eef The manufacturers' organisation

UPGRADING POWER: DELIVERING A FLEXIBLE ELECTRICITY SYSTEM

In partnership with:

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EXECUTIVE SUMMARY

A changing and challenging system

Security of energy supply is about ensuring consumers have access to an uninterrupted supply of energy at an affordable price. In the past this was largely a case of ensuring access to fossil fuels and the building of sufficient power stations; but the picture is growing increasingly complex. The need to decarbonise our electricity supply, coupled with the electrification of heating and transport, in order to meet our climate change targets, makes the challenge of achieving electricity security in particular more intricate, more difficult and more expensive.

Manufacturers' confidence in the Government's handle on security of supply is tepid at best with just one third agreeing with the statement that "the Government has a long-term strategy to ensure security of supply" and just 3.6% who felt energy infrastructure had improved in the last two years. The last 18 months have seen a high degree of uncertainty in the energy market as a result of numerous policy changes, the Brexit vote and the subsequent installation of a new administration. Decisions from the Government on Hinkley C and more recent announcements on Contracts for Difference auctions and a coal phase out consultation have started to steady the ship but more must be done to establish a clear and stable direction of travel for energy policy in the future.

Beyond these more traditional infrastructure concerns is a looming and more complex challenge. Because electricity cannot be stored, to any great degree, supply and demand must be matched on a second by second basis; the increasing penetration of intermittent renewables poses significant difficulties for achieving this balance. Backup is required for days when wind and solar farms are not producing power and greater flexibility is required to balance out increased uncertainty and variability in electricity supply. As major consumers of electricity the manufacturing sector has a pivotal role to play in helping deliver this increased flexibility, through demand side response (DSR) as well as and reducing overall demand for electricity, through greater energy efficiency. There are clear financial benefits available for businesses that do so, but it is evident reform is required from the Government if we are to realise this potential.

Energy Efficiency:

Continued improvements in energy efficiency help to deliver electricity security most obviously by reducing our overall annual consumption of electricity but also, importantly, by reducing demand at times of peak consumption thereby reducing our overall requirements for generation capacity. EEF conducted research, including analysis of audits carried out under the Energy Savings Opportunity Scheme (ESOS), to estimate the cost effective[1] electricity efficiency potential remaining with the UK manufacturing sector. We found that an estimated 14% in electricity efficiency is still remaining through cost-effective measures within the manufacturing sector. On average we found measures had a 20 month payback period and that a significant proportion required no-capital investment at all.

If this potential was realised it could lead to a 12 TWh reduction in annual electricity consumption, equivalent to 4% of the UK's current annual total. However, a survey of our members showed that under the current policy framework much of this potential will remain untapped. Just 34% of manufacturers felt that ESOS energy audits had provided them with new information, indicating that most companies are already well aware of many energy saving opportunities but for a number of reasons they were not taking them. Tellingly, just 13% felt ESOS had helped develop the business case for energy efficiency investment. Moreover, only 22% felt the introduction of a new energy efficiency reporting scheme, along the lines proposed by the Government earlier this

[1]Cost-effective here is defined as measures with a pay-back period of four years or less.

year, would help increase the importance of energy efficiency within their organisations, suggesting greater thought needs to be given before the introduction of any new regulation.

Accessing these potential efficiencies in the short term is entirely possible but reform is necessary to deliver on it.

Demand Side Response:

Demand side response (DSR) is the general heading given to a series of changes to consumption patterns that energy consumers may engage in to help balance the electricity system. As the levels of wind and solar in our power system increase so too does the difficulty of ensuring that electricity supply and demand are always balanced. Historically, the balancing of the system was carried out by thermal power plants but in the future relying exclusively on gas plants to make up for shortfalls in renewable generation and balancing out the fluctuations in supply and demand is unnecessarily expensive and carbon intensive.

Using a wider range of tools available to us, such as electricity storage, interconnectors and, vitally, DSR, will enable us to deliver electricity security in a cheaper, cleaner and more efficient manner. Indeed, the National Infrastructure Commission recently estimated that the benefits of a more flexible system could be as much as £8 billion a year by 2030.[2]

Manufacturers can play a significant role in this through taking part in DSR activities, reducing their electricity bills and earning additional revenue at the same time. However, DSR activity amongst manufacturers remains fairly limited. Our survey revealed that just 9% of respondents took part in some form of DSR activity with the most cited reason for this low level of engagement being the complexity of the system and a lack of understanding within companies. There are also a number of regulatory barriers which urgently need addressing in order to deliver the full potential of DSR right across our economy.

