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TOWARDS SUSTAINABLE DATA CENTRE OPERATIONS IN THE UK

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ABSTRACT

Purpose-The purpose of this practice briefing paper is to provide an exploratory review of the sustainability agendas being addressed and publicly reported by the UK's leading data centre operators*.*

Design/Methodology/Approach-The paper begins with a short discussion of the characteristics of sustainability and an outline of the origins and development of data centres within the UK. The paper draws its empirical material from the most recent information on sustainability posted on the UK's leading data centre operators' corporate web sites.

Findings-The findings reveal that all the UK's leading data centre operators provide only limited information on their commitment to sustainability with the dominant focus being on its environmental dimension and with little attention being paid to social and economic issues. More critically the authors argue that these commitments are driven more by the search for efficiency gains, that they are couched within existing business models centred on continuing growth and that as such the UK's leading data centre operators are pursuing a 'weak' rather than a 'strong' model of sustainability.

Practical Implications- The paper suggests that the leading data centre operating companies may need to extend their sustainability reporting and to introduce external assurance procedures.

Originality/Value- The paper provides an accessible review of the sustainability agendas being pursued by the UK's leading data centre operators and as such it will interest academics, students and practitioners interested in both sustainability and data centre operations and developments.

Keywords-Sustainability, data centres, UK

Paper Type- Practice Brief/Research Paper

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'An ongoing convergence of environmental, legislative, social and economic factors is driving IT organisations, suppliers and services providers towards more environmentally sustainable practices' (Power and Energy 2012).

Introduction

The continuing growth of digital technology in an ever-expanding range of business, government and social activities has been accompanied by an explosion in digital data

generation. This data is processed, stored, managed and exchanged in data centres, which have become the driving hub of the economy, and in some ways, of society. The Internet; email traffic; social networking sites; streaming sites; data processing; online retailing; credit and debit card transactions; electronic car parking, speed cameras and congestion charging; freight and parcel tracking by couriers; insurance documentation; and medical records all rely on data centres. The Telecity Group (2011), one of Europe's leading data centre companies, asserts that data centres are *'at the heart of the digital economy.'* Sustainability is increasingly seen to be an important issue for data centre operations. Data centres are major energy users. Hewlett Packard (2012), for example, estimated that the power consumed by data centres worldwide increased by 56% between 2005 and 2010 and data centres account for some 2% of global carbon dioxide emissions. While this raises obvious environmental concerns, sustananabilty is important across the life cycle of all the products and services associated with data centre operations. That said while Collins (2012) recognises that *'for most organisations today, doing business in ecologically responsible ways is a higher priority than ever'* he argues that *'many companies find achieving sustainability in their data centres challenging.'* In identifying *'sustainability'* as *'the next challenge for the Data Center'* Pflueger (2011) enquires *'are the resources that our data centres are consuming being put to use in a productive manner?'* and *'are the benefits we receive from these facilities being provided in an environmentally and socially responsible manner?''*With this in mind this paper provides an exploratory review of the sustainability agendas and achievements being publicly reported by some of the leading data centre operators within the UK and it offers some wider reflections on these agendas and achievements and on the reporting process.

Sustainability

The concept of sustainability can be traced back as far as the thirteenth century but in more recent times it re-appeared in the environmental literature in the 1970's (Kamara et. al. 2006) and since then it has attracted increasingly widespread attention. Diesendorf (2000) has argued that *'sustainability'* can be seen as *'the goal or endpoint of a process called sustainable development.'* The most widely used definition of sustainable development is '*development that meets the needs of the present without compromising the ability of future generations to meet their own needs'* (World Commission on Environment and Development 1987). However defining this concept is not straightforward and a number of different and contested meanings can be identified.

More specifically, there are sets of definitions that recognize that all human beings live on one planet with finite quantities of natural resources and fragile ecosystems on which all human life ultimately depends. There are also much more all embracing definitions that seek to include ambitious social and economic goals and to meet human needs in an equitable manner. Typical of the first set is ecological sustainability defined by Callicot and Mumford (1997) *as 'meeting human needs without compromising the health of ecosystems'* and Sutton's (2004) definition of environmental sustainability *as 'the ability to maintain things or qualities that are valued in the physical environment.'* The second set is reflected in McCann-Erickson's (2007) definition that *'sustainability is a collective term for everything to do with the world in which we live. It is an economic, social and environmental issue. It is about consuming differently and consuming efficiently. It also means sharing between the*

rich and the poor and protecting the global environment while not jeopardizing the needs of future generations.'

