The Association for Decentralised Energy

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Bringing Energy Together

Combined Heat & Power
District Heating & Cooling
Demand Side Services

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Flexibility on demand

Giving customers control to secure our electricity system

July 2016

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Executive summary

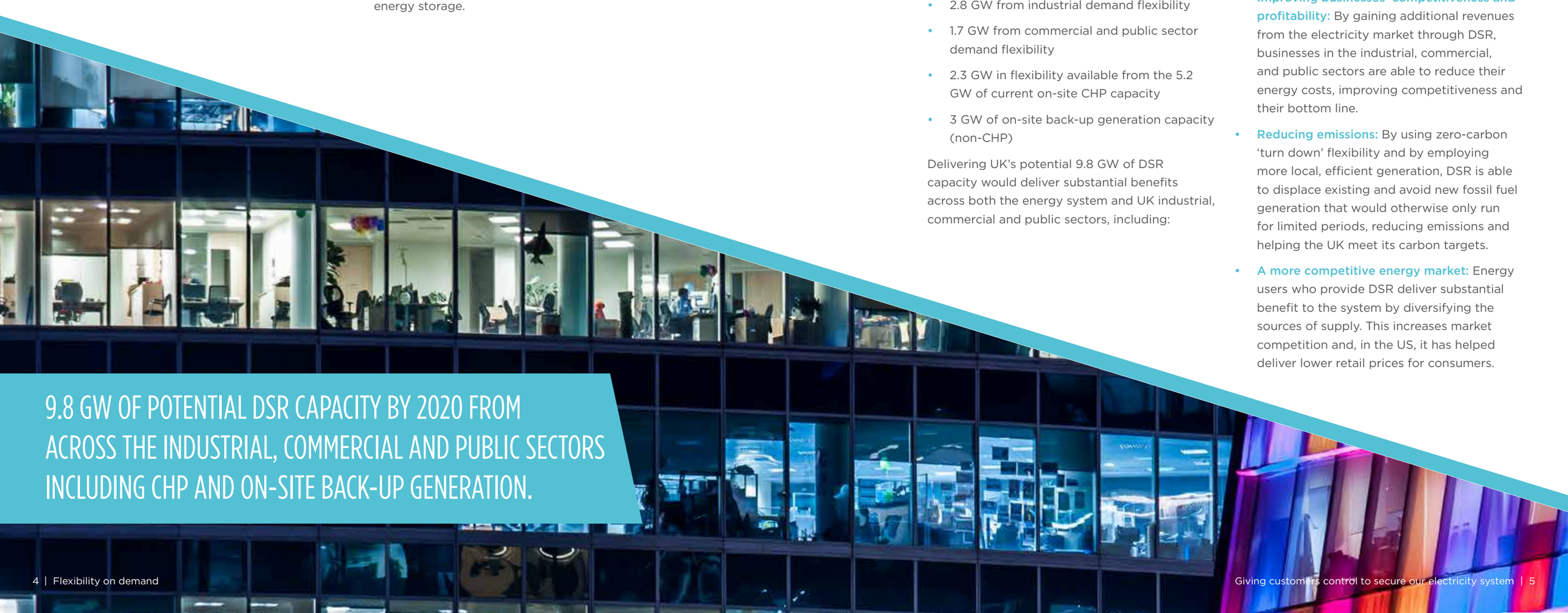
The electricity system in the UK is undergoing dramatic change. The way we generate and use power is very different today than even 20 years ago. With ever-increasing intermittent renewable generation, our ability to control power generation to meet demand is falling. A more flexible, user-led system is vital if we are to create a better value and less wasteful low carbon electricity system.

Production of electricity and its use must always match every second of the day to keep the system in balance. Historically, system balance has been ensured by increasing or decreasing generation at a few large power stations. However, with demand-side response (DSR), businesses can reduce their demand on the system or use different kinds of on-site generation to keep the electricity system in balance.

Demand-side response depends entirely on the actions of an energy user, whether that is an industrial manufacturer, a leisure centre, or a retail store. Through DSR, these users become active participants in the energy system, rather than passive bill payers.

They can be paid to change their demand by:

- **Turning down** the use of electricity-consuming devices, such as turning off refrigeration units for a period of time, using the fridge's insulation to maintain low temperatures;
- **Changing when** they use electricity, such as a quarry pausing its rock crushing unit if it has sufficient, stored rock supply available; or,
- **Turning on or increasing** production from on-site generation, such as highly efficient combined heat and power (CHP), or by using energy storage.



9.8 GW OF POTENTIAL DSR CAPACITY BY 2020 FROM ACROSS THE INDUSTRIAL, COMMERCIAL AND PUBLIC SECTORS INCLUDING CHP AND ON-SITE BACK-UP GENERATION.

Main findings

Demand-side response can contribute a range of benefits to the electricity system, from securing supply and balancing the system, to increasing competition and reducing network investments.

The size of today's active DSR market is challenging to estimate as the information on the various services that businesses and public sector organisations provide is not recorded. Approximately 930 MW cleared the most recent Capacity Market and Transitional Arrangements auctions, while 708 MW participates in the balancing National Grid uses to keep the system in balance.

Demand-side response in 2020

The total potential DSR capacity across the industrial, commercial and public sectors, including highly efficient CHP assets and on-site back-up generation, is conservatively estimated to be **9.8 GW by 2020**. This includes:

- 2.8 GW from industrial demand flexibility
- 1.7 GW from commercial and public sector demand flexibility
- 2.3 GW in flexibility available from the 5.2 GW of current on-site CHP capacity
- 3 GW of on-site back-up generation capacity (non-CHP)

Delivering UK's potential 9.8 GW of DSR capacity would deliver substantial benefits across both the energy system and UK industrial, commercial and public sectors, including:

- **Lower cost security of supply:** If the UK deployed 4 GW of user-led DSR through the Capacity Market, our analysis shows the UK would avoid the need for 50 new OCGT power plants or over 1,300 new small diesel engines, a net saving for consumers of £600 million by 2020 and £2.3 billion by 2035.
- **Controlling system balancing costs:** A further 4.5 GW of the DSR potential could help increase competition for balancing services, controlling costs of balancing the system for consumers.
- **Reduced energy bills by cutting network costs:** Work by Imperial College London and the University of Cambridge Energy Policy Research Group found that DSR, as part of a flexible system, could deliver network investment savings of up to £8.1 billion a year by 2030.
- **Improving businesses' competitiveness and profitability:** By gaining additional revenues from the electricity market through DSR, businesses in the industrial, commercial, and public sectors are able to reduce their energy costs, improving competitiveness and their bottom line.
- **Reducing emissions:** By using zero-carbon 'turn down' flexibility and by employing more local, efficient generation, DSR is able to displace existing and avoid new fossil fuel generation that would otherwise only run for limited periods, reducing emissions and helping the UK meet its carbon targets.
- **A more competitive energy market:** Energy users who provide DSR deliver substantial benefit to the system by diversifying the sources of supply. This increases market competition and, in the US, it has helped deliver lower retail prices for consumers.