[2]Ibid

Recommendations:

Recommendation 1: The Government should establish an annual Energy Statement to provide greater certainty on future energy policy for investors.

Recommendation 2: The Government should introduce a new energy efficiency investment discount on the Climate Change Levy (CCL).

Recommendation 3: Government should undertake a comprehensive assessment of the ESOS scheme and its effectiveness ahead of the 2019 compliance deadline, and implement reforms to ensure it adds value to all participants on a long-term basis.

Recommendation 4: The Government should re-evaluate the validity of the proposed introduction of a new energy reporting scheme in 2019.

Recommendation 5: The Government should develop a fully-fledged electricity demand response (EDR) scheme, building on the lessons learnt from the two pilot schemes and, in particular, the US experience.

Recommendation 6: The Government should investigate how to maximise the DSR benefits for manufacturers of smart meters, half-hourly settlement and time-of-use tariffs.

Recommendation 7: National Grid, as part of its charging review and in consultation with industrial energy consumers, should seek to reform the Triad charging system to deliver greater predictability for industrial energy consumers.

Recommendation 8: The Government should explore the incorporation of DSR aims and related electricity cost reduction strategies into energy efficiency schemes such as ESOS.

Recommendation 9: National Grid, in collaboration with energy consumers and the Government, should seek to reform the ancillary market to reduce complexity and create greater transparency.

Recommendation 10: Ofgem should amend the Balancing Settlement Code rules to allow participation of DSR in the balancing market.

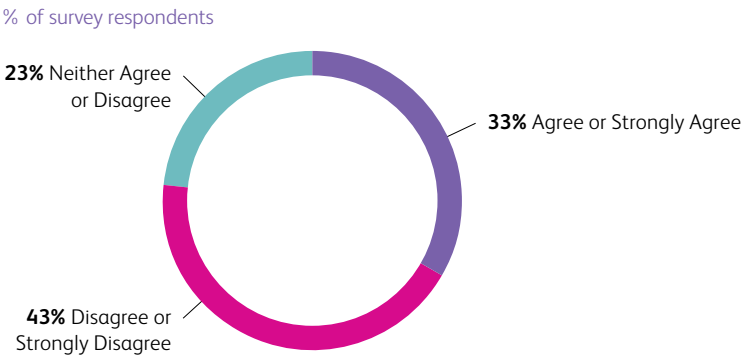
Recommendation 11: The Government should reform the Capacity Market to allow easier access for DSR assets in future auctions.

A CHANGING AND CHALLENGING SYSTEM

Introduction:
The International Energy Agency defines energy security as "the uninterrupted availability of energy sources at an affordable price".[3] By extension this definition necessitates that energy must be available to meet consumers' requirements at all times that they require it. In the past, this was a comparatively straightforward task contingent largely on secure access to fossil fuels and the building of sufficient power stations, however this picture is rapidly changing. Access to fossil fuels will continue to be central to our energy requirements for many years to come[4], but it is the changing nature of our electricity market that presents us with our greatest future challenge. The need to decarbonise our electricity system, our heating supply and our transportation will profoundly alter how we produce and use electricity in the future. This will make the challenge of achieving electricity security in particular more complex, more difficult and more expensive.

Whether the UK Government has a firm handle on long term energy security is subject to some debate. The Government, as recently as 2014, claimed that the UK was the fourth most energy secure country in the world.[5] The World Energy Council (WEC) 2016 "Trilemma Index" recently gave the UK a top AAA scoring and placed it 11th in the world.[6] Conversely, the same WEC report placed the UK on its "watch list" citing growing security of supply concerns emanating from the mismatch between the decline in conventional generation capacity and the slower increase in renewables. Echoing this, the Institute of Mechanical Engineers highlighted a potential 55% electricity supply gap by 2025 due to the closure of ageing stock and the difficulties of replacing it over such short timescales.[7]

Chart 1: To what extent do you agree or disagree with the view that the Government has a long-term strategy to ensure security of supply?