More critically Hudson (2005) argued that definitions range from *'pallid blue green to dark deep green.'* The former Hudson (2005) suggests centre on *'technological fixes within current relations of production, essentially trading off economic against environmental objectives, with the market as the prime resource allocation mechanism'* while for the latter *'prioritizing the preservation of nature is pre-eminent'* (Hudson 2005). Hudson (2005) suggests that the dominant view of sustainability *'is grounded in a blue-green discourse of ecological modernization'* and *'claims that capital accumulation, profitable production and ecological sustainability are compatible goals.'* Further he contrasts this view with the *'deep green'* perspective which *'would require significant reductions in living standards and radical changes in the dominant social relations of production.'* In a similar vein a distinction is often made, for example, between 'weak' and 'strong' sustainability and Roper (2012) suggests that *'weak sustainability prioritizes economic development, while strong sustainability subordinates economies to the natural environment and society, acknowledging ecological limits to growth.'*

As interest in sustainability has gathered momentum so a number of attempts have been made to develop theoretical frameworks connecting nature and society and to emphasise that social and economic development cannot be viewed in isolation from the natural environment. Amsler (2009), for example, has argued that *'the contested politics and ambiguities of sustainability discourses'* can be embraced to develop a *'critical theory of sustainability.'* She further argues that current debates should be located '*within a broader tradition of social criticism'* and that *'competing interpretations of sustainability'* should be viewed as '*invitations to explore the complex processes through which competing visions of just futures are produced, resisted and realized.'* Castro (2004) has sought to lay the foundations for a more radical theory of sustainability by questioning the very possibility of sustainable development under capitalism and arguing that economic growth relies upon the continuing and inevitable exploitation of both natural and social capital.

Data Centres: Characteristics and Origins

A data centre has typically been defined as *'a centralized repository, either physical or virtual, for the storage, management, and dissemination of data and information organized around a particular body of knowledge or pertaining to a particular business'* (TechTarget 2012). That said any consensus in precisely defining the term data centre is difficult not least in that *'the words data centre mean different things to different people'* (DatacenterDynamics 2012) and Rath (2011) suggests that the definition of what constitutes a data centre has evolved over the last twenty five years. Data centres vary in size and can occupy a single room within a building, one or more floors of a building or an entire building. The vast majority of the initial data centres were housed in existing industrial and warehouse properties, that were retro-fitted to enable them to house the racks of servers, but such centres generally do not meet the sophisticated demands of modern users. More recently the focus has been on the development of new custom designed and purpose built centres which are specifically designed to meet standardised global blueprints which in turn offer significant time and cost savings.

The main equipment within centres are servers, mounted on racks placed in single rows with aisles between them so that the staff have easy access to these racks, and sets of routers and switchers that facilitate communication between the servers and the outside world. The physical environment of data centres is strictly regulated and air conditioning is used to control both the temperature and humidity and centres also have water and smoke detection systems and sprinkler systems. Powerful cooling systems are required to offset the heat produced by the servers and more energy is needed for cooling than for data storage and processing. Data centres are major energy users and while smaller centres draw just a few kilo watts of power the larger centres will draw up to a hundred mega watts. Security is also a major operational concern. New measures are constantly being introduced to combat the threat of cyber crime, access by personnel is strictly controlled and data centres have video camera surveillance and security guard patrols.

While the global economy is increasingly seen to be dependent on data centres, information on the number of data centres and on data centre space is limited and defining data centre markets and market sizes is widely seen to be a major challenge (Applied Computer Research 2010). That said Emerson Network Power estimated that there are some 509,000 data centres worldwide, occupying some 26.5 million square metres of rack space (DataCenterKnowledge 2011). The emergence and rapid growth in the number of data centres reflects a number of developments in information and communication technologies. These include the advent and increasingly widespread use of micro computers: the growing complexity of IT systems; the expansion of client-server computing: the so called 'dot.com' boom around the turn of the millennium; and more recently the advent and growth of cloud computing and the expansion in the popularity of mobile computing and social media sites.