Recommendations

The industry has committed to delivering a Code of Conduct for DSR aggregators, providing assurance to customers to encourage their participation. However, to unlock the 9.8 GW of potential business-led DSR in the UK, there are three areas of policy and regulation that also need to be addressed:

1. Independent access and participation in the Wholesale Market and Balancing Mechanism

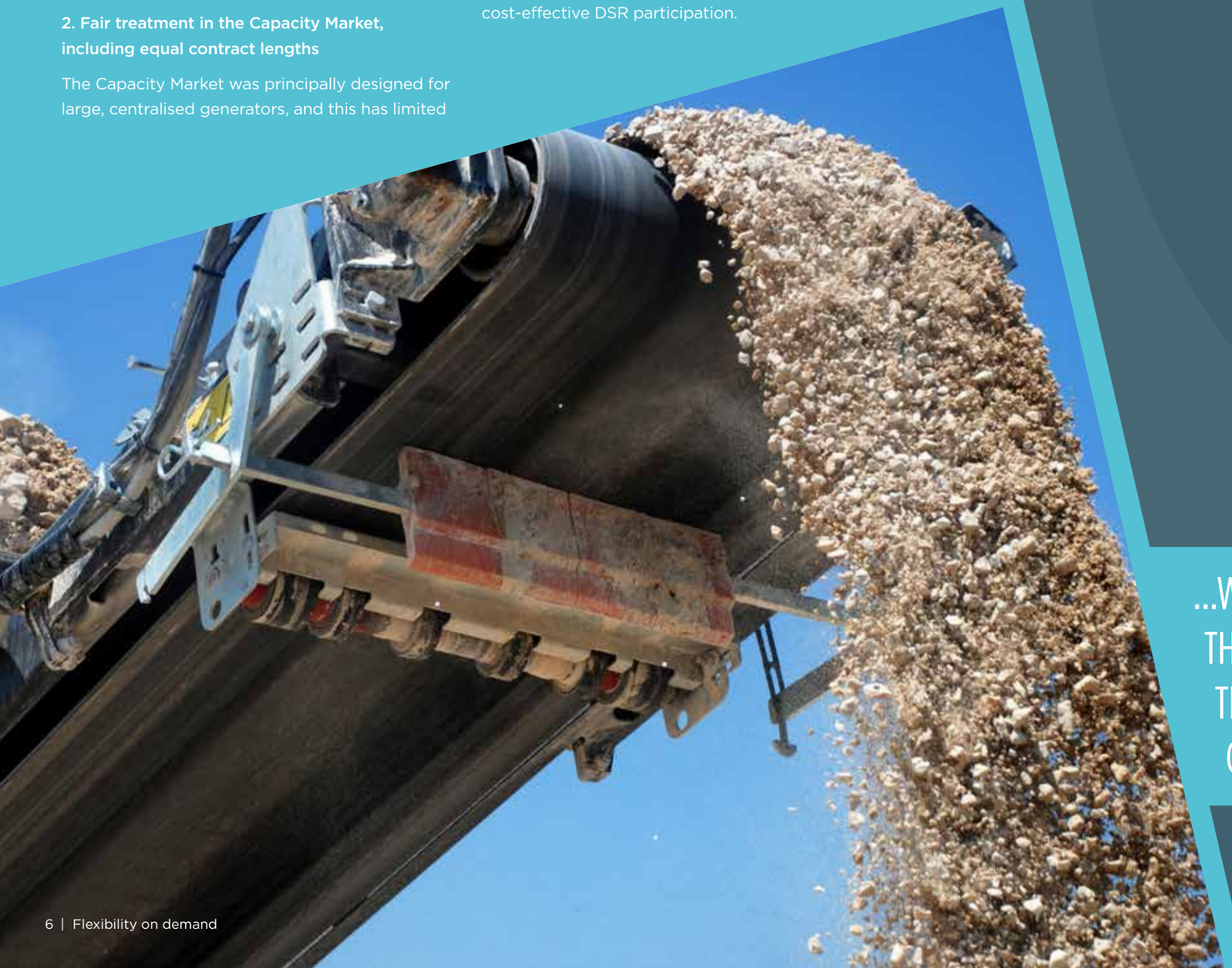
Currently DSR providers are not able to sell their electricity or demand reduction on the Wholesale Market or Balancing Mechanism without going through the customer's licenced supplier, limiting the participation and growth of the DSR sector.

2. Fair treatment in the Capacity Market, including equal contract lengths

The Capacity Market was principally designed for large, centralised generators, and this has limited the ability of DSR providers and distributed generation to participate. Participation by flexible business energy users can be increased, leading to lower costs for consumers, by: allowing all participants to access the same lengths of contract; setting a minimum procurement level for every year ahead T-1 auction; and simplifying the participation of DSR providers.

3. Simplified, user-friendly Balancing Services

National Grid procures Balancing Services that provide vital operational flexibility that the system needs. DSR could be a key participant in these markets. A simplified, more user-friendly system designed for energy users would help increase cost-effective DSR participation.



CHAPTER 1

Introduction

The way electricity is generated and used in the UK is changing dramatically.

We are seeing increasing amounts of renewable generation, such as solar and wind, that is dependent on the weather, delivering too much electricity at some times and not enough at others. With coal power plants all expected to close by 2025 and an ageing nuclear fleet reaching retirement, we are also losing significant amounts of generation that might have filled in the gaps. On the horizon, we face new power demands from heat pumps and electric cars.

As we look to electrify heat and transport while increasing the amount of intermittent renewable generation, the challenge of keeping the system in balance at a reasonable cost to bill payers is growing.

To address this challenge, we can build new power stations to run for only short periods of time, at a steep cost to consumers and with a negative impact on the environment. Alternatively, we can harness the inherent flexibility of businesses' electricity demand and their on-site generation to help balance the system. This solution is known as demand-side response (DSR).

Demand-side response, provided by businesses and the public sector, reduces the need to build new power stations, while also avoiding substantial network investments and improving market competiveness for the benefit of consumers. We will continue to need the flexibility provided by traditional power plants, but without demand-side flexibility, balancing supply and demand will become significantly more difficult and expensive beyond 2030[1].

This report investigates the current role of DSR in the electricity system, and then undertakes an industry-based analysis of the potential for industrial, commercial and public sector energy users to participate in DSR, calculating the total potential DSR capacity in the UK by 2020. The report then showcases the cost savings, value to businesses, and carbon reductions that a more demand-led, flexible energy system could deliver. Finally, the report sets out the policies needed to realise this potential capacity, focussing on ways to simplify policies and enable DSR to compete fairly in different energy markets.

Solving the challenges of our changing electricity system at the best value to the consumer is not an easy task. If we are to be successful we need to re-examine the way we secure the electricity supply, focus on the user as the centre of the energy system, and give them control to help manage it.

...WE NEED TO RE-EXAMINE THE WAY WE SECURE THE ELECTRICITY SUPPLY, FOCUS ON THE USER AS THE CENTRE OF THE ENERGY SYSTEM, AND GIVE THEM CONTROL TO HELP MANAGE IT.

CHAPTER 2

How does demand-side response work?

In an electricity system, the production of power (supply) must always exactly match the usage (demand). The system must be maintained in a near-perfect balance of supply and demand, even as demand varies throughout the day and across the seasons.

Demand-side response is an intentional change in electricity consumption, in response to a signal or incentive, to help balance the system. Demand-side response helps to match supply with demand when unpredicted fluctuations occur, and to shift demand to different times, including reducing peak demand.