Source: EEF (October 2016) Climate, Energy and Environment Survey

Assessments of business confidence in the UK's energy security, whilst also providing a somewhat mixed picture, do not indicate a resounding vote of confidence in the Government's strategy. An October 2016 survey of EEF members showed that just 33% felt the UK had a long-term strategy to ensure energy security compared to 43% who did not.[8] This mirrored another 2016 EEF survey which showed just 3.6% of

[3]International Energy Agency energy security definition: http://www.iea.org/topics/energysecurity/subtopics/whatisenergysecurity/
[4]DECC (2016) *Updated energy and emissions projections: 2015*. The reference scenario estimates that 69% of our energy requirements will still be met by fossil fuels in 2030
[5]https://www.gov.uk/government/speeches/uk-energy-security-active-government-smart-intervention
[6]The World Energy Council (2016) *Trilemma Index* ranks countries on their ability to provide sustainable energy through three dimensions: energy security, energy equity (accessibility and affordability) and environmental sustainability. https://trilemma.worldenergy.org/
[7]Institute of Mechanical Engineers (2016) *Engineering the UK Electricity Supply Gap*
[8]EEF Climate, Energy and Environment Survey conducted in October 2016. Responses to the question *"To what extent does your company agree with the view that the Government has a long-term strategy to ensure security of energy supply?"*

manufacturers thought the UK's energy infrastructure had improved over the last two years compared to 25% who felt it had worsened.[9]

The debate around security of electricity supply specifically has historically tended to focus almost exclusively on the supply side. This is hardly surprising given how electricity supply and demand has been managed historically, and it will continue to be the number one consideration in the future. With two-thirds of our current generation capacity set to close by 2030, and severe constraints set by our climate change targets on what can replace it, the Government's top energy priority over this parliament must be to establish some much-needed stability and a clear sense of direction for the future of energy infrastructure provision in the UK.

A clear direction of travel:
The last 18 months have seen the installation of two new governments with two attendant sets of ministers, a seismic referendum result to withdraw the UK from the EU, the amalgamation of the business and energy departments, and several unexpected energy policy changes. This has created significant uncertainty within the energy sector[10] which delays decisions, endangers our energy security, and increases capital costs, which must ultimately be borne by the energy consumer. Amidst the continued political uncertainty the Government must do all it can to reassure the sector and provide a clear sense of direction.

The Government's decision to combine the business and energy departments and the prioritisation of an enhanced industrial strategy should provide the foundations for a far more coherent and long-term energy policy in the UK. Business recognises the need for policy changes and amendments as and when required but this must be done in line with an overarching strategy and a clear direction of travel. This is vital for future investment in infrastructure as well as the manufacturing supply chains that rely on them.

Recommendation 1:
The Government should establish an annual Energy Statement to provide greater certainty on future energy policy.

The Government should introduce an annual Energy Statement in the mould of the 'energy reset' speech provided by Amber Rudd in 2015; clear and concise and confirming the Government's commitment to key policy mechanisms, funding choices and, where possible, any major policy decisions for the year ahead. Above all it should provide us with an unequivocal understanding of the Government's vision for energy and decarbonisation policy and how its decisions fit into this. Whilst annual Energy Statements were provided under the Coalition Government, these were largely self-congratulatory statements of success concerning existing policies and provided little in the sense of future direction or certainty. A 2017 Energy Statement should look to provide details on the following:

A full coal phase-out strategy early in 2017: The Government finally published its long-awaited consultation on the practicalities of delivering the phase out of coal power by 2025 on 9th November, a year after first announcing the phase out. It is imperative that it follows this up swiftly, delineating a clear strategy by the middle of next year. This must include contingency plans, including the ability to suspend coal curtailment arrangements, in the event that the Capacity Market[11] is unable to deliver sufficient replacement capacity. Ultimately industry needs to know the Government has a plan

> "We know all governments will intervene in the market, energy is too important for them not to, but investors in long term energy projects need a clear sense of direction from government that's evidence based and rational. Having a well developed and communicated energy strategy actually reduces the need for intervention and makes it more predictable."
>
> Matthew Knight - Director of Energy Strategy and Government Affairs - Siemens

[9]EEF Business Environment Survey conducted in September 2016. Responses to the question: *"How would your company rate the change in quality of the following infrastructure areas in the UK over the last 2 years?"*
[10]House of Commons Energy and Climate Change Committee (2016) *Investor Confidence in the Energy Sector*
[11]The Capacity Market is the Government's central policy for providing secure electricity supplies in the years ahead. Each year capacity providers (electricity generators and consumers agreeing to reduce demand) enter into auctions for a contract to deliver an agreed upon amount of capacity in certain years.

for the provision of reliable and cost effective base-load power to replace the coal and nuclear that will be coming off the system. This is not something it has confidence of at present.

