, workshop participant). Certainty is important for farmers given the loss of EU agricultural support payments, and unclear public support. As noted earlier, realistic figures about the potential yields and economic returns from biomass crops on marginal lands are also important. An industry interviewee (participant 2) highlighted the "*potentially significant benefits that energy crops could bring to diversifying a farmer's portfolio.*" They also considered that "*there is a strong case for a sort of smaller decentralised model, with local farmers supplying local power.*" This is in line with calls for to move away from a Drax-centric model and diversify domestic markets for feedstock to benefit communities and the bioenergy system as a way of distributing benefits more widely to achieve local benefits.

5.2.2. Procedural fairness

A number of requirements for achieving procedural fairness were identified including encouraging an open debate, raising awareness, seeking out trusted evidence, and developing engagement activities to suit different groups. The relationship between these processes and discursive power is significant for SLO.

Firstly, regarding debates, most interviewees agreed that biomass for BECCS is a difficult and complex process to communicate pointing out that the majority of people would not know what BECCS was. Furthermore "*Bioenergy is complicated because there are so many different types of feeds*". (Research participant 1). Critics tend to conflate different facets of BECCS: technology, feedstock sources, markets and impacts. Supportive discourse proponents call for disaggregation of the different dimensions and nuances in the debates to provide clarity, an industry workshop participant asked, for example: "*Is the issue really imports versus domestic biomass or is the issue just burning bioenergy?*"

Many participants argued for a more informed debate although framed this differently. Proponents of supportive discourses assert that education is needed to have a proper and less polarised discussion about BECCS. These appeals come from the presumption that BECCS is going to play a role in decarbonisation:

> "*The starting point for all of this, has to be a position in which, all stakeholders have a good understanding of the initial science and an agreement around the initial science. I am very aware that in many bits of the public debate, it's become very controversial. It's become very yes or no. That is not a useful debate to be happening anymore.*"
>
> Industry, workshop participant

Proponents of unsupportive discourses, however, framed this differently, pointing out that any awareness raising needs to be impartial and that currently it is often government-led and pro-industry, with little chance to hear opposing views or a more balanced critique. Although they also called for a more informed debate, this is from the perspective of questioning BECCS's rationale, and introducing more analysis, as this interviewee remarked:

> "*There's just so much concern whether that's actually renewable or not. … I think if there was a bit more academic discourse on the critiques around BECCS, it would be very helpful. At the moment it seems to be a bit sidelined to being a kind of campaigny kind of anti, you know, anti biology, anti BECCS. But I think it's the space to have a more nuanced discussion about it.*"
>
> NGO/Commentator, participant 6

Both sides of the debate therefore acknowledge that more understanding is required to remove the polarisation, but from fundamentally different standpoints.

Secondly, participants discussed the need for scientific evidence to be accessible in the public domain, to inform debates and support transparency in decision making. Different sorts of evidence were identified: scientific evidence about the impact and benefits of growing the crops in the UK (at national and local); evidence of integrity and transparency in the supply chain; and evidence that BECCS technology is feasible. For example, evidence is needed about the availability of so called 'marginal' land which is in high demand (for example for rewilding, solar panels or building houses):

> "*It* [*marginal land*] *gets semi mythical status, and gets called upon for a wide range of different things. So I think realistically* [*biomass crops*] *will displace existing cropping. And that means that there will be some displacement of something and that might mean food coming from abroad*".
>
> Science institution, workshop participant

Furthermore, presenting evidence about the environmental co-benefits of perennial biomass crops is needed so that it is "*not just about carbon savings, it is about these wider potential benefits*" (Researcher, workshop participant).

The source of evidence in particular is important in terms of its trustworthiness, credibility and objectiveness. Researchers see a role for themselves in providing balanced information:

"*The responsibility of people in my position as an academic and it's really about trying to communicate the evidence we have as clearly as possible and for biomass crops particularly, that's not just around the carbon savings, but those kind of multi-functional benefits, but also you know potential negative impacts as well. And so trying to provide a balanced presentation of the evidence and then being clear about any costs and also being really clear about what we don't know. So the uncertainties and it's everything about biomass.*"

Researcher, workshop participant

However, some participants suggested that researchers funded by government or commercial bodies take an inherently normative view that BECCS is the solution and tend to marginalise alternative mitigation options. For this NGO participant, lack of trust in independent assessment was raised as a concern:

"*I don't see much independent scrutiny of current operations happening, which is why there's a bit of a vacuum the* [*BBC*] *Panorama documentary was trying to fill by doing investigative pieces… …the CCC should be an independent robust body but I think they're underplaying the trade-offs quite significantly… So in my head I don't think there is a specific place yet where I feel I can absolutely 100% trust what's coming out on this topic*."

