

**Incumbents in transition? The role of the 'Big Six' energy companies in the UK**

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**Abstract**

Amid rapid changes to energy systems around the world, there has been ongoing debate regarding incumbent actors' ability to respond to disruptive forces. This paper investigates the corporate strategies of the UK's large vertically integrated energy companies (the 'Big Six') between 2008 and 2016. Four of these companies are part of international groups, with parent companies in Germany, France and Spain. By analysing data from publicly available documents and a small number of key informant interviews with current and former decision-

1 makers within Big Six companies and other stakeholders, this paper assesses their responses  
2 to three potentially disruptive changes to the UK's electricity sector: decarbonisation,  
3 decentralisation and digitalisation. Each of the Big Six have taken significant steps towards  
4 decarbonisation, with some progressing faster than others. Most have remained committed  
5 to centralised generation investments, and a couple have made early moves towards digital  
6 retail products and services but with limited impact thus far. The authors conclude that the  
7 UK's incumbent electricity firms have shown that they are able to adapt given strong policy  
8 incentives. Policy-makers should continue to set ambitious targets for the electricity sector,  
9 while taking into account the role of international parent companies in driving a broader  
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28 Keywords: incumbents, Big Six, power sector, decarbonisation, decentralisation,  
29 digitalisation  
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## 36 **1. Introduction**

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40 Energy systems around the world are changing fast due to rapid technical change, the  
41 imperative of climate change mitigation and wider social and economic drivers. The pace of  
42 change is especially pronounced in electricity, where the costs of some renewable energy  
43 technologies have fallen dramatically – for example, the costs of solar photovoltaic modules  
44 dropped by 90% between 2009 and 2018 (International Renewable Energy Agency, 2019).  
45 This has been accompanied by cost reductions in electricity storage, by 45% between 2012  
46 and 2018 (IEA, 2019). There has also been increasing 'digitalisation' of the electricity sector  
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1 through the application of information and communication technologies. New sources of  
2 electricity demand are emerging, particularly from the adoption of electric vehicles.  
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7 A key feature of this emerging revolution in energy systems is the disruption of established  
8 technologies, markets and business models. This has had a significant impact on  
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10 incumbent electricity companies (Kungl & Geels, 2018). The most prominent impacts have  
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12 been seen in Germany, where two of the biggest utilities implemented demergers to  
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14 separate their traditional fossil fuel power generation assets from other businesses.  
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23 The power sector in the UK has also been affected by these changes. It has been at the  
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25 forefront of the UK's progress with greenhouse gas emissions reduction. UK greenhouse gas  
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27 emissions fell by 43.5% between 1990 and 2018 (BEIS, 2019a). While this was partly driven  
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29 by changes in other sectors, the recent decline of coal-fired electricity generation has made  
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31 a significant contribution. In 2018, coal's share of generation fell to 5% whereas the share of  
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33 renewable generation reached 33% (BEIS, 2019b).  
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41 This paper examines how these potentially disruptive changes to the electricity sector have  
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43 affected the six largest incumbent electricity companies in the UK: Centrica, EDF, E.ON,  
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45 RWE, Scottish Power and Scottish and Southern Energy (SSE). Known as the 'Big Six', these  
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47 vertically integrated firms became dominant in the UK electricity industry following a period  
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49 of restructuring in the early 2000s (Helm, 2004). The paper is one of several published in this  
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51 special issue that present results from a two-year research project by the UK Energy  
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53 Research Centre (UKERC).  
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1 A focus on the UK is particularly relevant because it was one of the first countries to  
2 liberalise its electricity sector. It has also been an early adopter of ambitious emissions  
3 reduction targets through the Climate Change Act of 2008, and the more recent target of  
4 reaching net-zero greenhouse gas emissions by 2050 (BEIS, 2019c). It is therefore important  
5 to understand how this leading position with respect to liberalisation and decarbonisation  
6 has affected the largest electricity companies.  
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18 The paper focuses on the period from 2008 to 2016, starting with the passage of the Climate  
19 Change Act. It explores the extent to which the Big Six companies have been able to  
20 respond to three potentially disruptive changes: the requirement to reduce greenhouse  
21 gases to meet statutory targets, the shift towards more decentralised electricity generation  
22 technologies, and the impact of digitalisation on the electricity retail market.  
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33 The paper comprises four further sections. Section 2 discusses the literature on disruptive  
34 change, with a focus on implications for incumbent companies. It outlines our research  
35 question, and the methodology that has been used to answer it. Section 3 analyses the  
36 strategies of the Big Six companies in the UK between 2008 and 2016, focusing on their  
37 activities in generation, retail and networks. Section 4 discusses the extent to which they  
38 were able to adapt their strategies to three sources of disruption in the power sector:  
39 decarbonisation, decentralisation and digitalisation. Finally, section 5 draws some  
40 conclusions and discusses implications for policy.  
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## 57 **2. Literature review and methodology**

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1 There is an extensive literature on disruptive change and the impact on incumbent firms.

2 Clayton Christensen's research on disruptive innovation argued that incumbents are  
3 particularly vulnerable to the emergence of new entrants with innovative solutions  
4 (Christensen, 1997; Wilson, 2018). This is because their organisational cultures and practices  
5 favour incremental innovation (Winskel et al., 2006).  
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15 More recent studies have revealed a variety of ways that incumbent firms have responded  
16 to disruption (Berggren et al., 2015; Bergek et al., 2013; Smink et al., 2013). Anna Bergek  
17 and colleagues showed that different firms in the same industry have adopted different  
18 strategies. They argue that creative accumulation by incumbents can provide them with a  
19 competitive advantage over new entrants. Creative accumulation involves accelerating  
20 upgrades to existing technologies and expanding competencies by acquiring and integrating  
21 new innovations.  
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36 This literature has also explored the interaction between incumbents and government  
37 policies, rules, and regulations. For example, a comparison of UK and German electricity  
38 transitions by Geels et al (2016) argues that UK policies to support low carbon generation  
39 favoured large scale infrastructure projects led by established companies. Examples include  
40 the Renewables Obligation, which was introduced in 2002 to support renewable energy,  
41 and the more recent Electricity Market Reform package of 2013. The UK experience  
42 contrasts with the case of Germany, where *Energiewende* policies favoured renewables  
43 development by new entrants. This had negative impacts on incumbent companies by  
44 reducing their generation market share and by lowering wholesale electricity prices.  
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1 Several industry analysts and researchers have explored the possibility of disruptive change  
2 in the UK's energy and electricity systems (Energy Institute, 2017; PwC, 2016; Wilson, 2018).  
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4 For example, the National Grid included a decentralised energy scenario that meets the UK's  
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6 2050 carbon targets in its Future Energy Scenarios for the first time in 2018 (National Grid,  
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8 2018a), suggesting the UK's transition pathway could see a greater role for niche innovators  
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10 and disruptors. It is therefore important to consider how incumbent firms in the UK  
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12 electricity sector are responding to decentralisation, and to other potentially disruptive  
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14 changes.  
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23 This paper fills an important gap in the existing literature by analysing incumbent responses  
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25 to these changes. It complements previous research on the role of large incumbent  
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27 electricity utilities. This research has focused on the German energy transition (Kungl &  
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29 Geels, 2018); incumbent responses to government support for wind power in Spain,  
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31 Germany and the UK (Stenzel & Frenzel, 2008); the impact of electricity market structure on  
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33 competition in the UK and other countries (e.g. Boroumand, 2015; Pollitt and Brophy-  
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35 Haney, 2014); the responses of the seven largest power utilities in Europe to industry  
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37 changes over the past 15 years (Thomas, 2018); and responses of 25 of the largest global  
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39 utilities to these changes (Frei et al, 2018). However, previous research has not focused in  
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41 detail on the Big Six companies in the UK.  
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52 This paper fills this gap through the following research question:

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54 • How have the Big Six energy companies responded to potential sources of disruption to  
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56 the electricity sector?  
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1 Potential disruptions due to decarbonisation, decentralisation and digitalisation were  
2 selected because they have been identified by industry commentators and academic  
3 researchers as significant trends that pose a challenge to incumbent companies in the  
4 electricity sector (Di Silvestre et al., 2018; Laclau, 2019; National Grid, 2019).  
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12 With respect to decarbonisation, the UK electricity sector will need to be predominantly  
13 decarbonised by 2030 if statutory climate change targets are to be met. Low-carbon  
14 electricity will also be needed to contribute to decarbonising the more challenging heat and  
15 transport sectors by 2050 (CCC, 2013, 2015; Watson et al., 2015). Hence this paper assesses  
16 whether the Big Six firms have aligned their investments and strategies with this goal since  
17 the Climate Change Act was passed in 2008.  
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31 Second, there has been a shift away from large centralised power stations and towards  
32 smaller scale distributed generation and storage in some countries. Decentralisation is often  
33 seen as a threat to incumbent energy firms (Muaafa et al, 2017; Castaneda et al, 2017; Lee  
34 & Hess, 2019; Richter, 2013). This might be the case in the UK, where decentralised  
35 generation by households, community groups and others has grown as a niche market in  
36 recent years (Braunholtz-Speight et al., 2018). Nonetheless, incumbent firms could also use  
37 decentralisation as an opportunity to develop new businesses. Therefore, the paper  
38 considers evidence of positive and negative responses to this trend by the Big Six.  
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54 Third, digitalisation could have far reaching implications for the electricity sector. Examples  
55 include the integration and optimisation of different types of electricity generation within  
56 transmission and distribution networks, and enabling new business models and services  
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1 that change the way consumers engage with the electricity system (IEA, 2017 and 2019;  
2 Glachant & Rossetto, 2018; National Grid, 2019). This paper focuses on the retail market,  
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4 since this is where digitalisation has started to impact most directly on the strategies of the  
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6 Big Six firms.  
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12 The research question is answered using a mixture of quantitative and qualitative data,  
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14 primarily covering the period 2008-2016. This period was chosen since it starts with the  
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16 passage of the Climate Change Act in 2008, and spans the period when the Big Six had  
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18 dominant market shares in the electricity generation and retail markets. This dominance  
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20 began to diminish significantly after 2016. The paper also discusses more recent  
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22 developments in the strategies of the Big Six where these are particularly notable.  
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30 Publicly available documents (including annual reports, press releases, market data and  
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32 inquiry documents) were analysed to assess the companies' responses to decarbonisation,  
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34 decentralisation and digitalisation. This evidence was complemented by 11 semi-structured  
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36 interviews with high level energy stakeholders (Bryman, 2016). Nine interviews were  
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38 conducted with current or former senior employees from each of the Big Six firms in winter  
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40 2018/19. Two further interviews with a former Energy Minister and a financial consultant  
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42 provided an external perspective on policy and market developments. The transcribed  
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44 interviews were analysed using NVivo software. They were coded thematically, according to  
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46 types of activity and strategy drivers. Further information about the methodology is  
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48 available as supplementary material item, published alongside the paper. This  
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50 supplementary material includes numbering of the interviews, which are referenced in the  
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3 **3. Analysis of the Big Six companies' strategies**  
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6 This section presents an overview of industry changes between 2008-2016, before  
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8 examining each of the Big Six companies' strategies in turn.  
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13 The wider landscape  
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16 In the late 1990s, big European energy companies were attracted to invest in the UK's newly  
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18 liberalised electricity market (Geels et al., 2016). With strong balance sheets, they acquired  
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20 incumbent generation and supply businesses, resulting in six large vertically integrated  
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22 energy firms by 2008 - only two of which were British-owned (Centrica and SSE). Since the  
23  
24 early 2000s, UK and European-wide environmental and low carbon incentives prompted  
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26 some major investments in UK power assets from these firms. These include the UK's  
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28 Renewables Obligation (Woodman & Mitchell, 2011) and Electricity Market Reform package  
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30 (DECC, 2012a), and the EU's Directives to limit pollution from power plants - the Large  
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32 Combustion Plant Directive (LCPD) and its successor, the Industrial Emissions Directive  
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34 (European Commission, 2019). Combined with wholesale price fluctuations (Ofgem, 2020)  
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36 and company-specific factors, these interventions influenced the companies' UK generation  
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38 strategies in heterogeneous ways between 2008 and 2016. While these factors weakened  
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40 the economic viability of keeping ageing coal plants open, additional investment was made  
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42 in some of these plants (e.g. EDF's Cottam and West Burton plants) so they could be kept in  
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44 operation throughout the period.  
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By 2018, the Big Six showed signs of significant diversification in their generation assets and market share. Snapshots of each company's generation capacity (**Error! Reference source not found.**) and electricity generation market share (Figure 2) are presented below. Note that generation capacity does not translate into market share for a given year, as power sources dispatch in a merit order according to the availability of resources and cost-effectiveness.

Figure 1: Total installed generation capacity owned / part-owned by the Big Six energy companies, weighted by company share. Includes all UK sites larger than 1MW. Sources: BERR, 2008; DECC, 2012, 2015; BEIS, 2018, supplemented by company literature

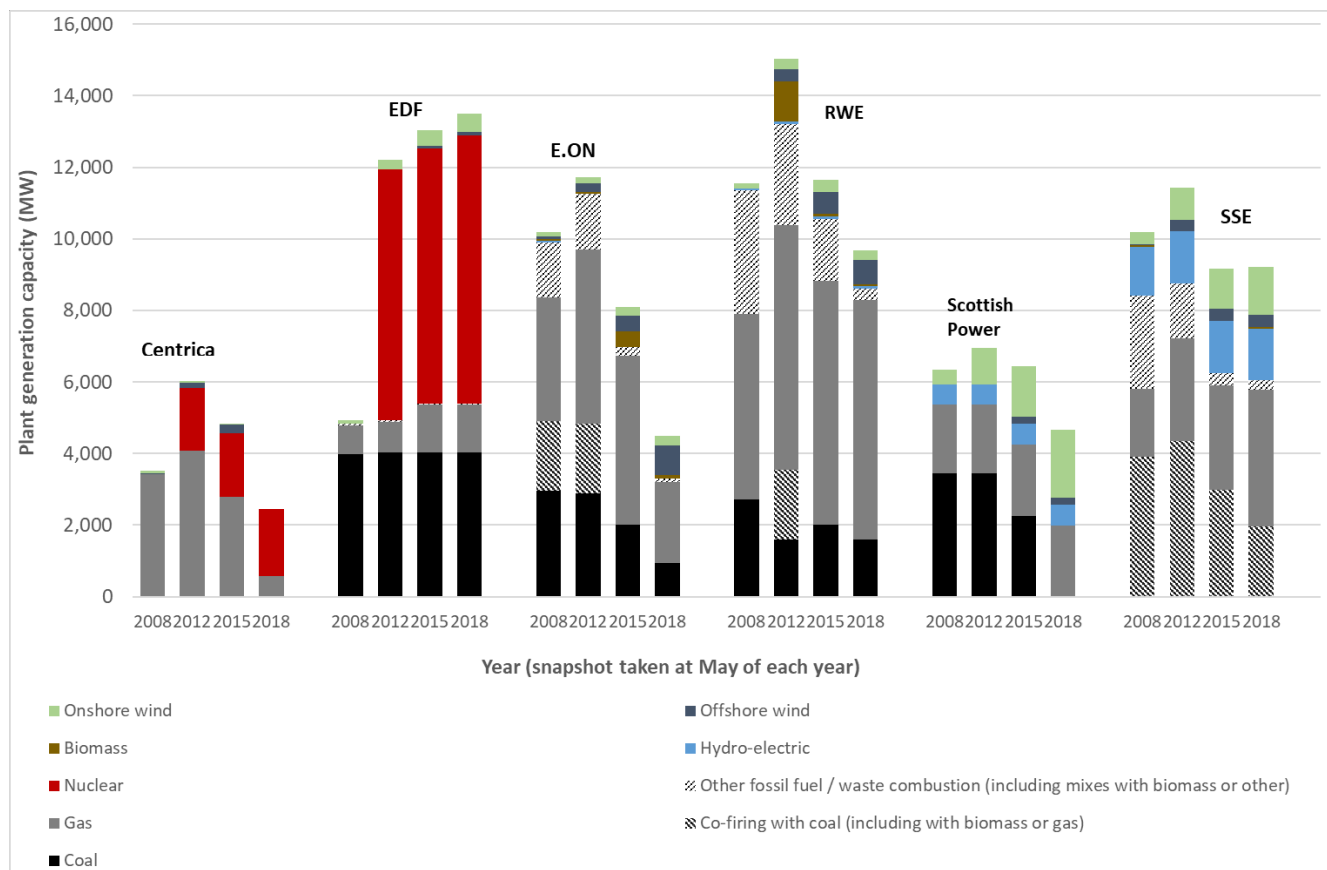
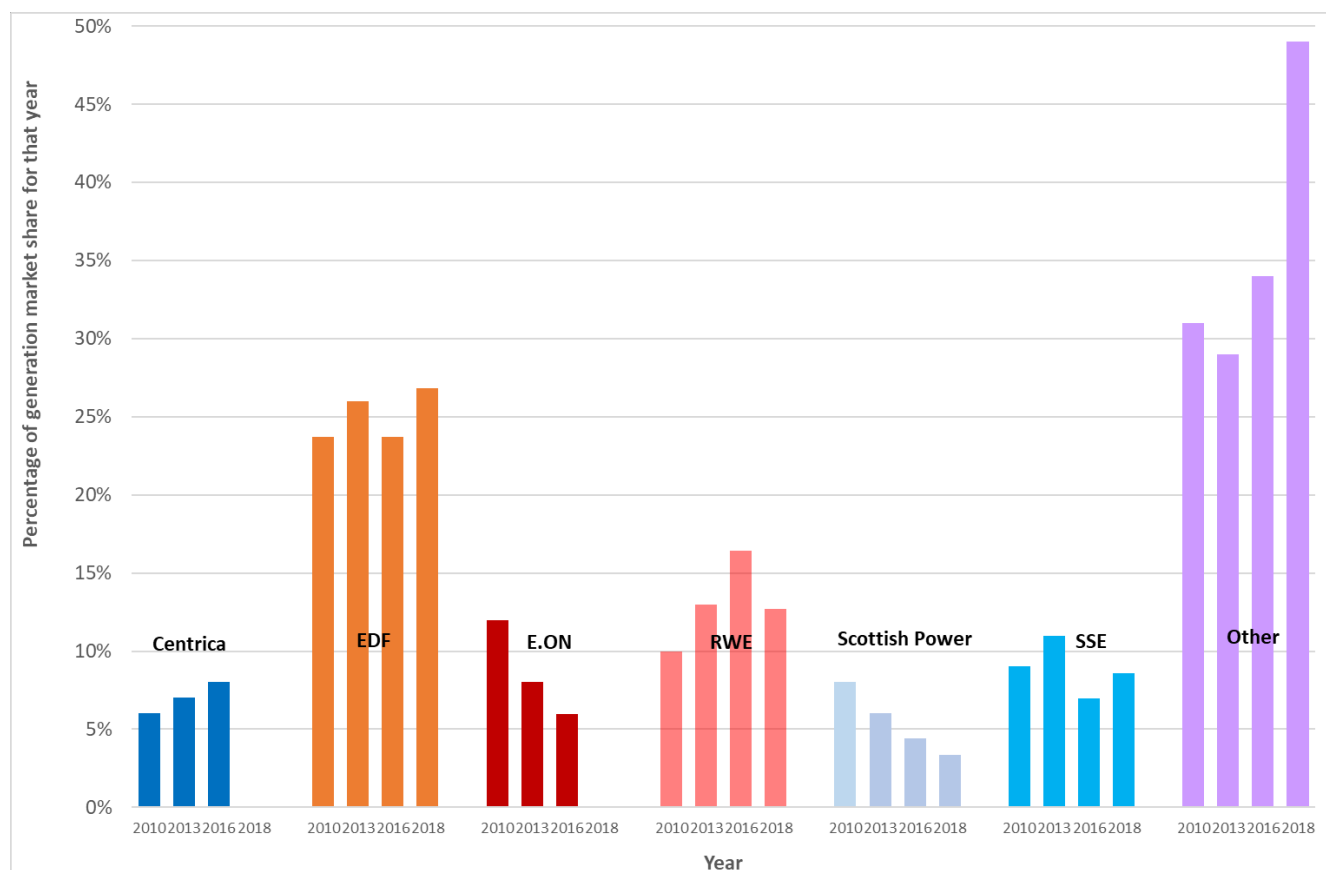


Figure 2 shows that the Big Six have lost market share in electricity generation production, with Centrica and E.ON's share too small to be listed in Ofgem's data for 2018. Their loss in

market share has been primarily due to other domestic and international companies expanding their UK portfolios (including Drax, Engie, ESB, Orsted, and Intergen).