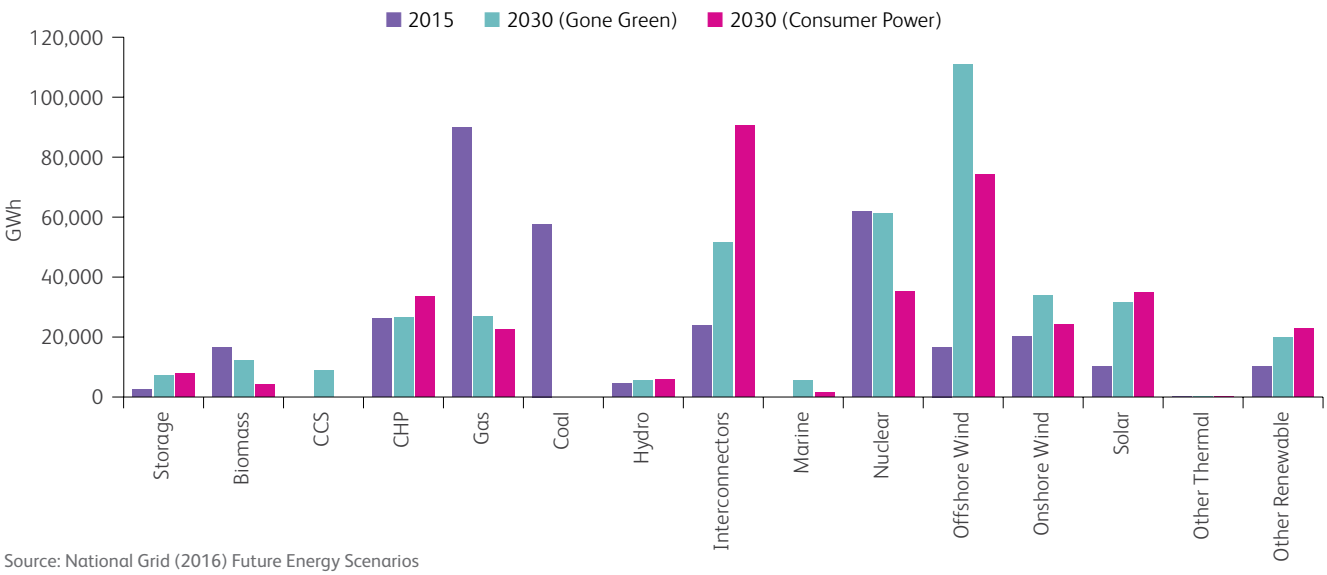
Carbon Capture and Storage Strategy: Following the cancellation of the Carbon Capture and Storage (CCS) competition last year, the Government has been silent on its future plans for this technology. A Government-commissioned report[12] from the Parliamentary Advisory Group on Carbon Capture and Storage, published in autumn 2016, again spelt out the financial benefits of utilising the technology and reiterated the costs of delaying action further. EEF has also recommended the National Infrastructure Commission undertake an investigation into the infrastructure requirements and costs of CCS deployment and alternative scenarios in which CCS is never deployed.

Future plans for support for low carbon generation: The Government should provide details about future support for new low-carbon generation. This of course does not mean providing a blank cheque to new generation projects, the Government must be transparent about how any future Levy Control Framework budget is arrived at, what precisely it is aiming to achieve, and what measures are in place to increase competition for contracts and continue to deliver cost reductions. Importantly, the Government must set out a target date for the introduction of technology neutral auctions and plans, previously expressed, to expose all forms of generation to the full costs they place on the electricity system.[13]

Matching supply and demand: Beyond these more traditional electricity supply concerns is a more difficult challenge. Electricity differs from other sources of energy in that its supply and demand must be balanced on a second-by-second basis because, at present, we cannot store it very effectively. Too little or too much supply in relation to demand results in imbalances and instability in the system, and can ultimately lead to power shortages and blackouts. This has always been the case but, as our electricity system changes, the task of achieving this becomes increasingly complex.

How we produce and use electricity will be radically different in the years ahead. Although evolving rapidly, our electricity generation today is still dominated by large industrial power stations; predominately coal, gas and nuclear.

Chart 2: Breakdown of UK annual generation by technology in 2015 (actual) and 2030 (projected – two scenarios)



Source: National Grid (2016) Future Energy Scenarios

[12]Parliamentary Advisory Group on Carbon Capture and Storage (2016) *Lowest Cost Decarbonisation for the UK: The Critical Role of CCS*
[13]Amber Rudd (2015) Speech on a New Direction for UK Energy Policy: *"In the same way generators should pay the cost of pollution, we also want intermittent generators to be responsible for the pressures they add to the system when the wind does not blow or the sun does not shine."*

In 2015, these 'traditional' power stations continued to represent 75% of our electricity production.[14] Whilst it is impossible to know exactly what mix of technologies will produce our electricity in the future, we are able to identify a number of probable trends. By 2030, it is highly unlikely we will have any unabated coal on the system at all, gas plants will be generating significantly less than they are now, and output from wind and solar will have expanded hugely.