NGO, participant 4

Others agree that the CCC can be perceived as supportive of BECCS in that they have published scenarios for BECCS, however another regards them as a neutral source " *In terms of a trusted voice in the debate from the public sector, they would be the body that I would look to, who I would expect to provide that*" (NGO, participant 7).

5.2.3. Confidence in governance

For those supportive of BECCS, the emerging concept of 'BECCS done well' foregrounds their discussion (corresponding to the discourse *an important climate solution if done well*). An industry participant noted the crucial role of governance in setting and maintaining sustainability standards, such as the Sustainable Biomass Program.[3] However, they acknowledged their own responsibility in this:

"*It is* [*incumbent*] *upon us to be able to communicate what those certifications/standards are and the transparency around them* […] *So there is a fairly strong governance arrangement in place around this, but just saying that from a public perception point of view, we're very aware that the public don't always know about those certifications or trust those certifications. As I say to our members, just having a logo on your website doesn't give you enough trust from the public's point of view to be operating correctly.*"

Industry, workshop participant

Proponents of supportive discourses acknowledged the need to continuously review governance arrangements:

"*Science is an evolving, discipline and it's important to continually be reviewing those governance arrangements to understand what the science is telling us* […]. *We're also supportive of continuing to understand impacts and ensuring that* […] *when BECCS becomes a significant thing that we make sure we do BECCS right.*"

Industry, participant 5

They argued that it is also the responsibility of campaigners critical of BECCS to engage with and keep up to date with development in governance and standards:

"*Yes, there are standards there. That doesn't mean that all the people that are involved in the debate either know those standards and recognise them, and that can be two different things … so one of the frustrating aspects of the public debate around this is people take an initial starting position, which is completely understandable… without engaging with the science and the governance arrangements that are in place…. So I think it's incumbent on people that are critical of the sector and absolutely right to be critical in some aspects. But to be engaging with the substance of what is going wrong, not just trying to be black and white and polarizing the debate.*"

Industry, participant 5

Those expressing unsupportive discourses argue for robust and enforceable standards to address perceived unsustainability and poor governance. They question the adequacy of sustainability standards, highlighting poor enforcement, remarking on, for example, "*flaws in the existing standards do not give us confidence*". However, according to some participants, this must go beyond sustainability standards and performance targets and must include balanced discussions. The point was made that any collaboration should accommodate all views including scrutinising the evidence about alternatives to BECCS for achieving net zero. Continuing to question assumptions and rationale for the use of UK biomass for BECCS was considered necessary, asking: "*What is the main motive behind doing BECCS and biomass crops?*"

6. Discussion

The analysis examines how different organisations have conflicting perspectives, articulated in different discourses, and the interplay between what is said, who is saying it, and the context in which it is said. This reveals the positions, intentions and arguments of each organisation behind the discursive production and helps us understand "the work discourses do" [[94] p5]. This analysis provides the backdrop for considering how a SLO might be achieved for BECCS and what form it might take. We add adaptability as an additional dimension to the SLO framework.

6.1. Discourse construction

The results provide insights into the discursive processes through which BECCS discourses are constructed. The discourse analysis of position texts confirm fundamental differences, consistent with opposing storylines reported elsewhere [39] and the polarisation described in previous analysis [37]. The argumentation behind unsupportive discourses expressed by NGOs and campaigners, is underpinned by the legacy of past debates which dominate and shape the discursive field in texts where actors largely rely on known experiences [6,99], with Drax becoming objectified and given iconic meaning, restricting the scope of the discussion [39,75]. Despite the new emphasis on domestic biomass production, debates tap into deeper more pervasive narratives [42] showing how historic as well as contemporary socio-political contexts, such as media coverage, reinforce arguments and shape what is being said by campaigners. However, text analysis can be 'partial' [32] as it conceals the underlying nuances expressed by individuals in the interviews and workshops, particularly land manager NGO participants; and overlooks the multifaceted nature of BECCS, specifically the implications for land use. The dynamic nature of discursive construction is clear, with ongoing processes of negotiating and adapting, as actors disentangle what BECCS means for them and for the UK. The analysis shows that it is possible for some individuals to construct arguments differently and to refer to and even 'inhabit' different discourses on the environment within different context, including the same organisation or coalition group [100]. As others have suggested, the ambiguity of the term provides flexibility for, and obscures, diverse and conflicting interests [101,102] and shows that BECCS is still an imprecise concept in the UK, particularly given the new focus on domestic biomass crops [75].