Figure 2: Electricity generation market shares (GB): 2010, 2013, 2016, 2018. Note – E.ON's 2016 market share includes Uniper's share, which E.ON part-owned between January and September 2016. Centrica's share for 2018 is unavailable, but less than 3%. Sources: Ofgem, 2011a, 2014, 2017, 2019a.

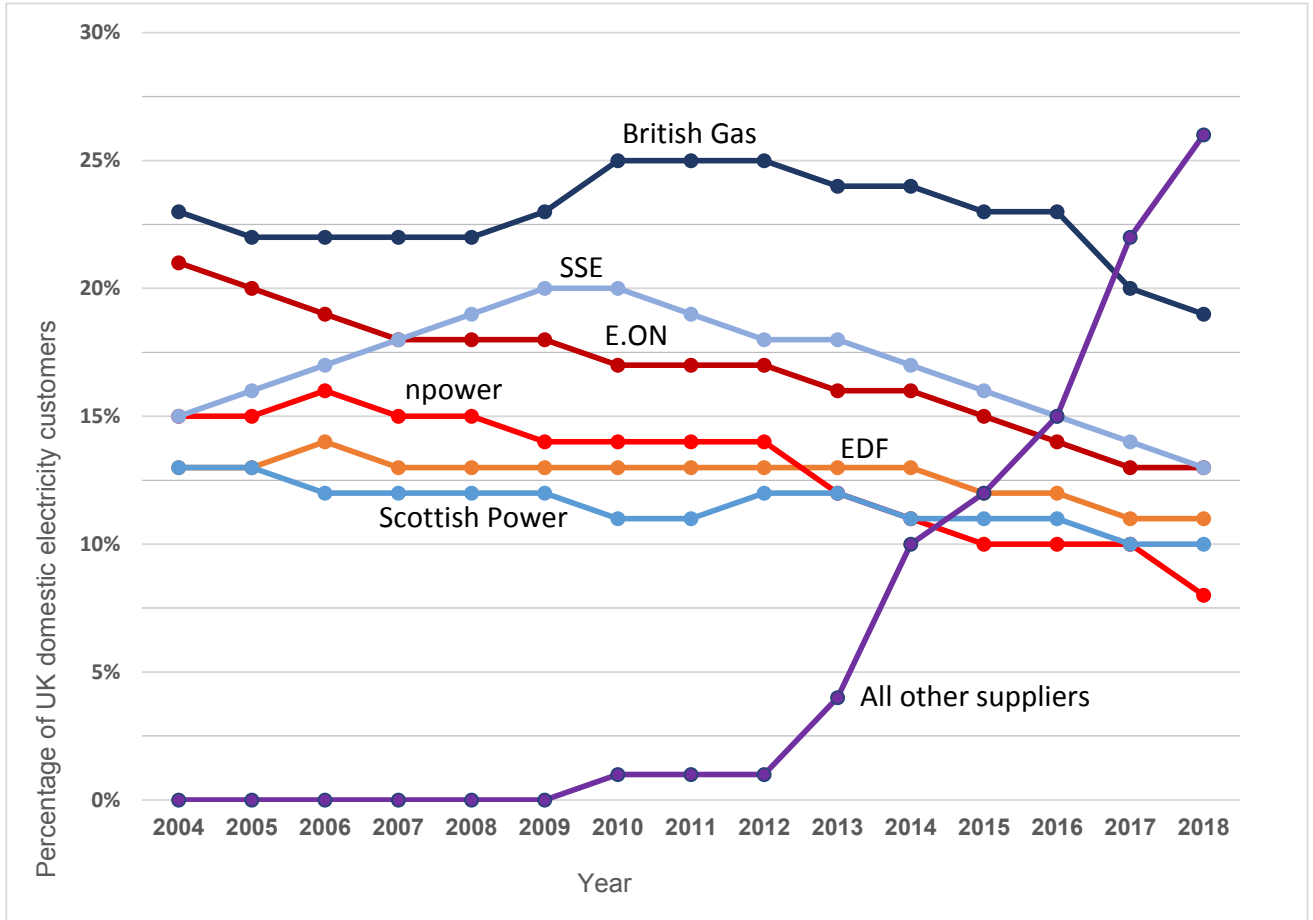


On the retail side, Figure 3 shows that all six firms lost domestic electricity customers between 2008 and 2016, mainly to new entrants. The companies operated in a changing market, due to a significant increase in government and regulatory intervention since 2008. Amid growing public concern over electricity and gas prices and standards of service, Ofgem's Energy Supply Probe (Ofgem, 2008) and Retail Market Review (Ofgem, 2016) and the Competition and Markets Authority's Energy Market Investigation (CMA, 2016) led to a succession of new rules on suppliers' tariffs and practices. The interventions culminated in

1 price caps for customers on prepayment meter tariffs and standard variable tariffs (Ofgem,  
2 2019b). Ofgem also conducted a series of investigations into individual firms' activities  
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4 throughout the period. Each of the Big Six were fined for mis-selling contracts to household  
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6 consumers (Ofgem, n.d.). In addition, penalties were imposed for missed energy efficiency  
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8 and smart metering deadlines, and for reductions in customer service associated with  
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10 migrating to new customer management software. Between June 2010 and the end of 2019,  
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13 42 fines were imposed on the Big Six, totalling £181m.  
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21 The period also saw a scaling up of the Government's energy efficiency interventions for  
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23 energy suppliers with over 250,000 customers. Under the carbon emission reduction target  
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25 (2008-2012), and community energy saving programme (CESP) (2009-2012) policies, energy  
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27 suppliers were obliged to fund measures to reduce energy consumption and carbon  
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29 emissions in homes across Great Britain (Rosenow, 2012). These supplier obligations were  
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31 replaced in 2013 by the Energy Company Obligation and the Green Deal, which failed to  
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33 deliver energy efficiency on the scale that was promised (Kattirtzi, 2016; Rosenow & Eyre,  
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35 2016). The Government also mandated a smart metering rollout intended to further  
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37 encourage consumer switching, energy efficiency and new business models (Darby &  
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39 Liddell, 2015; Kattirtzi, 2016).  
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Figure 3: Domestic electricity supply market share (GB), 2004 - 2018. Note: since the total number of UK domestic electricity meter points rose from 26m to 28.5m, between 2004 and 2016, a 1% change corresponds to approximately 300,000 customers. Source: Ofgem.



In summary, in a context of increasing landscape pressures and despite significant investments, the Big Six firms have, overall, declined in market share in electricity generation as well as retail. The next section looks in depth at the steps they each took.

## Company strategies

This section considers each company's strategies between 2008 and 2016 in depth, including significant outcomes of these strategies up to 2018. To aid the reader, the analysis of each company is split into two subperiods: 2008-2011 and 2012-2016. This demarcation is justified as both the generation and retail markets were more stable in the first subperiod. By contrast, the second subperiod was more challenging for the six firms. This was due to new policy and regulatory reforms pursued by the UK Government (DECC, 2011), the regulator (Ofgem, 2011b) and the European Union (European Commission, 2019a); the impact of the Fukushima accident on German parent company strategies (Thomas, 2018), and the rise of new entrants in the retail market (Figure 3 above).

### **Centrica**

Centrica is a British company formed in 1997, following the demerger of the original British Gas PLC into Centrica Plc and BG Plc, in which Centrica maintained the British Gas retail brand (British Gas, n.d.). As the 'gas incumbent' (CMA, 2016), Centrica is exceptional in that they never owned electricity distribution networks nor a home area<sup>1</sup> of electricity customers.

#### *2008-2011*

Despite holding the largest domestic retail market share, Centrica's retail profits fell sharply in 2005/6. In response, the company pursued a diversification strategy (Interview 1). Whereas

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<sup>1</sup> Prior to electricity supply privatisation, the UK's distribution and supply services were provided by 14 area boards. All of the Big Six except for Centrica either inherited or purchased distribution and retail operations from these boards after privatisation, thereby acquiring a 'home area' within which they initially served all customers.