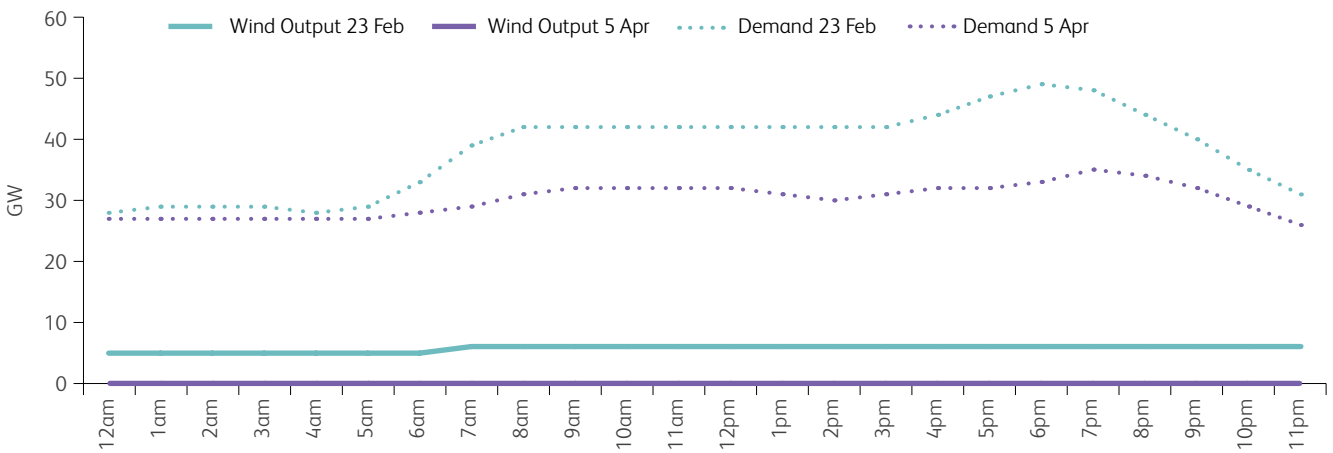
This shift from a system dominated by dispatchable conventional generation to one in which weather-dependent renewables play an increasingly important role will fundamentally alter the way we balance the system. Whilst these technologies can be relied upon to produce a certain amount of electricity across a year, they do not produce electricity continuously. On average across the year, wind farms produce about 30% of their maximum potential.[15] At times they will be producing at close to 100% of their potential, at others close to zero.

Even in the blustery UK there are periods where wind levels drop off nationally. The chart below demonstrates this with data from the highest and lowest days of output from UK windfarms in 2015. On their day of highest output, 23rd February, wind farms met on average 16% of UK demand. On their day of lowest output, 5th April, they were only meeting 0.6% of demand.

Our inability to control output from weather-dependent renewables necessitates these forms of generation are backed up with a range of technologies and approaches. For the time being at least, wind and solar should be thought of more as a means of saving fossil fuel and reducing emissions; they can displace the electricity produced by traditional power plants but they cannot replace the power plants gigawatt for gigawatt. At the same time as facing this intermittency challenge, decarbonisation of our heat supply and transport could place new pressures on our grid, particularly at peak times. Whilst our overall consumption of electricity is not projected to increase significantly in the years ahead, we could see peak demand double if we do not radically alter how we manage our electricity system.[17]

A scenario in which we simply back up all wind and solar with gas plants and have enough "peaking plant"

Chart 3: 2015 Maximum and minimum daily wind output (GW)

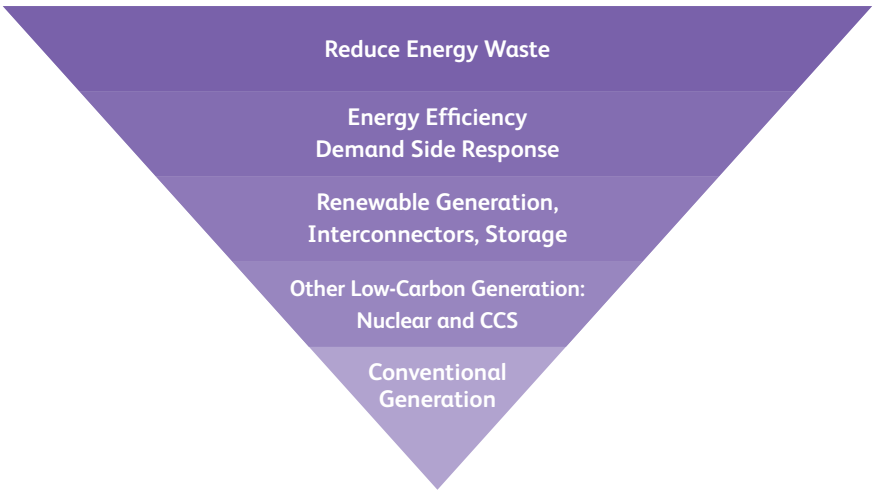


Source: Gridwatch data and EEF analysis[16]