Demand-side response depends entirely on the actions of an energy user, whether that is an industrial manufacturer, a leisure centre, or a retail store. Through DSR, these users become active participants in the energy system, rather than merely passive bill payers.

Industrial, commercial, and public sector energy users are particularly well placed to provide flexibility through DSR. These organisations represent nearly 70% of UK electricity demand, are significantly larger than householders, have more flexible electricity demand and more real-time information about their consumption, and many use on-site generation. However, as businesses and public sector organisations are focussed on their primary operations, such as making paper or steel, simple and fair energy policy must accommodate them, rather than expecting them to cope with extreme complexity.

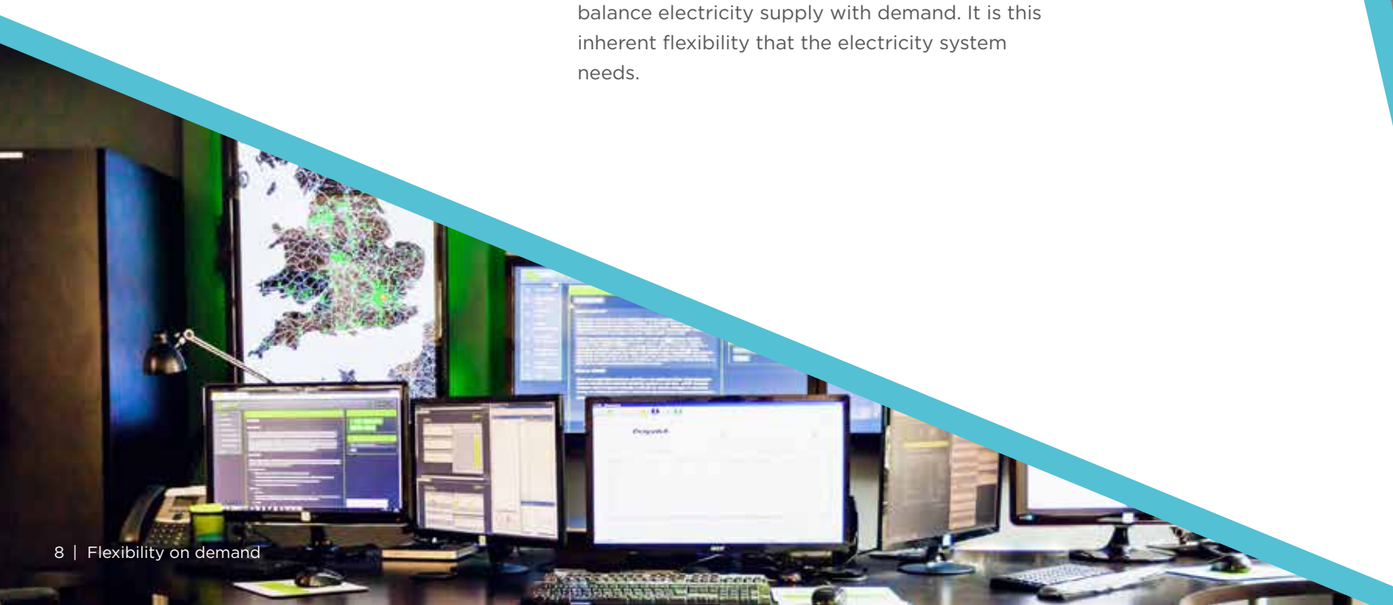
Household-led DSR represents an important future opportunity, but is a more difficult challenge. By delivering a system which works for businesses and the public sector, we can then extend that system to the household market.

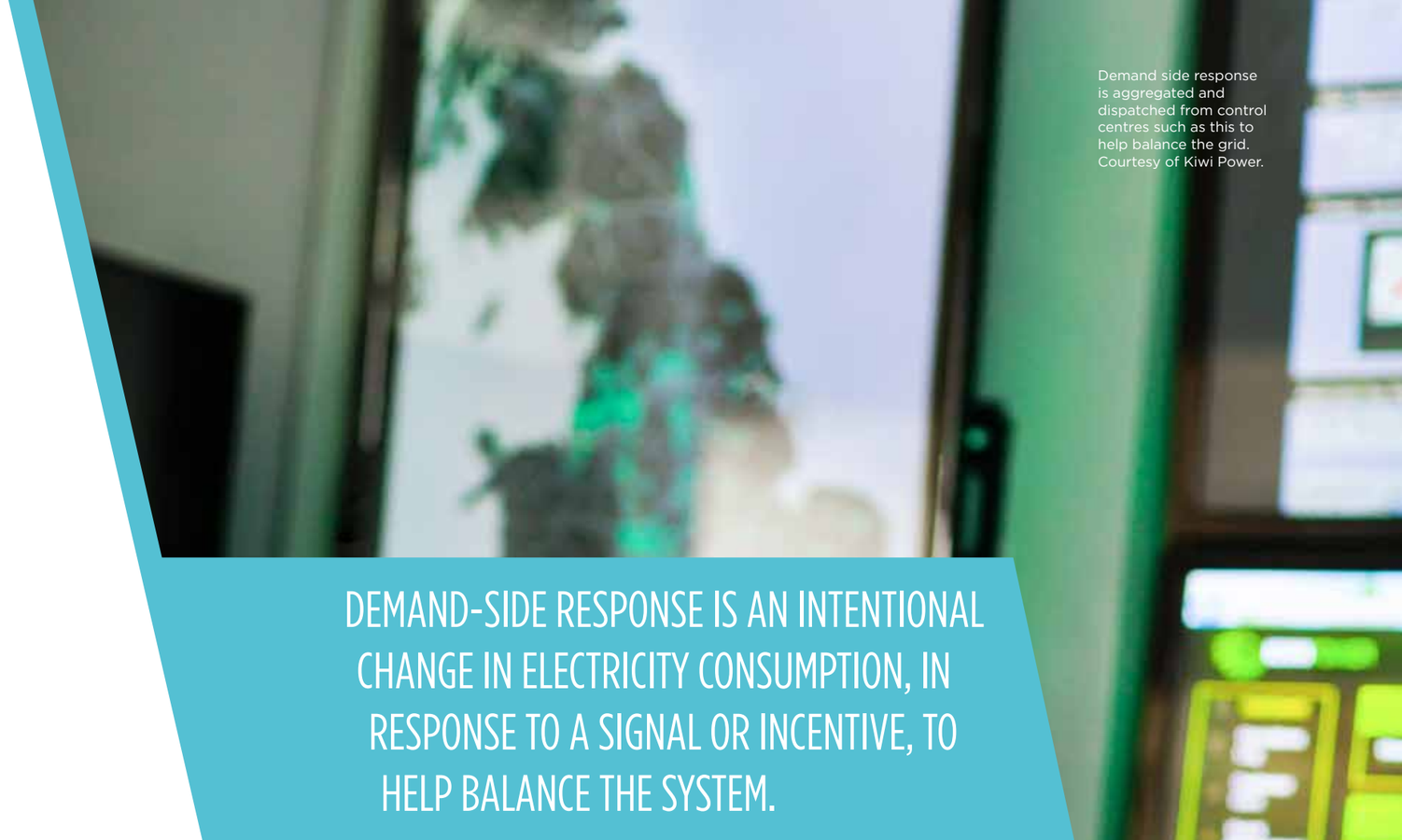
Businesses and public sector organisations can change their electricity demand in three ways[2]:

- **Turning down** the use of electricity consuming devices, such as turning off refrigeration units for a period of time, using the fridge's insulation to maintain low temperatures;
- **Changing when** they use electricity, such as a quarry pausing its rock crushing unit if it has sufficient, stored rock supply available; or,
- **Turning on or increasing** production from on-site generation, such as highly efficient combined heat and power (CHP), or by using energy storage.