1 competitors benefited from high dark spreads<sup>2</sup> and could shield consumers from increases in  
2 retail costs, Centrica's portfolio of 3.5GW of generation capacity was dominated by combined  
3 cycle gas turbines (CCGTs). To strengthen the company's robustness against fluctuations in  
4 the generation market, Centrica purchased an oil and gas exploration firm in 2009. They also  
5 acquired a 20% stake in EDF's British Energy's nuclear and coal portfolio and a 20% stake in  
6 new nuclear projects. This was complemented by the development of several wind farms and  
7 a large CCGT plant, in expectation of a UK capacity shortfall (Centrica, 2009).  
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21 At the same time, British Gas increased its share of the electricity retail market from 22% in  
22 2009 to 25% in 2010, by lowering electricity prices for new and existing customers. Amid  
23 growing competition, British Gas aimed to increase customer retention by broadening its  
24 range of services. New services included heating systems repair and maintenance, and  
25 plumbing and drains cover (following the acquisition of Dynarod) (Centrica, 2010).  
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### 33 *2012-2016*

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36 Centrica initially adopted a strategy of subsidy hunting followed by capital recycling for  
37 financing and developing wind farms, allowing them to gain Renewables Obligation  
38 certificates while turning a short-term profit. However, increased competition and the  
39 realisation that other firms were building wind farms more efficiently led the company to  
40 stop developing new sites (Interview 1). In addition, after appraising progress towards the  
41 development of new nuclear power stations in 2013, Centrica withdrew and wrote off its  
42 20% stake in new nuclear projects. The mothballing of old, inefficient gas plants during a  
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58 <sup>2</sup> Spark and dark spreads refer to the average margins that a gas or coal power station owner can expect to  
59 receive from generating a unit of electricity when run consistently without interruption, taking into account the  
60 costs of fuel and associated carbon emissions – but not other operational costs.  
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1 period of high gas prices contributed to a reduction in the firm's generation capacity  
2 (Centrica, 2013). Then in 2015 a large restructuring took place designed to cut costs and  
3 improve company agility. This reduced capital expenditure and shifted priorities towards  
4 customer-facing activities and flexible power. Centrica disposed of all wind assets but  
5 retained a gas fleet and continued to invest in gas-fired peaking power plants and battery  
6 storage sites (Centrica, 2015).  
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18 British Gas maintained 25% of the electricity retail market until 2013, but began losing  
19 customers as new entrants rapidly gained market share, despite offering a greater range of  
20 customer services. Unlike other suppliers, British Gas responded quickly to address mis-  
21 selling by its sales staff, and consequently received a fine of £1m (Ofgem, n.d.). Throughout  
22 this time, British Gas viewed energy services as a strategic priority. With an in-house team  
23 of field staff already active, they signed up to be a Green Deal provider and set out to  
24 deliver their energy company obligations internally – ambitiously purchasing British Energy  
25 and GDF Suez's obligations to fulfill too. This strategy backfired though as the company  
26 missed the CESP deadline, resulting in a £10.6m fine (Ofgem, n.d.).  
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44 British Gas began to install smart meters ahead of the mandated rollout (Interview 2). Smart  
45 products were described as an important aspect of the company's efforts to tackle climate  
46 change, as enablers of better energy management for customers. Moreover, an interviewee  
47 explained that the Hive range of smart products (launched in 2015), represented a move  
48 towards becoming an "energy *and* services company". The range was a key element of the  
49 firm's defence against new entrants.  
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## **EDF Energy UK**

EDF Energy UK is a subsidiary wholly owned by EDF SA, a French public limited company. Their UK activities began in 1999, with the acquisition of London Electricity's electricity supply and distribution business (Ofgem, 1999). EDF then grew in the UK's generation and retail markets.

### *2008-2011*

Starting with a generation capacity of 4.9GW (predominantly in the form of large coal power stations), EDF Energy UK pursued a strategy of power generation diversification between 2008 and 2011, including a specific aim to acquire and build nuclear power plants (EDF Energy PLC, 2008; 2009; 2010; EDF Energy Holdings Ltd, 2011). In line with the parent company's ambition to lead a global revival of nuclear generation (EDF Group, 2008), EDF Energy UK bought British Energy's portfolio of eight nuclear power stations (8.7GW capacity) and one coal-fired power station in 2009. Between 2008 and 2012, the firm also invested in 10 small onshore wind farms. Like Centrica, EDF pursued subsidy hunting and capital recycling to develop and then sell wind farms (Interview 8). Each site was held in a separate subsidiary business to enable a straightforward sale to investors, with a view to securing a contract to operate and maintain the turbines on their behalf.

In 2010 EDF launched the cheapest domestic electricity tariff with a view to gain new customers through online sales (Insley, 2010), but their share of the retail electricity market remained at 13% between 2008 and 2015 – as is clear from Figure 3. In 2011, the French parent company sold the UK distribution assets to recover the cost of the British Energy

1 investment, after E.ON's own sale of distribution networks proved there was investor  
2 interest in such assets (Interview 3).  
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### 6 7 *2012-2016* 8

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10 While other companies phased out their ageing fossil fuel plants in tough conditions, from  
11 2012 onwards, EDF Energy UK prioritised the optimisation of existing fossil fuel and nuclear  
12 generation assets by securing plant life extensions and compliance with European Directives  
13 where safe and commercially viable (EDF Energy Holdings Ltd, 2012, 2013, 2014, 2015,  
14 2016). All nuclear power plants achieved extensions and the two coal power stations were  
15 upgraded to comply with the Industrial Emissions Directive as part of the UK's Transitional  
16 National Plan, although the latter have struggled to stay competitive in the UK's capacity  
17 market amid falling dark spreads. EDF Energy UK also continued to build new generation  
18 sites, including a large CCGT plant and 418MW of onshore and offshore wind.  
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36 As EDF's domestic customer numbers gradually fell, company reports in 2015 and 2016  
37 emphasised that customers were at the centre of its long-term strategy (EDF Energy  
38 Holdings Ltd, 2015, 2016). Acknowledging a growing digital energy services market in 2016,  
39 EDF invested in a joint venture, EDF Energy Services, to develop bespoke services primarily  
40 for large industrial and commercial clients. EDF then created Blue Lab, an innovation unit  
41 tasked with developing digital products and services across its customer base (EDF Energy  
42 Holdings Ltd, 2016). Yet, in 2018, EDF Energy UK had to pay a penalty of £350,000 for  
43 missing their 2017 smart meter rollout target for domestic customers (Ofgem, n.d.).  
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1 Through the period 2008 to 2016, the industrial and commercial retail market was a  
2 strategic priority area (Interview 3). Despite having lost 40% of their non-domestic  
3 electricity customers since 2008, EDF ended the period with the largest share of the  
4 industrial and commercial electricity market (20%), as well as 12% of the small and medium-  
5 sized enterprise market (Ofgem, 2016). An interviewee claimed that while losing customers  
6 was regretful, the company focused on the high-consuming customers as these were most  
7 profitable for them (Interview 3).  
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## 20 **E.ON UK**

21 E.ON UK is a subsidiary of the large German parent company, E.ON. E.ON entered the UK  
22 energy market in 2003 when they acquired Powergen UK (Ofgem, 2003).  
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### 30 *2008-2011*

31 E.ON UK's 10.2GW generation portfolio was one of the largest and most polluting in 2008  
32 (Interview 4). Nonetheless, E.ON had a European-wide strategy to rapidly build new coal  
33 and gas generation plants in the expectation that rising energy demand and ageing power  
34 plants will lead to a capacity shortage by 2010. In the UK, this amounted to a new combined  
35 heat and power gas-fired plant, and a plan to build two large coal plants at Kingsnorth. Amid  
36 high profile environmental protests at the site and opposition from the newly-formed  
37 Committee on Climate Change (amongst others), the government announced in early 2009  
38 that new coal plants would only be approved if CCS technology is installed prior to operation  
39 (Scrase & Watson, 2009). E.ON UK initially entered Kingsnorth into the government's CCS  
40 competition, but as dark spreads fell faster than spark spreads in 2009 they terminated the  
41 Kingsnorth project (Interview 4). The firm then sold its distribution network assets to focus  
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1 on new, riskier projects. To this end, they started a joint venture with RWE to build new  
2 nuclear stations in the UK, and tried to capitalise on the international expertise of E.ON UK's  
3 former Powergen staff by investing in generation projects outside of Europe. Both strategies  
4 were soon abandoned though: the German Government's phase-out of nuclear power  
5 following the Fukushima accident in 2011 led the German companies to divest from nuclear  
6 power, while projects in Turkey and Brazil were not as successful as hoped.  
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18 Between 2008 and 2012, E.ON UK pursued the same subsidy hunting and capital recycling  
19 strategy as Centrica and EDF, adding 263MW of wind capacity to its books (Interview 4). The  
20 fall in electricity prices after the global recession was especially detrimental to the German  
21 firms, as they owned many gas-fired power plants with oil-indexed contracts.<sup>3</sup> In response,  
22 E.ON undertook a Europe-wide restructuring to cut costs and flatten the business structure  
23 (Interview 1). Plans to build new large fossil fuel power plants were shelved, and the  
24 company sought alternative profit streams without large capital expenditure, such as  
25 delivering decentralised energy solutions for industrial and commercial customers  
26 (particularly through combined heat and power units, CHPs). However, after three years  
27 E.ON closed this business down, finding the market not sufficiently profitable (Interview 4).  
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59 After suffering some reputational damage for mis-selling, residential electricity customer  
60 numbers fell by approximately 300,000 between 2008 and 2011 (a 1% drop in market share,  
61 as shown in Figure 3).  
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<sup>3</sup> Other generators did not use oil-indexed gas contracts, so when spark spreads dropped faster than the price of oil E.ON's and RWE's assets were made less profitable.

## 2012-2016

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Between 2012 and 2015, E.ON developed several large offshore wind farms, two onshore wind sites, and one small biomass CHP plant, totalling 743MW (E.ON UK PLC 2012, 2013, 2014, 2015; BEIS 2018). These additions were outweighed by the closure of large combustion plants due to opt outs from the LCPD, resulting in a net reduction of 3.6GW.

Responding to increased competition from new entrants leading the rollout of the renewable energy technologies in Germany, at the same time as falling electricity demand, declining prices and a nuclear phase-out, in 2014 E.ON announced plans to separate its conventional fossil fuel generation business from the retail and renewables business (Vasagar, 2014; Kungl & Geels, 2018). In 2016 the conventional fossil fuel generation assets were moved to a new company, Uniper, along with upstream exploration and production and other large-scale operations. E.ON fully divested from Uniper in June 2018, on the basis that each would benefit from greater agility and clarity of purpose (Kungl & Geels, 2018). E.ON now runs a largely fossil fuel-free generation portfolio in the UK.