[3] The largest biomass users in the UK use the Sustainable Biomass Program (SBP) certification scheme.

6.2. Discursive power and influence

Discourse has the potential to condition people's perceptions and advances some interests while suppressing others [103], this discursive power can have direct implications for any SLO processes. A broad array of actors taking ambiguous stances, related to the inexact BECCS concept, as observed elsewhere, can result in no actor type dominating discussions and debates [5,32,104]. This is in line with the observation that discourses, particularly around the new focus of BECCS with domestic biomass crops, is fragmented, with neither 'side' able to achieve discursive dominance. On the one hand, the normative government-led and pro-industry optimistic narratives are perceived by opponents to dominate and squeeze out alternative approaches to BECCS. This 'future essentialism' [105] stance tends to narrow public debate on the full range of decarbonisation options available [47]. As part of this the 'BECCS done well' concept [57] has emerged and is being repeated and reproduced, [94]; when this happens, a discourse can become calcified [69,92,97]. Thus, in terms of meeting Hajer's [87] two criteria of discursive hegemony, firstly there is 'discourse structuration', which occurs when a discourse begins to dominate the way in which a social entity (e.g., policy area, enterprise, society as a whole) conceptualises the world [52], although this is only within the policy arena. Secondly, specific institutional arrangements, the industry sustainability governance arrangements, demonstrate some 'discourse institutionalization'. With this discourse, the responsibility for SLO and incumbent power for implementing BECCS lies with the industry partners, policy makers and evidence providers, rather than stakeholders, opponents or affected groups [28,69]. The latter have little agency in setting the scope of the debate and are not in a position to give 'free and prior informed consent', a condition for SLO [106]. However, on the other hand, NGOs continue to challenge the hegemonic institutions, they are significant in number and they strengthen their influence when the actors form coalitions to create a shared dominant framing or narrative, akin to a discourse coalition [93] although, this is often a temporary reactive arrangement. This political influence is enhanced by their public influence, as shown in the matrix and the interview data suggesting that they are potentially more powerful in terms of steering the public discourse, if not the political one, due the stronger public trust. This discursive struggle for hegemony [87] sets the stage for SLO processes.

6.3. Distributional fairness

The discourse polarisation and discursive influence situates views about distributional fairness. Supportive proponents have created a dominant discourse around a large scale model that helps to meet climate targets and promises regional economic prosperity, in line with normative government policy [13]. Regarding rural communities, localised positive '*economic prospects*' are foreseen for those close to power stations, although public perceptions studies do not always support this [11], and where deployment overlays pre-existing histories, infrastructure and relationships, an ongoing SLO cannot be assumed [13]. For the farming community, some participants consider that biomass crops offer diversification and resilience opportunities. However, the legitimacy of these claims is questioned both with respect to the expectations of competitive yields from marginal land and the risks involved for farmers when markets and political commitment have been inherently uncertain. In particular ensuring "*those growing bioenergy crops are actually the ones that do get that benefit*", was highlighted as critical, as noted by other researchers, for achieving acceptance [6].

The differential impact of large-scale domestic planting is a concern for proponents of unsupportive discourses, as observed for other bioenergy industries [75]. This is expressed by unsupportive discourse proponents in terms of displacing food crops and threatening local culture, nature and landscape, and evidenced by some researchers, although some argue that this focus can distract from attempts to minimise and manage indirect land-use impact [107]. Sense of place has been recognised as important at community level [13,99,108], but needs to be extended to farmed cultural landscapes. To counter these concerns, small scale planting and community scale projects to localise benefits for the rural economy, nature and people were seen to have potential by some unsupportive proponents. However, previous localisation discourses have met a number of barriers [33] and economic viability compares poorly against large-scale monoculture plantations. This small scale vision does, however, resonate with opportunities for: integrating biomass crops into the farm system [61], combining or stacking ecosystem service payments and crop revenue streams [8], small scale energy systems [4] as well as being in line with a multifunctional land use model which underpins the governments Land Use Framework proposals for England [63,109].