Many businesses can also do the reverse and increase their electricity demand at times, such as on windy nights or sunny weekends, when demand is low but renewable output is high. Energy storage is a further way businesses can provide flexibility to the system. By storing electricity generation when it is cheap and saving it for when electricity prices are high, energy users can significantly reduce operating costs[3].

By operating flexibly, businesses can help to smooth out peaks in the system, and help balance electricity supply with demand. It is this inherent flexibility that the electricity system needs.





Demand side response is aggregated and dispatched from control centres such as this to help balance the grid. Courtesy of Kiwi Power.

DEMAND-SIDE RESPONSE IS AN INTENTIONAL CHANGE IN ELECTRICITY CONSUMPTION, IN RESPONSE TO A SIGNAL OR INCENTIVE, TO HELP BALANCE THE SYSTEM.

Demand-side response today

Demand-side response contributes a range of benefits to the electricity system:

- **Strengthening Wholesale Market competition**, by supporting every business and public sector organisation to become an active participant in the energy system, DSR helps make markets more competitive;
- **Improving security of supply and capacity reserves,** by ensuring the lights stay on and helping to overcome the intermittency of renewable generation;
- **Balancing the electricity system,** by responding to National Grid requests to ensure that demand and supply of electricity is in balance every second of every day;
- **Avoiding costly network investment,** by turning down demand when customers are drawing electricity heavily from the grid, thus reducing network reinforcement.

These benefits are in addition to the benefits DSR provides to the participating businesses themselves, by helping to control their energy costs. However, despite these benefits, a recent survey found that more than two-thirds of them are not yet participating[4], leaving an enormous untapped energy resource in the industrial, public, and commercial sectors.

Demand-side response is able to participate in three different marketplaces:

- **Wholesale Market and Balancing Mechanism**
- **Capacity Market**
- **Balancing Services**

The role of DSR in each marketplace is described below.[5]

DSR's role in competitive electricity markets

The Wholesale Electricity Market is where generators trade electricity with suppliers to ensure that their customers' demand is met. Contracts for electricity can be struck over timescales ranging from several years ahead, to just an hour before delivery.

Currently DSR providers are not able to sell their electricity or demand reduction on the Wholesale Market or Balancing Mechanism without going through each customer's licenced supplier. If DSR participants were able to participate independently in these markets, it could provide a new revenue stream for DSR and help limit price spikes.

DSR IS ABLE TO PARTICIPATE IN THREE MARKETS. HOWEVER COMPLEX POLICY DESIGN AND POOR ACCESS BLOCKS MANY HUNDREDS OF MEGAWATTS OF BUSINESS FLEXIBILITY FROM PARTICIPATING.

DSR's role in securing electricity supply

The Capacity Market rewards businesses which reduce their demand or increase their on-site generation during periods of electricity system stress.

There have been three Capacity Market auctions to date, two main auctions and one 'Transitional Arrangements auction', the latter focussed on DSR and smaller generators. In the most recent main auction, 456 MW of business-led DSR cleared at £18/kW[6], while in the first Transitional Arrangements auction 475 MW of DSR successfully cleared at £27.50/kW[7]. A further 4.5 GW of on-site generation, such as combined heat and power, also participated in these auctions. By helping to keep the lights on, businesses will be paid an estimated £100 million as a result of these auctions.

Following discussion with the industry and comparisons with international markets, we conclude that hundreds of megawatts more could have come from businesses, but were blocked due to complex policy design and poor access to key markets.

In contrast, significant amounts of new highly polluting diesel capacity, approximately 650 MW, cleared the most recent four-year-ahead auction, which will cost consumers £176 million over the next 15 years[8].

DSR's role in balancing the system

National Grid estimates that 2,634 MW of DSR capacity, equivalent to two large power stations, participated across their portfolio of balancing products and services in 2015.[9] However, this figure probably overestimates the amount of DSR participating as it includes smaller scale generation, such as diesel engine farms, which are not DSR as they are not associated with an energy user; rather, they are dedicated supply-side assets.

Considering only user-led demand management and on-site generation participating in the Balancing Services, the amount of DSR used for balancing the system in 2015 was approximately 708 MW[10].

CHAPTER 3

The potential for demand-side response in 2020

In collaboration with the DSR industry and drawing on existing research, this report undertakes an industry-based assessment of the potential for industrial, commercial and public sector energy users to provide flexibility to the electricity system by 2020. The assumptions used in the analysis are based on average demand flexibility from previous research and consultancy work, supplemented with additional data based on industry input.

How much flexibility do we need by 2020?

In 2020 the electricity system may rely on approximately 22 GW of wind capacity[11], which is almost a doubling of current levels. Flexibility through DSR can provide the much needed buffer these intermittent renewables will require.

DSR can help balance this intermittency, both by helping to balance the system every half hour, as well as by helping to meet our capacity needs during periods of peak demand or low output from intermittent resources. Some DSR would be able to provide both these services, while other assets will provide one or the other.

Based on these twin demands, we estimate the UK will need between approximately 4.5 GW and 8.5 GW of DSR in 2020:

- For balancing services, National Grid has set a goal to see 30% to 50% of balancing capability come from the demand side by 2020, by ensuring equal access for demand and generation to its schemes[12]. This would represent up to 4.5 GW of DSR in the UK.
- For securing supply, we estimate the capacity needed to deliver the peak 50 hours of demand in 2020 will be 4 GW, or 7% of peak demand. Because this capacity is so rarely needed, it would best be met by DSR and existing assets, instead of capital-intensive new power plants. International markets show this quantity of DSR should be available. The United States' regional capacity market can meet up to 15% of its peak demand with DSR[13] and approximately 10% of the New Zealand North Island's load participates in demand-side reserves markets[14].

These estimates are in line with Imperial College London research, which found that up to 12.7 GW of flexible DSR and storage technologies would be needed by 2030 to facilitate the penetration of renewable energy. Delivering this level of demand-led flexibility would deliver gross savings from reduced investment and operational costs between £3 billion and £6 billion a year[15].

THERE IS 9.8 GW OF POTENTIAL DSR FROM ACROSS THE INDUSTRIAL, COMMERCIAL AND PUBLIC SECTORS.

Total potential DSR in the UK by 2020

The ADE's analysis found that the total amount of potential DSR that could be secured across the industrial, commercial and public sectors, including highly efficient CHP assets and on-site back-up generation, can be conservatively estimated at **9.8 GW**[16]. This estimate includes:

- **2.8 GW** from industrial demand flexibility
- **1.7 GW** from commercial and public sector demand flexibility
- **2.3 GW** in flexibility available from the 5.2 GW of current on-site CHP capacity
- **3 GW** of on-site back-up generation capacity (non-CHP)

This DSR potential of 9.8 GW would represent 16% of the total winter peak demand and 33% of industrial, commercial, and public sector peak demand in 2020. Providing DSR during the 50 hours of the highest demand of the year would be equal to the yearly electricity consumption of more than 115,000 households[17].