E.ON UK received the largest penalty (£12m) for mis-selling of all the Big Six (Ofgem, n.d). To regain consumer trust and in anticipation of new Ofgem rules, in 2012 the company simplified its tariffs and sought to improve its customer contact experience (CMA, 2015; Interview 9). However, the firm continued to lose customers. E.ON also pursued an interest in energy services during this period, including digital home management since 2008 when it bought an energy services company, CHN. In 2013, they acquired Matrix, a large energy services company, whose services included energy efficiency for commercial buildings, street lighting, and micro-generation (Interview 4).

## **RWE Npower**

RWE is a German energy group which entered the UK market through the acquisition of Innogy PLC in 2002 – a UK generation and retail business which had just sold its distribution network. Innogy PLC was renamed RWE Npower in 2004, with Npower used as the UK retail brand. In 2013, all of RWE’s international generation assets were consolidated into a single business, RWE Generation SE, based in Germany (RWE, 2013). Like E.ON, RWE faced increased pressure as new entrants in Germany rapidly developed renewable generation technologies, electricity demand fell, and nuclear power plants were phased out. These factors led RWE to split in 2016, with conventional generation and trading teams staying in RWE, while renewable assets and the retail arms (including UK’s Npower) were moved into a new subsidiary, Innogy SE (RWE, 2015). In late 2019, the European Commission approved the sale of RWE’s majority share of Innogy SE to E.ON (European Commission, 2019b).

### *2008-2011*

In 2008, RWE Npower owned the largest portfolio of generation capacity in the UK (15GW), only 700MW of which came from renewable sources. Like E.ON, the group planned to invest €26 billion in new generation capacity across Europe by 2012, with the UK considered a primary focus at a time (Interview 5). The investments were intended to maintain UK market share despite anticipated closures due to the LCPD, while simultaneously diversifying RWE’s generation portfolio outside of Germany where lignite plants remained highly competitive. UK investments were directed towards a combination of new, highly efficient CCGT plants, improving the efficiency of existing CCGT plants, making the largest coal plant compliant with the LCPD, and converting plants to facilitate biomass co-firing.

1 They invested in large onshore and offshore wind farms in pursuit of Renewables Obligation  
2 certificates, but kept control of the built assets rather than selling them. RWE also partnered  
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5 with E.ON on plans to build new nuclear plants at this time (RWE, 2008).  
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10 Holding 15% of Great Britain's domestic electricity retail market, Npower's owners were  
11  
12 initially excited about testing out smart products in the UK's liberalised market before  
13  
14 rolling them out in Germany (Interview 5). However, this strategy was derailed as the retail  
15  
16 business faced multiple setbacks. In December 2008, Npower was fined £1.8m for doorstep  
17  
18 mis-selling after an undercover investigation revealed that salespeople were misinforming  
19  
20 to hit sales targets (Ofgem, n.d.). As the first to be fined for door-step mis-selling, Npower  
21  
22 suffered considerable reputational damage. Their domestic retail share dropped to 14%,  
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24 and the company turned to offering discounted tariffs online instead of on the doorstep.  
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### 31 *2012-2016*

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34 With some of the oldest coal and oil power plants in operation, RWE's UK portfolio was the  
35  
36 worst affected by the LCPD. RWE took opt-outs on four UK stations, leading to their closure  
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38 (BEIS, 2018). RWE faced multiple pressures as they responded to the nuclear power phase-  
39  
40 out in Germany while declining spark and dark spreads damaged the profitability of their  
41  
42 new and upgraded fossil fuel plants, and competition from renewables increased. In  
43  
44 response, the German parent company underwent a global cost-cutting exercise in 2013,  
45  
46 and took control of all international generation operations. In the face of high costs, some  
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48 UK offshore wind projects were scrapped (RWE, 2013). Innogy SE later invested modestly in  
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50 small onshore wind and hydropower sites and bought a 25% stake in the large Galloper  
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52 offshore wind farm (RWE, 2015).  
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2 Npower's domestic retail market share fell sharply again in 2013, as new entrants entered  
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4 the market and failings in the migration to a new customer management IT system led to  
5  
6 widespread consumer dissatisfaction. The company was fined a record £26m by Ofgem for  
7  
8 late and inaccurate billing (Ofgem, n.d.). At the same time, Npower transitioned to  
9  
10 outsourcing customer services. All of these changes, at a time of increased competition in  
11  
12 the retail market, were described by an interviewee as more than the company could  
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14 handle at once (Interview 5).  
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23 Npower did not view energy efficiency as a core business activity, and so it aimed to comply  
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25 with energy efficiency obligations at least cost by contracting large management agencies to  
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27 deliver sufficient measures. Npower eventually partnered with Google's Nest to launch  
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29 smart thermostats in 2014 (BBC News, 2014).  
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### 36 **Scottish Power**

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38 Iberdrola is a Spanish energy company which had capitalised on Spanish government  
39  
40 support to become an early leader in wind farm development (Stenzel & Frenzel, 2008).  
41  
42 Iberdrola was attracted to acquire Scottish Power in 2007 by the Scotland-based company's  
43  
44 early investments in onshore wind farms. Scottish Power owned transmission and  
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46 distribution assets, generation sites and retail businesses throughout the period (Interview  
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### 57 *2008-2011*

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1 In 2008, Scottish Power owned 6.3GW of generation capacity (BERR, 2008). Approximately  
2 half of this was coal-fired, while 972MW came from hydro-electric and onshore wind farms  
3  
4 (ScottishPower UK PLC, 2008; ScottishPower Renewable Energy Limited, 2008). With  
5  
6 Iberdrola's investments in the company, Scottish Power more than doubled its onshore  
7  
8 wind capacity by 2012, and invested in some of the UK's largest offshore wind projects  
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13 (ScottishPower UK PLC, 2012).  
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18 Scottish Power continued to develop fossil fuel plants, with plans approved for  
19  
20 a new 1GW CCGT plant with CCS-ready technology (Interview 6). However, the company  
21  
22 withdrew its bid for a coal CCS demonstration project at Longannet power station, blaming  
23  
24 high costs as the subsidies that government offered were insufficient to make the project  
25  
26 viable. Anticipating that the government will support new nuclear power stations, Iberdrola  
27  
28 (which operates multiple nuclear stations around Europe) entered a joint venture with SSE  
29  
30 and GDF Suez in 2009 (NuGen). However, following SSE's withdrawal in 2011, Iberdrola sold  
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32 its stake.  
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41 Starting the period with the smallest domestic electricity market share of the Big Six (12%),  
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44 Scottish Power used discounted electricity tariffs to gain new customers outside of their  
45  
46 home area. Scottish Power used doorstep and online channels to reach new customers,  
47  
48 while within their home area they focused on attracting existing customers with dual fuel  
49  
50 offers (Interview 6). Nonetheless, by 2011, Scottish Power dropped to 11% of market share.  
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56 *2012-2016*  
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1 Scottish Power continued to expand their renewable electricity generation fleet, with the  
2 company articulating successively bolder commitments to renewable energy (ScottishPower  
3 UK PLC 2012, 2013, 2014, 2015, 2016). Having invested substantially to build in-house  
4 expertise for developing onshore wind farms since the early 2000s, Scottish Power built  
5 1GW of new wind generation capacity between 2013 and 2018, mostly onshore (BEIS,  
6 2018). After a change in UK policy in 2015 meant that onshore wind projects would no  
7 longer receive subsidies and would also face stricter local planning regulations (BBC News,  
8 2015), Scottish Power focused on large-scale offshore sites, with several projects in the  
9 pipeline.  
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26 Scottish Power opted Cockerhulme coal plant out of the LCPD, leading to its closure in 2013.  
27 After withdrawing their last active coal power station (Longannet) from the government's  
28 CCS demonstration competition and in a context of low dark spreads, the station ceased  
29 operation in 2016 (Interview 6). The company then sold all of their fossil fuel plants (and  
30 hydroelectric sites) to Drax in 2019, becoming the first of the Big Six with a 100% renewable  
31 generation portfolio.  
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44 After growing to 12% of the domestic electricity market in 2012, Scottish Power dropped  
45 back down to 11% in 2016. Like Npower, Scottish Power responded to a fine for door-step  
46 mis-selling in 2013 (Ofgem, n.d.) by offering discounts online instead of at the door-step  
47 (Interview 6). According to an interviewee, this ultimately disadvantaged the disengaged  
48 customers, because overall doorstep selling increased switching. Scottish Power aimed to  
49 meet its CESP obligations through outsourcing the project to a single company, but the  
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1 contractor failed to deliver on time, and Ofgem fined Scottish Power for missing the target  
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3 (Ofgem, n.d.; Interview 5).  
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7 Like British Gas, EDF and Npower, Scottish Power's migration to a new customer  
8 management software system led to inaccurate billing and other customer service problems  
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10 in 2014 and they were required to pay an £18m penalty in 2016 (Ofgem, n.d.). The fine  
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12 received widespread media coverage (e.g. BBC News, 2016) and coincided with a large drop  
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14 in domestic market share.  
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## 23 **SSE**

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25 SSE is a Scottish company formed in 1998 following the merger of Scottish Hydro Electric  
26 and Southern Electric (SSE, n.d.). Throughout the period SSE owned transmission and  
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28 distribution networks, generation sites and a retail arm.  
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### 36 *2008-2011*