[14]DECC (2016) *UK Energy Statistics, 2015 & Q4 2015*
[15]BEIS (2016) *Digest of United Kingdom Energy Statistics: Chapter 6 Renewable Sources of Energy*. Load factor for wind in 2015 was 33.7% up from 30.1% in 2014
[16]Note that this data only displays output from transmission-connected wind farms. Distributed generation from windfarms accounts for roughly an additional 30% of this
[17]National Infrastructure Commission (2016) *Smart Power*

to meet peak demand levels of over 100 GW would be hugely expensive and inefficient. Instead we must move towards a more flexible way of working. Yes, gas back-up and peaking plant will be crucial, but they must be supplemented with interconnectors, storage, increased energy efficiency and a greater use of demand side response (DSR), whereby energy consumers become more active participants in helping to balance the system by changing their consumption patterns where economical beneficial to do so. The National Infrastructure Commission recently estimated that the benefits of a more flexible system could be as much as £8 billion a year by 2030,[18] we simply cannot afford not to change how we operate.

Figure 1: 'Electricity Security Hierarchy'



Source: Adapted from Energy Hierarchy

A hierarchical approach

It makes sense to think about the options available to us to achieve electricity security as a hierarchy, using an adaptation of the established energy hierarchy. We start with reducing energy waste, before moving on to energy efficiency measures and demand-side response and, only then, to the various supply side options be they generation, interconnection or storage. This hierarchy provides us with a basic order of preference that policy makers and system operators should be aiming towards to achieve a balance of cost effectiveness and sustainability.

It is telling then that far more attention and money is directed towards the generation rather than the energy efficiency end of the spectrum.

In 2020, £13 billion[19] of energy consumer money will be spent on low-carbon generation support and capacity market contracts alone. At present, there is no Government funding proposed for energy efficiency, business or domestic, and DSR only makes up a fraction of the capacity market. This needs to change if we are to have any hope of realising the full benefits of a smarter, more efficient electricity system.

As consumers of around one third of UK electricity[20], manufacturers have a key role to play in helping to create this more flexible and efficient grid; reducing the amount of electricity they consume, through continued improvements in energy efficiency, and playing a greater role in DSR activities.

[18]Ibid
[19]The Government estimates that Levy Control Framework spending will be £11.4bn by 2020. Capacity Market costs are likely to add a further £1-2 billion to this figure.
[20]DECC (2016) *UK Energy Statistics, 2015 & Q4 2015*. Industry consumed 92 TWh out of a total of 304 in 2015

ELECTRICITY EFFICIENCY

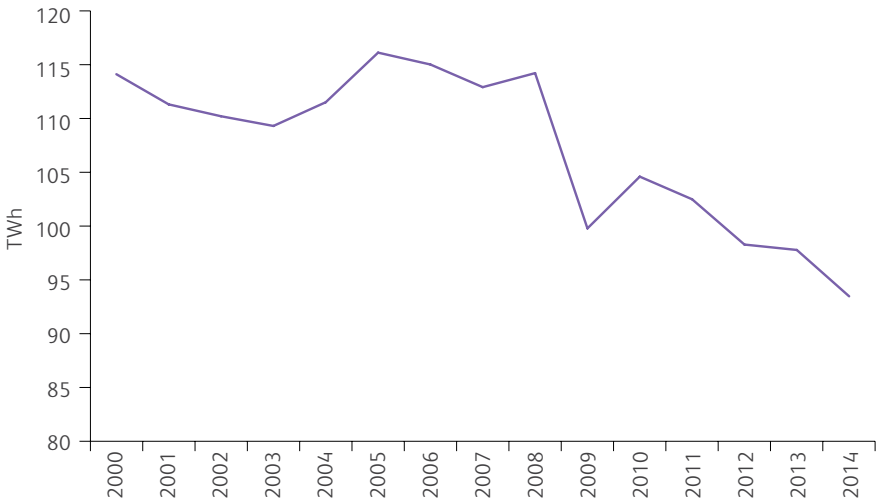
The role of electricity efficiency

As discussed above, reducing energy waste and investing in energy efficiency technologies must be our first port of call in ensuring stable and secure supplies of electricity. In nearly all cases these will be the lowest cost options.