The size of available DSR will likely grow further beyond 2020, as the electrification of heat and transport intensifies, and the industrial, commercial, public sectors, and eventually householder, participation increases. Additional assets will offer flexibility to the system in different seasons and times of the day, for different periods of time.

Industrial demand opportunity

In 2014, approximately 97 TWh of electricity demand was used in the industrial sector. Many of the end uses are able to provide a considerable amount of flexibility and already contribute significantly to the operation of the electricity system (Fig. 1).

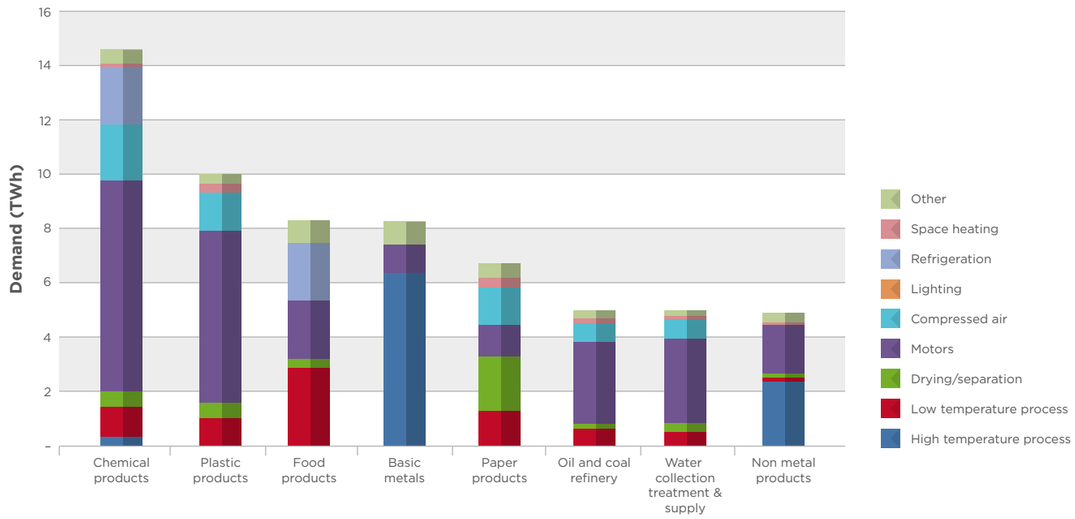


Fig. 1: Annual electricity consumption by sub-sector and end-use in the industrial sector in 2014[18]

The analysis considers the potential flexibility of each class of demand in different industrial sectors. A previous Frontier Economics study identified loads that offer potential for the provision of DSR in heating, ventilation and air conditioning, hot water, lighting, refrigeration, and water pumping[19].

Using data from by DSR providers, we have also included potential flexibility from motors and high temperature processes, assuming a similar level of flexibility as the other demands. Motors include pumping, fans and machinery drives, while high temperature processes include coke ovens, blast furnaces, and other furnaces, kilns and glass tanks. The average flexibility assumption across these different demands is 33%.

By estimating the peak demand of industrial customers and calculating the maximum potential size of the flexible demand, we estimate that industrial sector demand flexibility could provide up to **2.8 GW** of DSR.

Flexibility in the paper sector

The paper making process consists of three stages: pulp production, paper production and rewinding. Pulp production is stockpiled to allow some interruption without affecting overall site production. During such a period, the pulp stockpile is consumed by the papermaking process. Therefore the operation of large pulp making machinery can be delayed to a different time of day without affecting the plant's final output, but such a delay can help the grid enormously if a sudden surge of demand occurs or a traditional power station has a fault. The same principle can apply to electric arc furnaces or induction heaters in the steel industry.

Commercial and public sector demand opportunity

The total commercial and public sector electricity consumption in 2014 was 93 TWh, and included an array of sub-sectors from retail and government to the leisure industry (Fig. 2). Many of these businesses are able to provide flexibility to the electricity system, with the greatest potential in the retail sector.

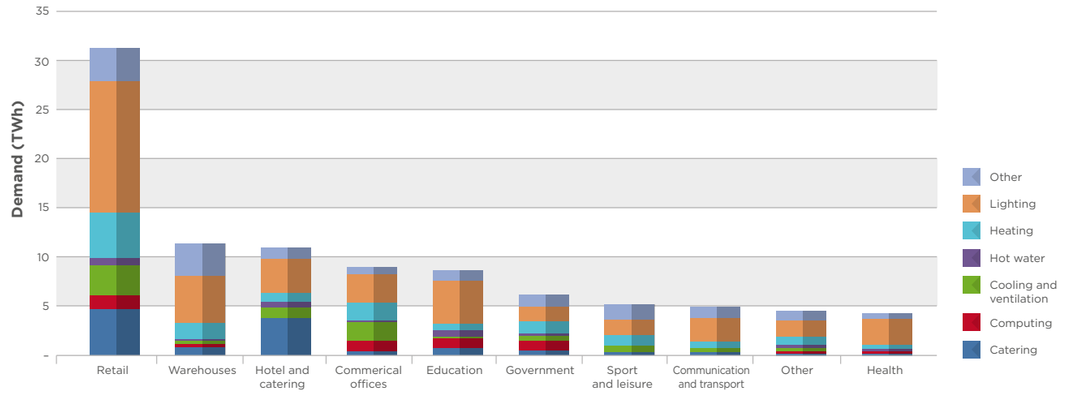


Fig. 2: Annual electricity consumption by sub-sector and end-use in the commercial and public sectors in 2014[20]

A recent Element Energy study report considered the technical potential for demand response in the non-domestic sector, including from heating, ventilation, and air conditioning (HVAC) of buildings, and food refrigeration[21]. Element Energy's most conservative scenario for the available commercial and public sector flexibility assumed an average 14% potential flexibility in the HVAC, hot water, lighting, and refrigeration loads during winter, when the demand associated with heating and lighting is high. Demands in catering and computing loads offer limited flexibility without changing operating patterns and so are not included.

Taking the peak electricity demand of the non-domestic sector and applying the weighted flexibility potential of electricity demand, the estimated total commercial and public sector DSR potential is **1.7 GW**.

Flexibility in the food and drinks sector

There are many ways in which the food and drinks sector can provide temporary flexibility within their processes. For example chiller compressors on refrigerators and chilled stores can be reduced or switched off for limited periods and automated temperature ranges can be altered temporarily without affecting the finished product. The period of time that flexibility can be provided depends on the type of product being stored. Storing fresh products is more sensitive compared to deep-frozen products in well-insulated freezers, which can reduce demand and provide flexibility for several hours.

Highly-efficient combined heat and power opportunity

There is a total of 5.2 GW of on-site CHP capacity installed on the distribution network in businesses across the UK. This excludes CHP capacity that is no longer connected to a main source of heat demand.[22] Combined heat and power integrates the production of electricity and the use of the resulting waste heat in one single, highly efficient process, reducing fuel use by about 30%. Combined heat and power is business-led energy generation that can help support the electricity system while delivering efficiency and cost savings to businesses and public sector organisations.