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38 SSE started the period with 10.2GW of generation capacity, 1.7GW of which came from  
39 hydroelectric and onshore wind sources. After acquiring a diverse range of potentially  
40  
41 disruptive firms such as Solar Century, Vital Energy, Cyber Hawk and Intelligent Energy, SSE  
42  
43 focused more on renewable energy investments from 2008 onwards (SSE, 2008). Already  
44  
45 committed to expanding their renewable portfolio, the CEO was motivated to invest heavily  
46  
47 in large-scale offshore wind projects because he deemed this necessary for achieving the  
48  
49 European Union's ambitious target of 20% renewable energy by 2020 (Interview 7). To this  
50  
51 end, SSE purchased Airtricity (a Dublin-based wind farm development company), acquired a  
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53 25% stake in a 367MW offshore wind site, and developed a handful of onshore wind sites.  
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1 The company continued to invest in fossil fuel plants too, on the basis that these provide  
2 flexibility and security. New projects included coal/biomass co-firing plants, CCGT plants,  
3  
4 and site-specific gas-fired CHPs (SSE, 2010). Last, SSE invested in the NuGen nuclear power  
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6 development consortium in 2009, but later pulled out to focus on renewable energy  
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8 projects (SSE, 2011; SSE, 2012).  
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15 Following many years of growth in the domestic retail market, SSE held the second largest  
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17 share in 2010, at 20%. The growth was achieved through discounting outside of its home  
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19 area, and additional promotions. The company was making healthy profits from the  
20  
21 generation business and so cut their retail prices to gain customers. Customer numbers  
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23 declined after the door-step mis-selling revelations, and SSE simplified their tariffs to rebuild  
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25 consumer trust (SSE, 2012).  
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33 From 2005, Ofgem's innovation funding initiatives, coupled with the increase in renewable  
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35 electricity, encouraged greater investment in the transmission and distribution networks.  
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37 This prompted SSE to spend more on network assets (Interview 7). Investments included an  
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39 active power management network in Orkney, which monitors and controls connected  
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41 devices (such as generators and sources of flexibility).  
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#### 49 *2012-2016*

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51 Amid low spark spreads and declining dark spreads, SSE continued to reduce capital  
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53 expenditure in 2012 by mothballing or opting out several fossil fuel plants from European  
54  
55 Directives, reinforcing their focus on renewables. To this end, the company completed the  
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57 construction of various large onshore wind farms (SSE, 2012, 2013). However, after a review  
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1 of their offshore wind farm investments in 2014, SSE decided to only continue with a stake  
2 in one project, divesting from four others. The cancelled projects all required significant  
3 capital investments and exhibited uncertainty over their potential returns for investment  
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5 (SSE, 2014).  
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12 At a time of restructuring to reduce costs, SSE faced increasing consumer complaints and its  
13 domestic market share dropped to 18% in 2012. SSE was then fined £10.5m for its role in  
14 door-step mis-selling (the largest fine ever imposed by Ofgem at the time) – and  
15 subsequently also fined £1.75m for falling marginally short of the CESP target (Ofgem, n.d.).  
16  
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18 The first of these fines received widespread media coverage which damaged SSE’s  
19 reputation (e.g. BBC News, 2013). Similarly to Npower and Scottish Power, SSE responded  
20 by shifting its target from the door-step to high-usage customers through competitive  
21 pricing online, as well as offering discounted tariffs and other promotions. Despite these  
22 efforts and the release of bundled packages and maintenance services in 2013, SSE  
23 continued to lose market share, reaching 15% by the end of 2016. The company had a  
24 business interest in smart devices since at least 2012, but launched its range of smart home  
25 services in collaboration with Climote in 2018 (Interview 7).  
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57 While all of the Big Six lost non-domestic customers during this period, in 2016 SSE held the  
58 largest market share of small and medium-sized customers (17%) and 11% of the industrial  
59 and large commercial market.  
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#### 4. Comparison of the Big Six: decarbonisation, decentralisation & digitalisation

1 Having outlined how each of the six firms' company strategies responded to changes in the  
2 electricity generation and retail market between 2008 and 2016, this section focuses on  
3 their responses to the three trends of decarbonisation, decentralisation and digitalisation.  
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## 8 9 10 Decarbonisation

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15 Decarbonisation has been a key policy objective in the UK for over two decades, following  
16 the 2003 Energy White Paper (DTI, 2003) and the 2008 Climate Change Act (HM  
17 Government, 2008). It is therefore not surprising that it is prominent in each of the Big Six  
18 firms' company reports and annual statements.  
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28 Overall, the generation portfolios of the Big Six companies have become less carbon  
29 intensive since 2008. This is in line with overall trends in the UK power sector, where carbon  
30 intensity of electricity generation fell from around 500g of CO<sub>2</sub> per kWh in 2008 to around  
31 300g of CO<sub>2</sub> per kWh in 2016 (CCC, 2018). Since 2016, intensity has fallen further – to less  
32 than 200g of CO<sub>2</sub> per kWh. While in 2008, 93% of the Big Six's generation capacity  
33 comprised large fossil fuel plants, by 2018 this had dropped to 59% (see Figure 1). Most of  
34 their coal-fired capacity has either been closed or is being operated at very low load factors,  
35 partly due to European legislation but also because of the UK carbon price floor. Whilst  
36 there are important differences between the approaches taken by the Big Six, their  
37 investments in renewables and nuclear power (in the case of EDF) have increased. By 2018,  
38 some of them still had significant gas-fired capacity. So there is still some way to go before  
39 they meet the Committee on Climate Change's goal to 'largely decarbonise the power  
40 sector over the period to 2030' (CCC, 2015).  
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3 The investments made by SSE and Scottish Power were more geared towards large scale  
4  
5 renewables, particularly wind and hydro-electricity (see Figure 1). SSE began the period with  
6  
7 clear aspirations of transitioning to a low carbon generation portfolio, and increasing their  
8  
9 generation capacity with large scale plant (Interview 7). However, this commitment to  
10  
11 decarbonising their portfolio was scaled back around 2012, partly due to uncertainty in the  
12  
13 UK policy landscape. Investment levels peaked in 2012 at £1707m (SSE, 2012) and  
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15 generation capacity in 2013 at approximately 13GW (SSE, 2013).  
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23 Scottish Power's strategy is distinctive in that it remained committed to decarbonisation  
24  
25 throughout this period, setting out increasingly more challenging targets for their  
26  
27 generation portfolio (ScottishPower, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015,  
28  
29 2016). Like SSE, their focus was on large scale low carbon plants. Figure 1 shows that  
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31 Scottish Power's generation portfolio included a significant proportion of gas generation  
32  
33 (43% of their total portfolio) in May 2018. However, the sale of assets in late 2018 meant  
34  
35 that Scottish Power transitioned to an all-wind generation portfolio (ScottishPower, 2018).  
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41 The extent of this shift to renewables is unique among the Big Six.  
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49 Whilst EDF has also invested in large scale low carbon generation, its approach is unique.  
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51 Throughout this period it has been the main UK investor in nuclear power as the pathway to  
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53 a low carbon system. This strategy has been heavily influenced by EDF's French parent  
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55 company (EDF Group, 2008; Interview 3). EDF is also unique in that, in the face of the LCPD,  
56  
57 it invested in fossil fuel plant extensions instead of mothballing or closing plant (EDF Energy  
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59 Holdings Ltd, 2012, 2013, 2014, 2015, 2016). As a result, EDF retained the highest coal  
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1 capacity out of the Big Six (Figure 1), though it operated at a very low load factor at less than  
2 15% for both plants in 2017 (National Grid, 2018b).  
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7 Centrica was the only other Big Six company to invest in nuclear power, via their share in  
8 British Energy. But this was at a smaller scale than EDF. Following a revision of their overall  
9 strategy and a restructuring across the different businesses in 2015 (Centrica, 2015),  
10 Centrica radically scaled down their electricity generation portfolio to just over 2GW by  
11 2018 (see Figure 1). Instead, decarbonisation was pursued through their customer facing  
12 businesses, e.g. by selling energy saving products and services (Centrica, 2015).  
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25 The two other Big Six companies – E.ON and RWE – had generation portfolios that were  
26 dominated by fossil fuels throughout the period of analysis. This is despite stated  
27 commitments to decarbonisation and renewable energy (Interview 4; Interview 5). Their  
28 strategies diverged towards the end of the period. E.ON opted out several plants from the  
29 LCPD, resulting in a significant reduction in fossil fuel capacity (E.ON UK PLC 2012, 2013,  
30 2014, 2015; BEIS 2018; Interview 4). This was followed by the sale of Uniper in 2018, which  
31 left the firm with the second smallest level of generation capacity out of the Big Six (BEIS,  
32 2018).  
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#### 49 Decentralisation

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54 There has been some decentralisation within the UK electricity system since 2008. In  
55 particular, there has been a rapid growth in solar PV installations. By the end of 2018, over  
56 13GW of solar PV had been installed, compared to 30MW at the start of 2010 (BEIS, 2019b).  
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However, the strategies of the Big Six reveal a mixed picture – and show that the centralisation that has historically characterised the UK electricity system still continues, despite the shift towards low carbon sources of generation. Table 1 presents the average power capacity of all the sites that each of the firms owned in 2008, 2012, 2016 and 2018. Unlike in Figure 1, capacity is not weighted by ownership share.

*Table 1: Average power capacity per generation site in given year (MW/site). Sources: BERR, 2008; DECC, 2012, 2015; BEIS, 2018, supplemented by company literature.*

	<b>Average power capacity per generation site (MW)</b>			
<b>Company name</b>	May 2008	May 2012	May 2015	May 2018
Centrica	360	629	678	903
EDF	309	358	363	323
E.ON	238	261	175	170
RWE	232	251	190	226
Scottish Power	192	174	151	97
SSE	108	118	98	103

Some companies' rhetorical commitment to decentralisation is not reflected in the data in Table 1. For example, Centrica set up a Distributed Energy & Power unit in 2015 as part of a company restructuring. However, the data shows that the average capacity per site increased throughout the period 2008 – 2018. This is because they sold smaller generation sites which meant that their portfolio was dominated by large-scale nuclear power and CCGT plants by 2018. It suggests a mixed strategy which includes both centralised and decentralised generation activities.