Energy efficiency evidently reduces our overall annual demand for electricity, if this is coupled with gradual changes in consumption patterns (i.e. altering when electricity is consumed to reduce and smooth out demand peaks) it can play a vital role in reducing the overall level of generation capacity we require. More specifically, and with more immediate impact, if we can permanently reduce the consumption of electricity at peak times (typically 4-8pm, November to February) through investments in energy efficiency we can again reduce our overall need for generation and related infrastructure in advance of more long term alterations in consumption patterns.

As a major consumer of electricity, the manufacturing sector plays, and must continue to play, a leading role in reducing consumption. Industrial electricity consumption has fallen by 18% since 2000, an average of 1.3% a year.[21] There is a host of reasons for this fall, including the make-up of the manufacturing sector and reduced output following the global financial crash. However, a significant proportion of the reduction has come through improvements to energy efficiency on sites, driven by cost cutting, regulation, and energy efficiency schemes/taxes. But we know significant potential remains.

Chart 4: UK Industrial Electricity Consumption 2000 to 2014 (TWh)



Source: DECC (2016) Updated energy and emissions projections and EEF analysis

The electricity efficiency potential in manufacturing

To obtain an up-to-date idea of the electricity efficiency potential in the manufacturing sector, EEF analysed the conclusions of energy efficiency audit reports from manufacturing sites conducted under the mandatory Energy Savings Opportunity Scheme (ESOS) in 2015. These reports show what 'cost-effective' energy efficiency potential remained at 70 manufacturing sites in a wide range of sectors including food and drink, electrical equipment, paper, automotive and aerospace, and considered almost 450 different energy efficiency measures and investments.

Our headline result was an estimated 18% potential reduction in annual electricity consumption across the sites audited. Four per cent of this could be achieved by low/no cost measures such as better energy management plans, improved monitoring and targeting, and behaviour change. The other 14% would require investment in a range of technologies applicable to any manufacturing operation such as LED lighting, variable speed drives and high

[21] DECC (2016) *Updated energy and emissions projections* and EEF analysis.

efficiency motors. This aligns closely with other recent estimates of the level of electricity efficiency remaining in UK manufacturing.[22]

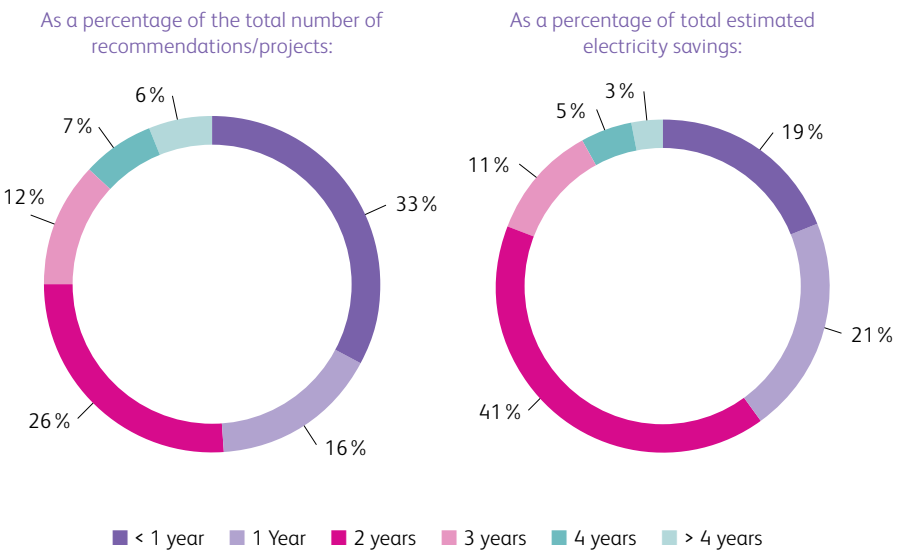
We supplemented our ESOS analysis with sub-sector specific information from the Climate Change Agreements (CCA) scheme, including progress made against targets, and existing literature on the subject. Whilst the 18% estimated efficiency correlated closely with other efficiency estimates for manufacturing in general, we know there is significant variations in the potential remaining in different sectors.