Based on current CHP load factors, more than 48% of the current business-led CHP capacity remains available for flexibility services and is not being taken advantage of – equivalent to **2.3 GW** of the total capacity[23].

Flexibility from combined heat and power

Large industrial sites tend to use gas and steam turbine CHP, which follow a production process, but some regularly operate below full load and so can turn up at short notice. Other forms of CHP in commercial sectors, often using reciprocating engines, can provide much needed flexibility during the critical period of high demand between 7am and 9am, when the CHP would otherwise be unused.

On-site back-up generation opportunity

The primary function of back-up generators is to power essential services, such as data centres, hospitals, sewage works and water supply works, during power failures.

By using existing back-up assets such as on-site diesel generators, that are primarily reserved for emergency use, businesses and the public sector are able to secure additional revenue. As back-up diesel generation is necessary for emergency purposes, the engines must be tested regularly throughout the year to ensure they run efficiently and safely. Compared to diesel engine farms, which do not need to be tested as there is no back-up responsibility, on-site diesel back-up generation is an important element of a secure electricity system through the Capacity Market and National Grid's balancing services.

It is challenging to estimate the capacity of the UK's back-up generation fleet. The most recent work, by Frontier Economics, estimated the fleet at approximately 3 GW of installed capacity. Of this total capacity, some units are already routinely used to provide non-emergency services such as feeding power into the local electricity distribution system. Further potential exists in this sector from back-up generation geared towards emergency services.

The potential of **3 GW** of on-site back-up generation is based on existing equipment, avoiding the capital cost associated with new generation assets.

BY USING HIGHLY EFFICIENT COMBINED HEAT AND POWER, AND EXISTING BACK UP ASSETS, BUSINESSES AND THE PUBLIC SECTOR ARE ABLE TO SECURE ADDITIONAL REVENUE.

Highly-efficient combined heat and power engine that integrates the production of electricity and the use of the resulting waste heat in one single, highly efficient process. Courtesy of Veolia.

CHAPTER 4

Benefits of delivering our demand-side response potential

Unlocking the UK's potential 9.8 GW of DSR capacity would deliver tangible benefits across both the energy system and the UK's industrial, commercial, and public sectors, including:

- **Lower cost security of supply:** It is estimated the UK will need 4 GW of capacity only to meet peak demand during 50 hours of the year in 2020[24]. If the UK deployed 4 GW of user-led DSR through the Capacity Market, our analysis shows the UK would avoid the need for 50 new OCGT power plants or over 1,300 new small diesel engines: a net saving for consumers of £600 million by 2020, rising to £2.3 billion by 2035[25].
- **Controlling system balancing costs:** A further 4.5 GW of the DSR potential could help increase competition for balancing services, making balancing services markets more competitive and controlling costs of balancing the system for consumers[26].
- **Lowering energy bills by reducing network costs:** Work by Imperial College London and the University of Cambridge Energy Policy Research Group found that DSR, as part of a flexible system, could deliver network investment savings of up to £8.1 billion a year by 2030[27].
- **Improving businesses' competitiveness and profitability:** By gaining additional revenues from the electricity market through DSR, businesses in the industrial, commercial, and public sectors are able to reduce their energy costs, improving competitiveness and their bottom line. Despite DSR only achieving a tenth of its estimated potential in the Capacity Market, businesses have already secured £100 million in value[28].
- **Reducing emissions:** By using zero-carbon 'turn down' flexibility and by employing more local generation, DSR is able to displace fossil fuel generation that would otherwise run fewer than 50 hours per year. This would avoid having to new build carbon-intensive plant to meet these limited periods, reducing emissions and helping the UK meet its carbon targets. For example, more than 650 MW of diesel engine farms cleared the Capacity Market auction in 2015.
- **A more competitive energy market:** Energy users who provide DSR deliver substantial benefit to the system by diversifying the sources of supply. This increases market competition and, in the US, it has helped deliver lower retail prices for consumers.

Open Energi's Dynamic Demand technology is invisibly adjusting demand at United Utilities sites in real-time to help National Grid.

Hanson UK is installing Open Energi's Dynamic Demand technology at 29 sites UK-wide, delivering around 2MW of dynamic frequency response to National Grid.

CHAPTER 5

How to deliver the 2020 demand-side response potential

While businesses are technically able to participate in a range of different energy markets, the structures of these markets currently prevent businesses providing DSR from competing on a level playing field and securing fair value. We estimate that DSR providers currently miss out on hundreds of millions of pounds per year because they cannot access the full value of these services. At the same time, consumers are bearing higher costs than they would otherwise need to, because the tilted playing field prevents the lowest cost combination of supply and demand-side resources from being procured.

The industry has committed to delivering a Code of Conduct for DSR aggregators, providing assurance to customers to encourage their participation. However, to unlock the 9.8 GW of potential business-led DSR in the UK, there are three areas of policy and regulation that also need to be addressed:

- Independent access and participation in the Wholesale Market and Balancing Mechanism;
- Fair treatment in the Capacity Market, including equal contract lengths; and
- Simplified, user-friendly Balancing Services.

Independent access and participation in the Wholesale Market and Balancing Mechanism

The Wholesale Electricity Market is where generators trade electricity with suppliers to ensure that their customers' demand is met. Contracts for electricity can be struck over timescales ranging from several years ahead to just before delivery.

National Grid has overall responsibility as 'residual balancer' of the electricity system, and takes actions to ensure that electricity supply and demand match at all times. Every half hour, the wholesale market closes for trading and National Grid can then accept offers of electricity (generation increases and demand reductions) and bids for electricity (generation reductions and demand increases) at short notice through the Balancing Mechanism.

Currently DSR providers are not able to sell their electricity generation or demand reduction either on the Wholesale Market or in the Balancing Mechanism without going through the customer's licenced supplier. As aggregators are often competing directly with suppliers, such an arrangement severely hinders their participation. It also adds unnecessary transaction costs, preventing larger businesses from engaging directly in this valuable marketplace.

Prices in the Wholesale Market have previously peaked at £358/MWh[29], while the Balancing Mechanism can see prices as high as £2,500/MWh in cases such as the Notification of Inadequate Supply Margin (NISM) last November[30]. The price cap will be doubling to £6,000/MWh from 2018[31]. The absence of DSR also removes an opportunity for greater competitive pressure in the market to reduce costs to consumers. By not being able to access this value, it places DSR providers at a competitive disadvantage in other areas, such as the Capacity Market.

Ofgem should make the necessary regulatory changes to allow DSR providers to independently access these valuable markets. One way to achieve this end could be to allow DSR providers to participate as Balance Responsible Parties, who are able to participate in both the Wholesale Market and Balancing Mechanism.

OFGEM SHOULD MAKE THE NECESSARY REGULATORY CHANGES TO ALLOW DSR PROVIDERS TO INDEPENDENTLY ACCESS THESE VALUABLE MARKETS.

CURRENTLY, NEW BUILD POWER PLANTS ARE ABLE TO SECURE 15-YEAR CONTRACTS, WHILE BUSINESSES PROVIDING DSR AND EXISTING GENERATORS ARE ONLY ABLE TO SECURE ONE-YEAR CONTRACTS.

Fair treatment in the Capacity Market, including equal contract lengths

The Capacity Market was principally designed for large, centralised generators, and this has limited the ability of DSR providers and on-site generators to participate.