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3 Most of the other Big Six companies have also continued to own and develop centralised  
4  
5 generation technologies during this period. As shown in Figure 1, RWE group's generation  
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7 capacity in the UK includes a high percentage of large centralised plant, implying a low level  
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9 of interest in decentralisation. E.ON initially showed an interest in decentralisation, which  
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11 would have been delivered through acquisitions and the expansion of their energy services  
12  
13 activities. However, the decentralised energy solutions team was dissolved in 2013 due to  
14  
15 low profit levels (Interview 4). Similarly, EDF's portfolio is dominated by large nuclear plants,  
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17 with small-scale and distributed generation projects remaining a relatively marginal interest  
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19 (Interview 8). The two Big Six companies based in Scotland have a lower average generation  
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21 plant size, due to their greater involvement in wind and hydro generation.  
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### 30 Digitalisation

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33 In their published material and interviews, all of the Big Six acknowledged digitalisation as a  
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35 key trend in the power sector. Whilst digitalisation can apply to all levels of operation in an  
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37 integrated utility (McKinsey & Company, 2018), the Big Six mainly refer to it when discussing  
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39 their retail businesses. Therefore, this has been the main focus for this paper. While there is  
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41 some evidence of increased interest in developing new products and services that  
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43 incorporate digital technologies, the impact on their operations is unclear.  
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52 In some cases, plans for digitalisation of their retail business have not been implemented as  
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54 quickly as planned. The most prominent example is Centrica, which appears to have been  
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56 more focused on digitalisation than the other Big Six companies. Energy management and  
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58 smart homes were identified as a priority by Centrica as early as 2013 (Centrica, 2013).  
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1 Following the 2015 restructuring of the company, more emphasis was placed on their retail  
2 business, including the provision of smart energy products (Centrica, 2015). However,  
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4 Centrica has recently admitted that it is a long way from meeting the revenue goals for this  
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6 new 'smart homes' business. This lack of progress has been cited as a contributing factor in  
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8 the company's poor financial performance, and the decision of the chief executive to step  
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10 down (Ambrose, 2019).  
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18 All of the other Big Six companies have implemented specific initiatives that emphasise the  
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20 application of digitalisation to the retail market. For example, RWE set up Innogy as a  
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22 separate pan-European company that focuses on low carbon activities, including  
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24 digitalisation (RWE, 2015). Scottish Power expressed an interest in digital services in  
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26 successive company reports, which materialised mainly via the 'Power Up' app, launched in  
27  
28 2016 (ScottishPower UK PLC, 2011, 2012, 2013, 2014, 2015, 2016). The service allows  
29  
30 customers to purchase electricity units ahead of consumption with paying a standing  
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32 charge, but has been temporarily suspended and is planned for relaunch in the near future  
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34 (ScottishPower UK PLC, n.d.) .  
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43 Similarly, EDF invested in EDF Energy Services in 2016, targeting large industrial and  
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45 commercial clients (EDF Energy Holdings Ltd, 2016). At the time of writing, a new EDF  
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47 innovation unit (Blue Lab) has begun selling a range of products to household customers. It  
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49 has launched a vehicle-to-grid platform and an energy services platform, and partnered with  
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51 other energy service providers. E.ON has also acquired digitalisation businesses for domestic  
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53 and non-domestic customers, but this area has appeared to have fallen in priority for the  
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55 company (Interview 4).  
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2 Overall, the evidence suggests that the impact of digitalisation on the Big Six's retail  
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4 businesses has been limited so far. However, digitalisation could have a more significant  
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6 impact in the near future due to the smart meter roll out in all UK households and the  
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8 proliferation of new entrants and business models in the electricity retail market.  
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## 18 **5. Conclusions and policy implications**

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21 This paper has explored the strategies of the largest vertically integrated electricity and gas  
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23 companies in the UK, the Big Six. It has shown how they have responded to some of the  
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25 potentially disruptive changes that have affected many electricity systems in recent years. It  
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27 has focused on changes due to decarbonisation, decentralisation and digitalisation.  
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34 The ways that each of the Big Six responded to these potential sources of disruption were  
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36 shaped by global trends such as increased evidence about climate change and falls in the  
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38 costs of some low carbon technologies – and by policy and market drivers that are specific  
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40 to the UK. Examples of the latter include the increasing availability of strong policy  
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42 incentives for investment in low carbon electricity generation and changes to the electricity  
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44 retail market due to regulatory interventions and the increase in new entrants. In many  
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46 cases, the firms' parent companies also affected their responses. Rapid political and market  
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48 changes in Germany due to the *Energiewende* have strongly influenced the UK strategies of  
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50 E.ON and RWE, whilst EDF's investments in new nuclear power are part of the French parent  
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52 company's broader strategy.  
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3 Out of the three trends, decarbonisation has received the most attention from the Big Six.  
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5 This has contributed to a significant drop in carbon intensity in the electricity sector – from  
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7 around 500g CO<sub>2</sub> / kWh in 2008 to less than 300g CO<sub>2</sub> / kWh in 2018 (CCC 2018; 2019). At  
8  
9 the time of writing, Scottish Power have transitioned to a fully decarbonised generation  
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11 portfolio, and almost all of the UK’s coal-fired plants have closed. Most of the remaining  
12  
13 fossil fuel power plants owned by the Big Six are gas-fired. The adoption of a more  
14  
15 ambitious target for reducing greenhouse gas emissions to net-zero by 2050 is likely to lead  
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17 to further reductions in carbon intensity. In the first few months of 2020, carbon intensity  
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19 has averaged well below 200g of CO<sub>2</sub> /kWh (Ambrose, 2020).  
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29 Decentralisation has also attracted attention from all of the Big Six. However, the available  
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31 data suggests that most of them still have a predominantly centralised generation portfolio  
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33 – perhaps with the exception of the two companies based in Scotland. This tendency  
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35 reflects the largely centralised nature of the UK’s electricity system, which has endured  
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37 despite the rapid growth in domestic solar power and the shift to low carbon sources.  
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45 Their response to digitalisation has been harder to measure. Their interest in this respect  
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47 mainly focused on the retail sector. In this respect, digitalisation was perceived as an  
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49 opportunity for growth and diversification for some of the Big Six, especially Centrica and  
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51 Npower.  
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58 This paper leads to four main implications for policy. First, despite significant change in the  
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60 UK electricity sector, incumbent firms have been able to adapt their strategies, investments  
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1 and portfolios. Adaptations have been extensive in some cases, whereas in others the  
2 changes they anticipated have failed to materialise on a scale that was expected. An  
3 important lesson is that governments should continue to implement the policies required to  
4 reduce emissions rapidly. Whilst they should take into account the ability of incumbents to  
5 deliver, this paper shows that these firms can play an important role in meeting  
6 decarbonisation and other objectives if policy incentives are strong enough.  
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18 A second implication is that the UK's centralised approach to the electricity transition has  
19 reduced the level of disruption experienced by the Big Six. This may have made it easier for  
20 the UK government to meet its policy goals, particularly for reducing emissions. While  
21 decentralised generation has grown in the UK, this has not occurred on the scale seen  
22 elsewhere, such as Denmark and Germany (Kuzemko et al., 2016). In Germany more  
23 extensive decentralisation, coupled with the important role of new entrants as developers  
24 of renewable energy, has had a much bigger impact on incumbent firms – two of which are  
25 owners of the Big Six. Our findings support the conclusion of Geels et al (2016) that the UK's  
26 policy approach to decarbonisation has favoured centralised solutions and, by implication,  
27 incumbent firms. This approach went 'with the grain' of the capabilities of the Big Six (and  
28 other European incumbents looking to invest in the UK, such as Orsted) – even though there  
29 has been a significant shift away from fossil generation and towards renewables. The UK  
30 experience does not mean that a centralised approach to power sector decarbonisation is  
31 necessary for success. However, it suggests that policies for decarbonisation should take  
32 into account the extent of centralisation (or decentralisation) of the electricity system.  
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1 A third implication is that some of the potential disruptions due to digitalisation have had  
2 minimal impact so far. Most of the Big Six have responded with new customer-focused  
3 businesses or offers. However, some early moves into areas such as domestic energy  
4 services have not paid off yet (see Centrica, for example). It is too early to tell whether  
5 digitalisation will have a more widespread, disruptive impact in future. The latest retail  
6 market review by the UK regulator and government could result in reforms that enable  
7 more disruptive business models – some of which could help deliver the low carbon  
8 transition. The reforms could also enable new entrants to undercut incumbents by offering  
9 more targeted products and services. So far, the evidence fits with Bergek et al’s  
10 observations about creative accumulation by incumbents (Bergek et al, 2013). But the  
11 situation could change so that it is more in line with the challenge to incumbents discussed  
12 by Christensen (Christensen, 1997). The eventual outcome will partly depend on whether  
13 the extensive policy rhetoric about digitalisation is matched by specific policy reforms. In  
14 the absence of such reforms and actions to protect consumers and their data, the impacts  
15 of digitalisation on the retail market may continue to be limited.