There is some general consensus within the industry that the UK represents one of the largest data centre markets in the world. In the June 2012 issue of its monthly Data Centre magazine GVA Connect (GVA Connect 2012a), for example, argued that *'the data centre sector has begun 2012 in bullish fashion'* and it ranked the UK as the second best country in which to locate data centres reporting that* its high international internet bandwidth capacity and ease of doing business put it above all other European locations surveyed.'* However there is no independently audited register of data centres in the UK and E&T (2011) has suggested that variations in physical size and data storage capacity mean that *'arriving at a headcount figure can only be an educated estimate.'* In 2011 E&T (2011), for example, reported approximately 250 commercial data centres in addition to some 220 data centres across central government, some 600 in local government and the wider public sector and a further 88 with police authorities in the UK. A year later GVA Connect (2012b) estimate there to be 325 data centres within the UK while the Royal Institute of Chartered Surveyors (2012) put the figure at 1,450. More generally an *'Industry Census'*, carried out *by* DatacenterDynamics (2011), suggested that there was some *'7.59 million square metres of dedicated data centre and data comms space'* within the UK.

Four principal business models of data centres can be recognised. Firstly what might best be described as the corporate data centre which is located in-house and managed by the company's own staff and which is exclusively used by large companies or governments for the storage of their own data. Many companies and organisations certainly believe that

owning and operating their own data centre makes sound economic and/or strategic sense. However in the face of rising costs and seemingly ever more sophisticated technological innovation, many companies have not been in a position to develop and manage their own facilities and they have increasingly come to regard outsourcing as a compelling and competitive alternative to operating and managing their own data centre. Here a distinction is often made between wholesale and retail data centres.

In the former property focused companies lease data centres to service the wholesale data management, storage and processing needs of large organisations such as banks and financial service companies, large corporate customers and government departments. The accommodation is usually let on a shell basis to be fitted out by the tenant with the landlord providing power only and leases typically last for at least ten years. In the latter the operating companies offer data storage, processing and management services to a large number of customers and varying amounts of space are let fully fitted with leases typically lasting between three and five years. Fourthly there are carrier owned data centres which, as their name implies, are owned and operated by data carriers and connected to the network of that carrier. The users of these centres tend to be either carriers themselves or small companies which rent rack space in the centre.

Frame of Reference and Method of Enquiry

In order to obtain a preliminary overview of the extent to which data centre operators are facing up to the challenges in *'achieving sustainability in their data centres'* (Collins 2012) referred to earlier, the UK's leading retail and wholesale data centre operators', namely Equinix: Interxion, the Telecity Group; Telehouse; Global Switch; Digital Reality, Infinity; Virus; and Colt, were selected for study. These companies were identified as the leading operators by Andrew Jay (personal communication 16.08.2012), Head of Data Centres at CBRE, the world's largest commercial real estate services company. These are leading operators in the field and as such they might be expected to reflect cutting edge thinking and practice and as they are actively and widely competing for business they might consider it vitally important to publicly demonstrate their sustainability credentials to potential customers and more widely to governments, society and the media.

During the past decade *'sustainability reporting has evolved from a marginal practice to a mainstream management and communications tool'* (Global Reporting Initiative 2007). Capriotti and Moreno (2007) have argued that *'in a short time the Internet has become an essential tool for organisational communication'* and Bowen (2003) has suggested that the majority of large companies have realised the potential of the World Wide Web as a mechanism for reporting sustainability agendas and achievements and has argued that its interactivity, updatability and its ability to handle complexity adds value to the reporting process. With this in mind the authors undertook an Internet search for material on sustainability on each of the selected data centre operators' web sites in August 2012 employing Google as the search engine.

The information revealed by this search provided the empirical information for this paper. The specific examples and selected quotations from the data centre operators' websites cited within this paper are used primarily for illustrative rather than comparative

purposes, with the focus being on conducting an exploratory examination of the current sustainability issues being addressed by the UK's leading data centre operators rather than on providing a systematic analysis and comparative evaluation of their sustainability policies and achievements. In undertaking this examination the authors used the conventional 'three pillars' of sustainable development, namely environment, society and economy with which to group specific sustainability issues. In discussing the reliability and validity of information obtained from the Internet Saunders et.al. (2007) emphasise the importance of the authority and reputation of the source and the citing of a contact individual who can be approached for additional information. In surveying the leading retail and wholesale data centre operators the authors were satisfied that these two conditions were met.