Examples from other energy markets show the impact of enabling decentralised energy to participate in Capacity Markets. The most cited example is the PJM electricity market, where market arrangements have evolved over time to allow different demand-side solutions to be rewarded for the services they can provide.

PJM's approach has led to a reduction of the average wholesale price of between 5% to 8% and a much larger reduction of peak wholesale prices[32]. Compared to the UK market, US markets are also providing easier access for smaller, non-traditional providers of DSR to participate, with a minimum bid size in the range of 100 kW – 1 MW, compared to 2 MW. Increased participation results in greater diversity of supply and generation, leading to increased reliability and system resilience.

Recent changes to help address some of these challenges have been welcome. However, these changes do not go far enough and their benefits are negated by 'negative' reforms, which unintentionally damage both on-site generation and turn-down DSR.

To support the participation of DSR and distributed generation in the Capacity Market, three areas should be addressed:

Fairness under contract lengths

Allow all participants to access the same lengths of contract, including DSR providers and existing generators.

Currently, new build power plants are able to secure 15-year contracts, while businesses providing DSR and existing generators are only able to secure one-year contracts. While the Government has said only new generation assets require long-term contracts due to their higher capital cost, this disparity in contact lengths puts new build generators at an unfair competitive advantage.

New generation assets can factor in 15 years of guaranteed Capacity Market revenue in their auction bid price. In contrast, other Capacity Market participants can only bank on one year of revenue when bidding into the auction. For example, in the 2015 Capacity Market auction, DSR and existing generators received a revenue commitment of only £18/kW, while new generation assets received guarantees of £270/kW, allowing these participants to bid more competitively.

The lack of a long-term guarantee also prevents DSR providers from accessing lower-cost debt to meet their bid bond costs, further exacerbating the competitive advantage. Compared to new build assets who can bank the up-front bid bond payment against their 15 year contracts, DSR participants face a high up-front bid bond cost against only a one year contract. Levelling bid bonds so that DSR can either borrow against longer contracts, or be allowed to participate without the need to raise a bond, would increase investor appetite in the DSR sector and grow its participation in the Capacity Market.

Further, one-year contracts mean Capacity Market participants are required to make critical investment decisions from year to year, raising Capacity Market bid prices and preventing better medium-term investment planning.

As the Capacity Market is designed to be technology-neutral, this approach unfairly skews the market towards new build generation and away from DSR and existing assets, all while increasing the cost to consumers. Equal contract lengths for all participants would result in a more competitive Capacity Market, significantly lowering the costs to consumers of delivering security of supply.

Certainty over future year-ahead auctions

Set a minimum procurement level for every year-ahead capacity auction.

Government holds a Capacity Market auction one year before the electricity capacity is needed, known as the 'T-1 auction', which is considered an important route for flexibility resources to participate.

The year-ahead auction is critical to ensuring the system is able to cope with unforeseen supply shortages while keeping the lights on. The Capacity Market originally set a minimum amount of capacity to be procured in a year-ahead auction three years in advance.

Government has consistently recognised the value of a minimum year-ahead auction set aside for the fledgling DSR market; however a shift in policy now means the Government will remove this minimum amount.

As a flexible and easily dispatchable resource, DSR plays a key role in delivering the needed flexibility in a short-term auction and the year-ahead 'set-aside' has been a key building block of the DSR market strategy for participation. Without such assurance that a short-term market will be available, DSR providers are less able to build up their customer base and supply chain. DSR providers are less likely to invest their time and money in providing new DSR services if there is reduced certainty about access to future markets.

Creating a permanent minimum for the year-ahead auction will ensure that potential providers of short-term flexibility will have confidence there will be accessible value on an annual basis, ensuring Government is able to secure short-term flexibility when needed. Without such a minimum short-term market size, there is a substantial risk that the short-term flexibility market will not be available when the Government needs it, resulting in price spikes in the Capacity Market when T-1 auctions are held, increasing costs to consumers.

Simplifying participation in the Capacity Market

Simplify the testing and metering Rules, allow the flexible reallocation of DSR assets, and enable businesses to provide all types of DSR including Firm Frequency Response.

While recent reforms announced by Ofgem in May 2016 will make some rules simpler for Capacity Market providers, there remain a number of barriers to participation for DSR participants and smaller players. This challenge was recognised by the National Infrastructure Commission in its 2016 report, which noted that *"rules around testing and the makeup of portfolios of capacity, unintentionally precludes the participation of demand flexibility and storage"*[33].

The Capacity Market Rules set out how participants can prequalify and take part in the auctions. The current Rules however are too prescriptive and a move to a more outcome-based approach would drive down costs to consumers, while increasing participation from DSR providers and other non-traditional participants.

Three examples of areas where the Government and Ofgem could reduce complexity in the Capacity Market Rules are set out below, with further details available in Annex 1:

- **Testing and Metering:** Reform the testing and metering provisions as currently they impose a high burden on businesses providing DSR without demonstrable benefit.
- **Asset reallocation:** Deliver on Ofgem's commitment to allow DSR participants to change and reallocate specific DSR assets following a Capacity Market auction.
- **Firm Frequency Response (FFR) participation:** Enable FFR providers to carry out the DSR test, allowing these assets to qualify for and participate in the Capacity Market.

Simplified, user-friendly Balancing Services

National Grid procures a suite of Balancing Services to provide support to ensure that the system remains stable at all times.

However, the current system is complex for energy users to navigate, creating obstacles to DSR participation, and does not always place equal value on the services DSR can provide.

As National Grid has a goal of 30% to 50% of balancing capability come from the demand side by 2020 (approx. 4.5 GW), there is a need to look at the array of services to ensure they are simple, user-focused, and designed to secure best value services, whether from generation, DSR, or storage. This review should also align with a growing role for distribution networks to become distribution system operators, allowing more decentralised solutions to come forward to balance electricity supply at a more local level.