6.4. Procedural fairness

The discourse polarisation and discursive influence have implications for achieving procedural fairness. Proponents of BECCS argue for a more informed evidence-based debate to avoid a dichotomy of views, however, this is from the normative stance that BECCS is essential to achieving net zero, "*we know we need this*". These proponents position critics as ill-informed and as needing to take responsibility for keeping up to date with developments in governance standards and scientific evidence, especially about the co-benefits of biomass crops and spatially targeting them to maximise ecosystem service benefits [4,110,111]. This view reflects the "deficit models" of public understanding and engagement articulated in a body of research on CSS that identifies communication as important [28,112]. Proponents of unsupportive discourses call for opening up the scope of the discussion with exploration of alternatives to BECCS, they question the assumptions and motives for the use of domestic biomass for BECCS, and reflect on what sort of societal development the BECCS trajectory implies [113]. They call for independent scrutiny, and trust in the impartiality of the evidence source. Although the CCC is trusted by some critics as an independent body, it is seen by others as operating within the same orthodoxy as policy makers and industry, in what Booth [32] calls a 'technocratic subhegemonic' fraction within this discursive space. Thus, although both 'sides' agree the need to overcome a polarised debate, each particular discourse has its own argumentative rationality [90] which impinges on this. This can undermine any procedural fairness processes of communication and engagement.

This, together with a sense of limited agency, might explain critics' reluctance to engage with deliberative processes [114], although capacity to keep up to date on research and standards, or to review their policies about BECCS, is also an issue. This can restrict their communications to more reactive consultation responses, as found for other polarised discourses [115]. Overall, the deliberative quality of discussions about BECCS is poor. Procedural fairness could be, not only enhanced with more opportunities for dialogue and engagement, but also reoriented by enabling democratic decision-making [116] which incorporate multiple interpretations, values and knowledge about BECCS, and so provide the basis for knowledge democratisation [64,117]. Some studies propose public controversies as a means of broadening appraisals of the feasibility of GGR approaches and articulating future issues and governance challenges [118]. However for this to work, it is important not to see BECCS as a fixed technology [26] but to explore mitigation alternatives. Meanwhile there are possible 'entry points' for dialogue that domestic biomass crop production and supply might enable such as exploring options for context-sensitive small scale production and community based bioenergy systems, which can align with societal and local values [85] and emerging evidence supporting integration options [119]. Such dialogue could start to shift the debate currently anchored in legacy issues and normative discourses [77,120].

6.5. Confidence in governance and trust

Trust is tightly coupled to all SLO dimensions and lack of trust in government and industry can translate into the withholding of a SLO [80]. Past experience reflected in unsupportive NGOs' comments has led to poor transactional trust with low confidence in governance arrangements and ability to enforce standards, as identified by independent reviews [56]. Equally farmers' trust in policy-makers and industry to support and foster stable markets has been eroded over the years. Trust is expressed as credibility, whereby NGO participant question the impartiality of 'independent' sources of evidence [121]. It is also expressed as economic legitimacy and sociopolitical legitimacy. The former with respect to biomass production and farm businesses, the latter with respect to the perception that BECCS is not in line with general societal values and established norms [15]. With the centrality of trust, the question emerges of what options are open to develop meaningful, long-term, trust-based relationships, which have been shown to be important for advancing SLO with communities [69,74,81]. As noted above, facilitating deliberative processes could build relational and transactional trust and allow the debate to be more inclusive and open [12].

6.6. Adaptability

The diverse and changing discursive field across and within social groups aligns with Thomson and Boutilier [73] observation that SLO is "dynamic and non-permanent because beliefs, opinions, and perceptions are subject to change as new information is acquired" (p. 1779). Proponents of supportive discourses acknowledge the need to continuously review governance arrangements for supply chains, and respond to calls for improvements [56,57]. They also argue that it is incumbent on critics to keep up to date with standards and scientific evidence. Furthermore, there is a need for adaptive policy-making to allow farmers to confidently diversify, and bioenergy industries to invest, as supported by other research findings [8]. This includes responding to emerging evidence about the role of biomass crops in delivering co-benefits, such as biodiversity and flood mitigation change, and about spatial considerations [110]. Although the SLO notion of adaptability and resilience was developed for communities affected by mining [82], it is pertinent to BECCS in the UK, not only with respect to the need to continuously reassess the implications of new feedstock supply chains and new evidence, but also for consideration of alternative mitigation options. Adaptability (including associated concepts such as flexibility and responsiveness) is coincident with the changing meaning, interpretation and implementation, that is discourse, of the net zero context and of BECCS itself [89]. Adaptability is also central to recognising SLO's embedded normative complexity—that is, how competing values and disagreement about what is desirable make SLO hard to pin down as a unified, objective standard [68,77].