Findings

The Internet search revealed that the selected data centre companies publicly provided relatively limited information on their sustainability agendas and achievements. Only two companies, namely the Telecity Group and Colt, produced a dedicated corporate social responsibility report which focussed on a range of sustainability agendas and achievements and all the other companies provided brief brochures and statements concerning their approach to sustainability. Of the 'three pillars' of sustainable development mentioned earlier environmental issues were by far and away dominant and here companies were generally keen to emphasise their general environmental sustainability credentials. Equinix, for example, claims to be *'working towards a sustainable future'* and reports that its *'global international business exchange operations and engineering teams have implemented comprehensive conservation and efficiency programs that include energy and water conservation, solid waste reduction, pollution prevention and recycling.'* Telehouse stresses its commitment to *'developing initiatives to conserve the global environment'*, to *'employ energy saving green technology'*, to *'comply with environmental regulations, legislation and policies.'* Interxion claims to be *'sustainable and responsible'* and to be *'always looking at new ways to optimise energy efficiency, reduce carbon emissions and cut waste'* and in a similar vein under the heading *'Green initiatives'* Global Switch stresses its commitment to *'reducing the impact of our data centres on the environment through using energy efficiently, reducing our carbon emissions and providing green energy solutions.'*

A minority of the selected companies provided some specific commentary on how they are addressing a range of environmental issues and impacts including energy consumption and efficiency; carbon emissions; cooling systems; waste management and recycling; water management and environmentally responsible procurement. Energy efficiency is very much the dominant issue. The Telecity Group stresses its belief that that *'the data centre industry has vital role to play in creating a more environmentally efficient economy'* and emphasises its commitment to *'minimising its environmental impact.'* At the same time while the company recognises that securing improvements in energy efficiency is a major environmental challenge it reports on *'introducing more energy monitoring and targeting systems and installing more sophisticated monitoring systems and energy analysis.'* Colt reports on the reduction in the power usage effectiveness in its data centres and stresses its commitment to pursuing continuing reductions.

Digital Realty argues that the operational efficiency of a data centre is a function of two objectives *'effective electrical power utilisation'* and *'heat removal'* and it identifies five design elements of energy efficient data centres which it suggests are required to achieve these objectives. These elements are a hot aisle/cold aisle configuration; the operating temperature; an appropriate building management system; building out incrementality; and the distribution and sealing of floor tiles. By placing servers in alternating cold (air intake side) and hot (heat exhaust side) aisles, for example, the company argues provides an effective way to balance the hot and cold air input and output within data centres. An appropriate building management programme allows operators to capture and monitor key performance data and to identify variations in power usage levels.

The majority of the selected companies acknowledge the need to reduce carbon dioxide emissions. The Telecity Group reports on its carbon usage effectiveness (CUE) measure introduced in during 2011 and designed to capture *'a combined picture of the energy efficiency of operations and the carbon intensity of the energy used.'* The company argues that the introduction of the CUE measure encourages individual data centres to improve the efficiency of their systems and procedures and to seek out low carbon sources of energy, allows individual data centres to compare their performance with each other and across time and more generally provides opportunities to improve data centres' sustainability.

A small number of the selected companies identify water consumption and waste management as increasingly important issues within their sustainability agendas. The Telecity Group, for example, argued that water and waste management are emerging concerns that are likely to assume greater importance in the future as the complexity of pursuing data centre companies' sustainability agendas unfolds. The company suggested, for example, that many of the new technologies that drive energy efficiency will also increase water usage through evaporation associated with cooling and it reports developing water efficiency initiatives. At the same time although waste accounts for a relatively small fraction of the company's overall environmental impact it reports taking measures to minimise waste and to recycle as much unavoidable waste as possible. Colt reports similar initiatives in that it has introduced a waste minimization programme to reduce paper consumption within the company's offices and an electronic invoicing system for customers and it is also planning to measure water consumption and to assess whether water consumption levels and costs are issues for the company.