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41 Fourth, in seeking to understand how incumbents will respond to change, policy-makers  
42 need to take into account their international reach. Four of the Big Six are owned by larger  
43 European utilities. As noted above, their responses to policy have been partly shaped by the  
44 broader strategies of these groups, and not just by the priorities of their UK-based  
45 subsidiaries. Our evidence has highlighted examples of tensions between the international  
46 and UK-based strategies of some of these firms. This means that the stated strategies by UK  
47 subsidiaries can’t always be taken at face value – and there is a need for a detailed  
48 understanding of these tensions by government. Furthermore, this suggests a need for

1 continued policy collaboration between the UK government and other governments in  
2 Europe after the UK leaves the European Union.  
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8 Finally, it is important to acknowledge the limitations of this paper. It has focused on six  
9 companies in one country over a specific time period. General lessons and policy  
10 implications have been identified, which could be developed through further research.  
11  
12 Further research could, for example, focus on developments in other countries to allow  
13 more direct comparisons between the strategies of the Big Six and those of other  
14 incumbent energy utilities. This could include the Big Six utilities (or parent companies) that  
15 also have operations in other countries. Further research could also focus on other parts of  
16 the energy system. For example, the oil and gas sector also faces disruption from ambitious  
17 plans to reduce emissions. However, that sector has a different structure to the electricity  
18 sector, and is likely to be affected in different ways. As the energy transition continues to  
19 unfold, it will be important to understand the role of incumbents alongside the potential for  
20 new entrants and business models to disrupt markets and help meet policy goals.  
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Figure 1 data in Excel



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**Supplementary Material**  
Fig1 Big 6 gen portfolios .xls

Figure 2 data in Excel



Figure 3 data in Excel





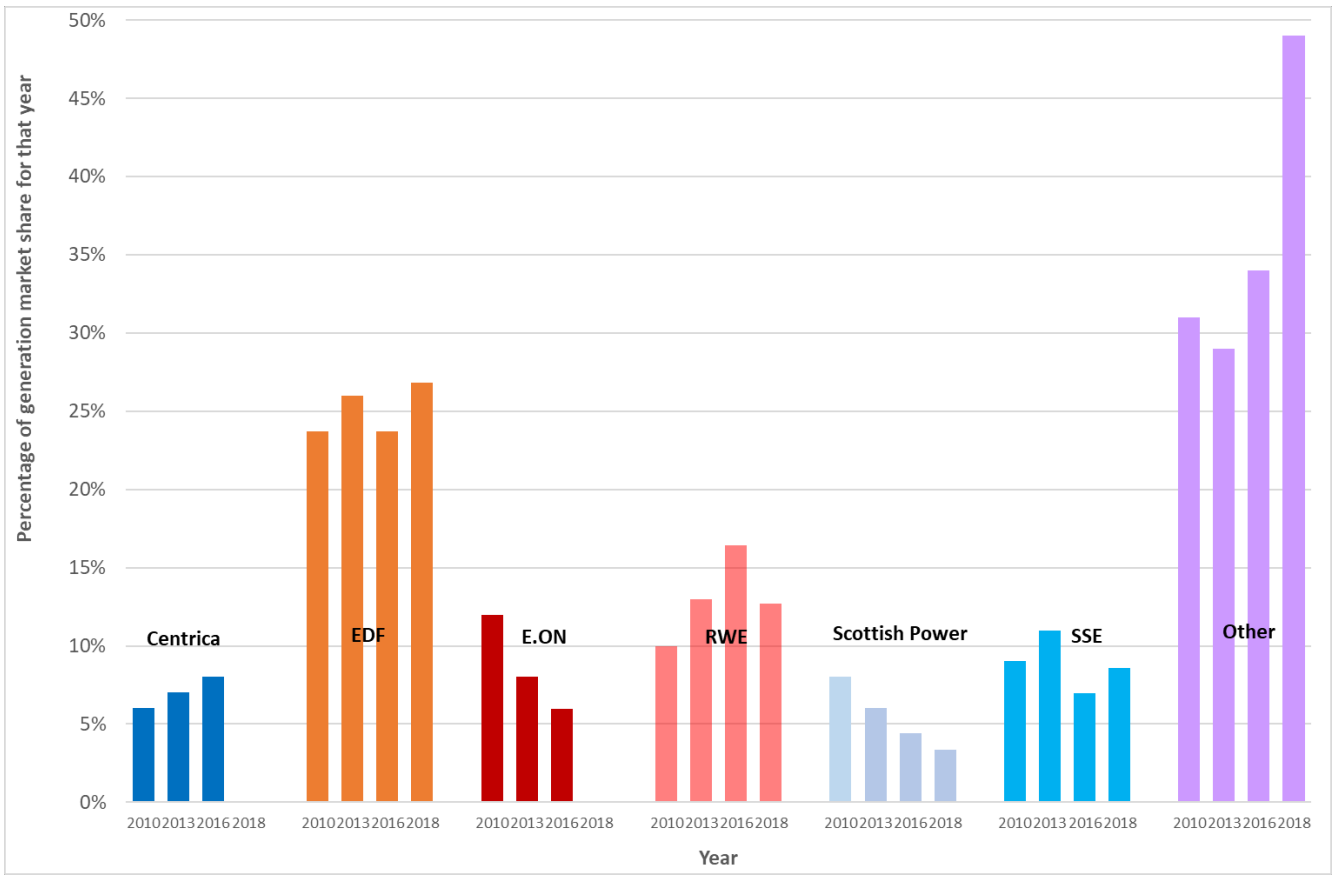
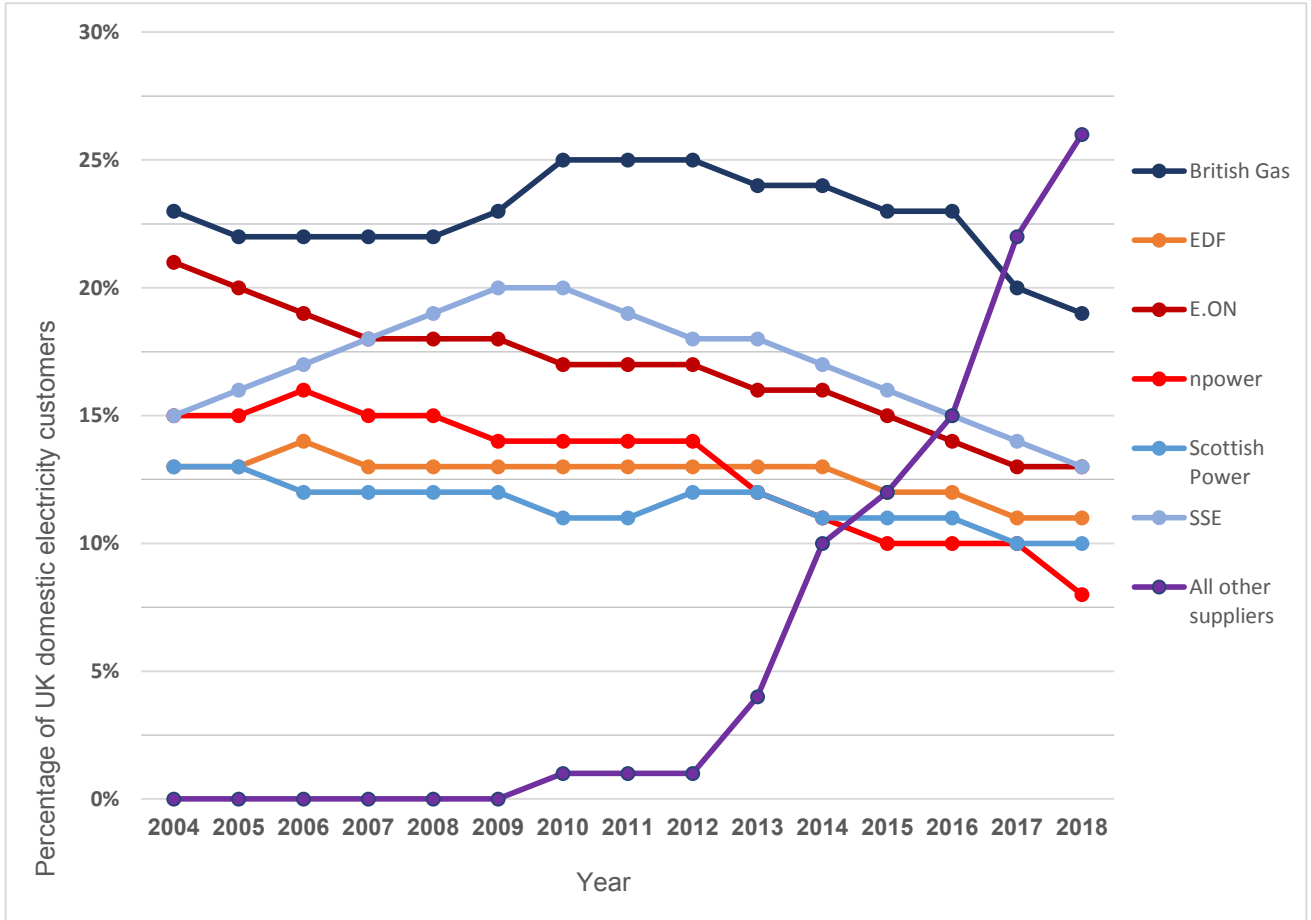




Figure 3: Domestic electricity supply market share (GB), 2004 - 2018. Note: since the total number of UK domestic electricity meter points rose from 26m to 28.5m, between 2004 and 2016, a 1% change corresponds to approximately 300,000 customers. Source: Ofgem.



*Table 1: Average power capacity per generation site in given year (MW/site). Sources: BERR, 2008; DECC, 2012, 2015; BEIS, 2018, supplemented by company literature.*

Company name	Average power capacity per generation site (MW)			
	May 2008	May 2012	May 2015	May 2018
Centrica	360	629	678	903
EDF	309	358	363	323
E.ON	238	261	175	170
RWE	232	251	190	226
Scottish Power	192	174	151	97
SSE	108	118	98	103



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**Supplementary Material**

Supplementary Material - Research Methods v2.docx



Credit Author statement

Michael Kattirtzi: Literature review, research design, data collection and analysis, data visualisation, writing: original draft preparation, reviewing, editing, data validation. Ioanna Ketsopoulou: Initial conceptualisation, literature review, data collection and analysis, writing: original draft preparation, editing. Jim Watson: Initial conceptualisation, supervision, literature review, writing: original draft preparation, reviewing and editing

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