7. Conclusion

Foregrounding domestic biomass crop production and land use issues, we draw on a wide range of constituent actor groups to explore the discursive field, its development and power relations and how these might condition a SLO. This allows us to understand how the multiple meanings of the contested concept of BECCS might steer SLO processes. We build on existing scholarship on SLO in energy transition research providing empirical data with novel insights into perspectives about BECCS in the UK. In doing this we position the research within a shift in the literature from social acceptance to a more nuanced analysis of the social, political, ethical, and governance context, and respond to calls for incorporating issues of justice, equality, power, and responsible innovation. Methodological and theoretical synthesis of discourse analysis and SLO advances scholarship in both these areas and reorientates discussions away from notions of acceptability of BECCS.

Polarised discourses underpinned by fundamentally different rationale, prevail in texts across different organisations in the UK, with industry stakeholders, associated researchers and farming representatives constructing supportive discourses, and NGOs (land managing and campaigning) expressing unsupportive discourses. In-depth investigation beyond position statements, revealed the multi-faceted nature of the arguments and meanings underpinning these discourses which relates to the imprecise nature of BECCS and the context in which the actors consulted operate. Analysis also showed the dynamic and somewhat fragmented discursive field which is developing as these organisations respond to the new complexities and communities of implementation of BECCS. Supportive discourses reflect the normative more institutional framing of BECCS, and partially meet criteria for hegemonic dominance, while unsupportive discourses are reinforced by coalitions, however overall discursive dominance is not yet fully established. The implications of this discursive field for the delivery and conceptualisation of a SLO are equally complex.

Overcoming the discourse polarisation and associated hegemonic struggles emerges as a key need for achieving a SLO. Firstly, the importance of deliberative discussions to accommodate polarised views and give voice to different social groups is clear. In this way, by bringing in different knowledges and values, a SLO that reflects all discourses might be achieved, rather than simply advancing political ambitions for a prescribed technological fix. This would enhance both distributional and procedural fairness processes and build confidence and trust in government and industry. Secondly the dynamic BECCS discursive field calls for adaptability from all groups, including a shared responsibility and agency for reviewing and responding to governance, political demands, evidence and societal interests. Adaptability is critical to the dynamic, contingent and somewhat intangible notion of SLO, a feature of global and national political unpredictability. Introducing these two elements to the concept of SLO allows for normative complexity around achieving net zero and positions the debate within a wider range of mitigation options and climate futures. This enables critical reflection on whose values and visions are embedded in efforts to secure a more normative 'BECCS is desirable' framing and supports a value free discussion of desirability, risks, and broader societal implications of BECCS. This is in line with calls for a shift from a transition to a transformation perspective to keep the option open of not relying on end-of-pipe solutions like CCS, and allows the current power structures to rebalance [28]. Fig. 3 illustrates this new conceptualisation of SLO for BECCS.

BECCS and the transition towards more domestic biomass feedstock is given a central role in the CCC's balanced pathway for the UK. From a normative perspective, BECCS, as a socio-political technology, requires strong social and institutional support and ultimately a SLO, if the government are going to follow this recommendation. However, this analysis questions and reorientates the notion of SLO and presents an opportunity to rethink meanings of BECCS in the next context of domestic crop production.