Two of the selected companies report on moving towards environmentally sustainable procurement. Telecity, for example, recognise that procurement includes three principal elements namely buildings, energy and equipment and it emphasises its commitment to minimise its environmental impact for all three elements. The company reports on using renewable energy at its Powergate data centre in London and working with IT infrastructure manufacturers to help *to 'develop devices that consume less power without compromising operational efficiency.'* More generally the company also argues that *'the process of engagement with suppliers is one important way in which the Telecity Group is trying to influence industry-wide standards for environmental performance.'* Colt reports on initiatives to calculate the carbon footprint within its supply chain and suggest that the early

evidence indicates that this footprint is material to the company and that the production of footprint data helps to provide a benchmark against which the company can calibrate and reduce carbon emissions.

The selected data centre operating companies generally provide only very limited public information on social and economic sustainability issues. Only the Telecity Group and Colt report on social issues including staff training and development, diversity, health and safety, community investment and ethically responsible sourcing. The Telecity Group, for example, recognises that *'the skills, knowledge and commitment of our workforce are vital factors in our continuing success'* and reports on investing *'significantly in the skills and expertise of our people.'* In claiming to be *'creating a great place to work'* Colt reports on diversity and health and safety issues. Thus the company recognises that *'a diverse workforce is key to success in the modern business world'*, argues that *'it is difficult to serve the needs of our customers if we do not reflect their diversity'* and reports on the establishment of a *'Women's Group'* to *'support and encourage the career paths of women within Colt.'* Colt also reports on its appointment in 2011 of a new Director for Learning and Development which *'signals a longer-term determination to encourage and foster talent within Colt'* and on the introduction of personal development plans for employees and management training courses.

 The Telecity Group claims that it *'only engages with suppliers whom it believes conduct their businesses in a compliant and ethical manner'* and reports that by the end of 2011 some 60% of the value of the company's new capital projects within the UK were covered by anti-bribery legislation. Colt reports on its community involvement with educational and children's charities and while it stresses that its community programmes vary according to the needs of its charity partners such programmes include a combination of fundraising, volunteering and awareness generation. In a similar vein the Telecity Group reports being *'fully committed to and engaged with a number of important activities that support the local communities in which the business operates.'* Although a number of the selected data centre operating companies claim a commitment to providing value and to supporting the long term business growth of their customers and to sustainable business growth, issues of economic sustainability receive no explicit public commentary.

Discussion

Sustainability is an increasingly important topic within the data centre industry and four sets of issues merit closer attention and reflection. Firstly while the majority of the leading data centre operators within the UK claim to recognise the importance of sustainability they provide limited public information on their sustainability agendas and achievements and the information they currently provide is predominantly focused on the environmental dimensions of sustainability. This in turn begs some wider questions about the way in which the leading data centre operators seem to collectively construct their definition of sustainability. Such a definition is built around business efficiency and the search for competitive advantage and as such can be seen to be driven as much by business imperatives as by any concern for sustainability. Colt, for example, recognises that energy prices continue to rise and that this will increase costs but argues that this in turn *'provides significant incentives for improving our energy efficiency.'* Thus while many of the

environmental initiatives addressed in the sustainability reports are designed to reduce energy, water consumption and waste emissions, for example, they also reduce data centre operators' costs. In a similar vein the selected companies' commitments to their employees focusing for example, upon management training programmes, diversity and health and safety at work all help to promote stability, security, loyalty and efficiency within the workforce.

The leading data centre operators within the UK might thus be seen to have constructed sustainability agendas, which are driven largely, though not necessarily exclusively, by their own commercial interests. The accent being on efficiency gains across a number of environmental and social areas rather than on maintaining the viability of natural ecosystems and reducing demands on finite natural resources. This reflects the suggestion put forward by Collins (2012) that sustainable data centre operations *'deliver tangible and significant business benefits including.......financial savings'* and *'enhanced public reputation.'* More critically this echoes Hobson's (2006) argument that rich and powerful groups will construct sustainability agendas that do not threaten consumption, *per se*, but seek to link them *'to forms of knowledge – science, technology and efficiency – that embody the locus of power '*already held by large business corporations. Here Fernando's (2003) assertion that *'capitalism has shown remarkable creativity and power to undermine the goals of sustainable development by appropriating the language and practices of sustainable development'* resonates loudly.