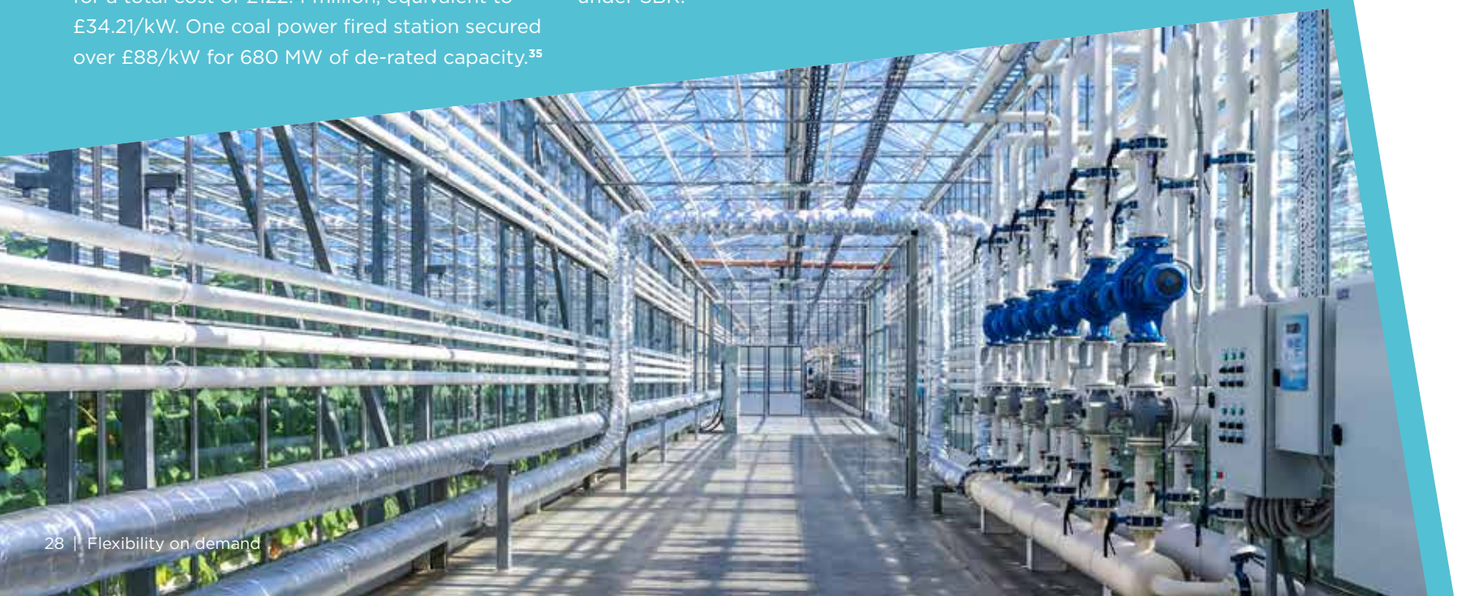
The launch of National Grid's Power Responsive in 2015 was a positive step in bringing attention to how the System Operator can facilitate a cost-effective DSR market through its Balancing Services. The long-term goal, as recognised by the National Infrastructure Commission, should be for *"a more strategic and transparent approach to the procurement of ancillary services and more cost reflective charging"* [34]

We would encourage National Grid and Ofgem to work closely together to see how we can review the services in the round to deliver a simplified, more user-friendly system. This is necessary to enable cost-effective DSR participation and reduce the cost of the electricity system to consumers.

A missed opportunity for DSR?

The Supplementary Balancing Reserve (SBR), a specific balancing service procured by National Grid, showcases some of the current challenges in ensuring fair treatment between supply and demand in Balancing Services. The SBR is only open to traditional generators that would otherwise be closed or mothballed, such as coal-fired power plants. In the most recent SBR tender round for delivery in winter 2016/17, 3.58 GW of capacity was bought by National Grid for a total cost of £122.4 million, equivalent to £34.21/kW. One coal power fired station secured over £88/kW for 680 MW of de-rated capacity.[35]

In contrast, National Grid's Demand-Side Balancing Reserve (DSBR) service, which is open to DSR providers, procured 177 MW of de-rated DSR capacity for winter 2015/16 at a total cost of £3.4 million; equivalent to £18.87/kW. DSBR is providing a similar service as SBR at less than half the cost and with lower emissions, and DSR providers indicate they have significant unused resources which could have displaced the high-cost coal power stations previously secured under SBR.



ANNEX:

Simplifying participation in the Capacity Market

Three examples of areas where the Government and Ofgem could reduce complexity in the Capacity Market Rules are set out below:

1. Simplifying participation in the Capacity Market

a. **Testing and Metering:** Reform the testing and metering provisions as currently they impose a high burden on businesses providing DSR, without demonstrable benefit.

   i. Many DSR participants are not energy market experts, and do not have the technical experience or resource to gather all the testing data that is required under the current Rules. As most metering is dealt with by licensed third parties, business energy users and small generator owners seldom have access to the documentation demanded.

   ii. Gathering this and other information in the time available can be extremely difficult as it may require site shutdowns; these are often very difficult to arrange at (for example) hospitals or datacentres.

   iii. Recent DECC and Ofgem reforms, such as risk-based testing in the Transitional Auction, are welcome but need to be extended and expanded across all Capacity Market auctions.

b. **Asset reallocation:** Ensure the Ofgem decision to accept a recent industry proposal to allow a form of DSR asset reallocation is delivered.

   i. In the Capacity Market, DSR participants will bid in a collection of different DSR assets. Sometimes a DSR asset, for example a refrigeration unit or motor, or an entire customer site, may cease to be able to respond due to an unforeseen breakdown or maintenance, or the site closing down. If the DSR provider is not allowed to manage its portfolio by adding a replacement asset, it must reduce the total amount of electricity provided.

   ii. Existing rules in some balancing services, such as Short Term Operating Reserve (STOR) and Frequency Control by Demand Management (FCDM), permit more flexible allocation and re-allocation and have proven to be highly effective in allowing aggregators to manage portfolios and maximise reliability.

c. **Firm Frequency Response (FFR) participation:** Enable FFR providers to carry out the DSR test, allowing these assets to qualify for and participate in the Capacity Market.

   i. Providers of dynamic FFR face further barriers to participation. Firm Frequency Response is a demand response service classified as a relevant Balancing Service eligible to participate in the Capacity Market.

   ii. However, a dynamic FFR provider cannot carry out the DSR test as it is currently stipulated in the rules and regulations and therefore cannot participate in prequalification for a capacity market auction. Ofgem has committed to examine this issue further, and continued progress is necessary.

Glossary

ADE ..... The Association for Decentralised Energy

CAPEX ..... Capital Expenditure

CHP ..... Combined heat and power

DECC ..... Department of Energy and Climate Change

DSBR ..... Demand Side Balancing Reserve

DSR ..... Demand-side response

ERCOT ..... Electric Reliability Council of Texas

FCDM ..... Frequency Control by Demand Management

FFR ..... Firm Frequency Response

GW ..... Gigawatt

HVAC ..... Heating, Ventilation and Air Conditioning

kW ..... Kilowatt

MW ..... Megawatt

MWh ..... Megawatt-hours

NISM ..... Notification of Inadequate Supply Margin

O&M ..... Operations and Maintenance

Ofgem ..... Office of Gas and Electricity Markets

OCGT ..... Open Cycle Gas Turbine

PJM ..... Pennsylvania, Jersey, Maryland Power Pool

SBR ..... Supplementary Balancing Reserve

STOR ..... Short Term Operating Reserve

TWh ..... Terawatt-hours

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23. DECC, Digest of UK Energy Statistics, Chapter 7 on CHP, 2015.
24. Fifty hours of DSR per year has been used as a key assumption in previous modelling work performed to provide insights into the challenges of managing system flexibility whilst decarbonising the electricity system, such as that by the Energy Research Partnership. This number of hours of response is readily provided by most demand-side resources, whereas building dedicated supply-side assets for such limited use is expensive.
25. Estimate based on the CAPEX and fixed O&M costs of small diesel engines. DSR costs are factored in the calculations, covering the costs associated with the site audit and metering incurred by DSR aggregators.
26. Estimate based on industry analysis derived from National Grid's "Future Requirements for Balancing Services".
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About the Association for Decentralised Energy

The Association for Decentralised Energy (ADE) is the UK's leading decentralised energy advocate, focused on creating a more cost effective, efficient and user-orientated energy system. The ADE has more than 100 members active across a range of technologies, and they include both the providers and the users of energy. Our members have particular expertise in combined heat and power, district heating networks and demand-side energy services, including demand-side response and storage.

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