The research was designed to explore the links between discourse and SLO, rather than to provide an in-depth study to support the respective concepts. However, a robust approach was taken to data collection and analysis for both, following recognised procedures and methods. There were, however, limitations. Regarding participant engagement, the sample size was relatively small, some campaigning NGOs did not engage, and stakeholders from the devolved nations of the UK were not specifically identified. However, a good range of texts and stakeholders were included representing the BECCS debate in the UK, and the quality of the engagement was excellent. Identifying the influence, discursive power and dominance was methodologically the most challenging aspect. We were limited to assessing relative influence subjectively from the organisation profiles and expert opinion, however we drew on discourse analysis (text and interview) to provide supplementary insights into discursive dominance. In future studies a stronger focus on facilitating deliberative engagement with a larger and well-balanced set of stakeholders would provide an opportunity to

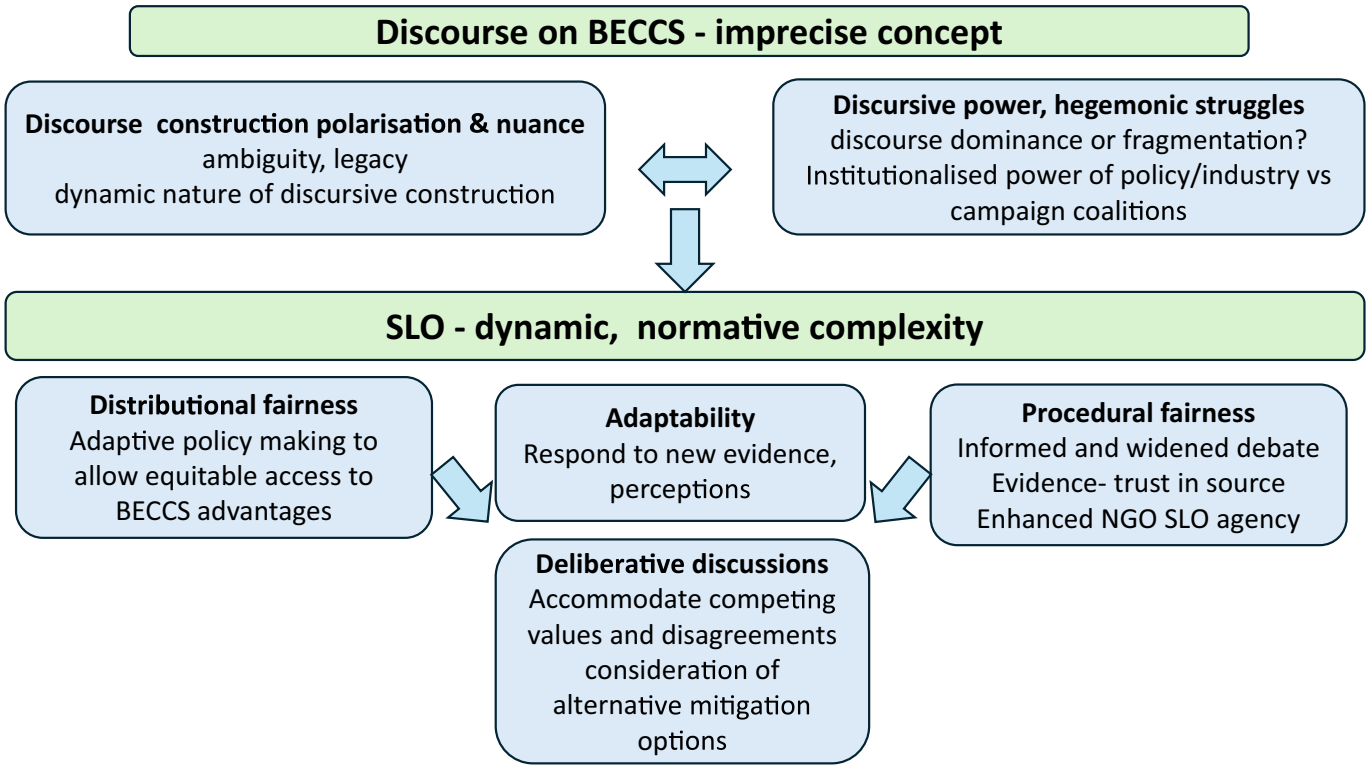

Fig. 3. Conceptualisation showing how discourse analysis informs processes for achieving a SLO for BECCS.

consolidate and build on these findings. Although undertaken in the UK, the empirical, methodological and conceptual insights can be applied across international contexts which face similar discourse development, and political and social demands.

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CRediT authorship contribution statement

Julie Ingram: Writing – original draft, Supervision, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Rhian Brimble:** Writing – review & editing, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation. **Jane Mills:** Writing – review & editing, Supervision, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that there are no conflicts of interest related to this paper.

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Data availability

The data that has been used is confidential.

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