Secondly the increasing focus on sustainability is contributing to changes in the geography of data centre provision. Initially data centres were concentrated within large cities. Within Europe, London, Paris, Frankfurt and Amsterdam have been widely recognised as the principal locations for data centres. Within the UK, for example, London has traditionally been seen as the preferred location and this reflects cable connectivity, accessibility and community. However as data centre operating companies are coming under pressure to demonstrate how they will reduce energy consumption and carbon emissions and mitigate the resulting environmental impact so new locations are being seen as increasingly attractive. There is also growing interest, for example, in purchasing power from cleaner and more sustainable sources, including wind, hydro, geothermal and tidal power, in an attempt to assuage growing environmental pressures. There is also growing interest in siting new data centres in locations with cold or mild climates and on using fresh air for cooling. The developers of the Peelhouses data centre at Lockerbie in south west Scotland, for example, claimed that *'the cool climate enjoyed in Lockerbie, and amplified by the site's 215 metres of elevation, provides a perfect background for ambient air cooling throughout the data centre'* (Lockerbie Data Centres undated).More remotely the Verne Data Centre, near Keflavik on the south west tip of Iceland, the Green Mountain Centre north of Stavanger in Norway, and the Facebook data centre at Lulea in northern Sweden all harness sustainable power resources and utilise cold natural air to cool their servers. These trends add to the locational attractions of new centres in isolated rural locations and could potentially reduce development pressures within the UK.

Thirdly while the majority of the UK's leading data centre operators publicly provide commentary and information on their sustainability commitments and achievements there is currently no independent external assurance of this material. This in turn can be seen to

undermine the transparency, reliability and integrity of the sustainability information posted by the selected data centre operating companies. Capturing comprehensive sustainability information and data and then providing access to allow external assurance is a challenging, commercially sensitive and potentially costly venture and one which the majority of the leading data centre operating companies currently choose not to publicly pursue. At the same time while data on a company's carbon emissions may be systematically collected, collated and audited as part of the company's environmental commitments, information on their impact on local communities and levels of staff satisfaction may be more difficult to measure, collate, interpret and assure.

Finally there are broader and more fundamental tensions between commitments to promoting sustainability and the pursuit of continuing economic growth. The Telecity Group, for example, reported concerns that *'business expansion will inevitable mean an increase in power usage'* but emphasises that *'this increased growth will contribute to the UK economy's overall energy efficiency'* and argued that concentrating data centre facilities in the company's large centres is *'far more efficient to run than if it were hosted in smaller organisations smaller proprietary server rooms.* More generally future data centre development is seen by some commentators as being a pre-requisite for continuing economic growth. In its report *'Digital Britain'* the Department for Culture, Media and Sport (2009), for example, argued that *'the data centre sector must strive to build more data storage facilities in the UK if it is to meet growing demand'* and warning that *'failure to do so will impact on the British economy.'* More recently in its review of European Data Centres CBRE (2012) warned the industry *'critical IT investment decisions can no longer wait for signs of economic recovery and as such, we are seeing the early signs of pent-up demand being released.'* This approach is certainly consistent with the argument by Reisch *et al*. (2008), that while moving towards sustainability is a major policy agenda, *'growth of income and material throughput by means of industrialisation and mass consumerism remains the basic aim of western democracy*.'

Conclusion
The leading data centre operating companies within UK publicly provide only limited information on their commitment to sustainability with the dominant focus being on its environmental dimensions while little attention is paid to social and economic issues. At the same time these commitments can be interpreted as being driven as much by business imperatives as by a genuine and deep-seated concern for sustainability. Thus the accent is upon making efficiency gains principally across a number of environmental issues rather than on maintaining the viability and integrity of natural ecosystems and on reducing demands on finite natural resources. As such the leading data centre companies might be seen to be pursuing a 'weak' rather than a 'strong' model of sustainability. More critically, the authors suggest that the leading data centre operators' commitments to sustainability are couched within existing business models centred on continuing growth. As such this echoes Roper's (2012) belief that weak sustainability represents *'a compromise that essentially requires very little change from dominant economic driven practices but effectively works to defuse opposition , increase legitimacy and allow business as usual.'* As such the leading data centre operators might attract increasing criticism from those who are concerned about what Jackson (2009) has described as *'an emerging ecological crisis that is likely to dwarf the existing economic crisis.'*

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