With this sub-sectoral variation accounted for, we estimate that a 14% reduction in electricity consumption could be made across the manufacturing sector.[23] This is equal to some 12 TWh a year, 4% of the UK's entire electricity consumption and over £1 billion a year in savings.[24] It is important to note that this estimate does not represent the total potential available in the manufacturing sector but instead the potential remaining from cost-effective solutions widely applicable to all manufacturing sites.[25] Further potential is available from sector-specific technologies and innovations and measures requiring longer payback periods than is typically acceptable in manufacturing businesses.

ESOS audit findings in more detail

Our analysis of the ESOS reports showed that, despite good progress on energy efficiency to date, there still remains a significant amount of low/no cost measures. Furthermore, the vast majority of energy savings identified by the audits had payback periods of two years or less, well within the two-to-four year average payback period required by most manufacturers.[26]

Chart 5&6: Payback period of electricity efficiency measures



Source: EEF analysis of ESOS reports

Low and No Cost Options (4% electricity savings possible across all the sites examined)

- **Energy Management Policy:** Two-thirds of the sites audited could still save energy from implementing an energy management policy, or improving an existing one. In the context of these audits, an energy management policy referred to energy efficiency targets, a senior management commitment to achieving them, a set of steps for doing so, and communication of this to staff members. A well designed energy management policy is absolutely vital when it comes to decisions on equipment replacement, repairs and procurement. Amongst the sites for which this measure was recommended, it was estimated that an average of 1% in electricity savings could be achieved.
- **Metering, Monitoring & Targeting:** Eighty percent of all sites were recommended a measure in relation to metering, monitoring and targeting. This ranged from simple improvements to current regimes through to the installation of sub-metering and implementation of automated monitoring and

[22]Siemens Financial Services (2015) *More From Less*, estimated a potential 14.1% reduction in electricity consumption from manufacturers using available technologies and Siemens (2011) *Energy Saving Solutions* estimated a median efficiency potential of 15-20%
[23]14% estimated electricity efficiency potential refers to central scenario with a 25% confidence level
[24]£1 billion of estimated savings based on an average industrial electricity price of £95/MWh
[25]This estimate fit broadly with other recent studies. Next Manufacturing Revolution (2013) *Non-Labour Resource Productivity and its Potential for UK Manufacturing* summarised recently published estimates of total energy efficiency potential in manufacturing which ranged between 15 and 24%.
[26]The Manufacturer (2014) *Annual Manufacturing Report*

targeting systems. Effective metering and monitoring is one of the most important elements of an energy management programme and can typically pay back within one to three months. Across the sites examined, it was estimated that an average of 2% in electricity savings could be achieved through measures in this category.

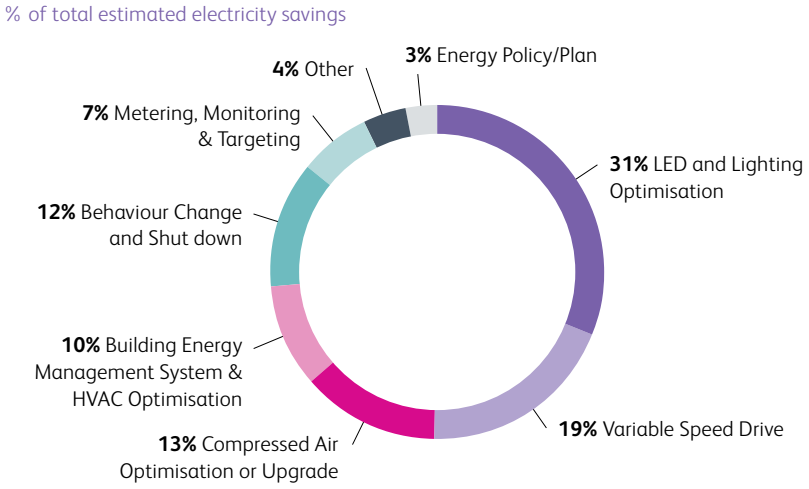
– **Behaviour Change & Shut-down Procedures:** Seventy eight percent of the audited sites were advised to implement energy awareness programmes for staff and/or structured shut-down procedures for unused equipment, potentially cutting their electricity bills by an average of 3%. Some 60% of the sites audited did not have shut-down procedures leading to high levels of wastage during non-manufacturing periods.

Capital Projects (14% savings possible across all audited sites)

– **Lighting:** Lighting upgrades or controls were recommended at 90% of sites audited and would be expected to cut electricity consumption by an average of 7%. Lighting consumes a significant proportion of electricity even within the manufacturing sector. The possible savings are also considerable, with LEDs using up to 80% less electricity than traditional lamps and 40% savings possible through lighting controls.[27]
– **Variable Speed Drives (VSD) and High-Efficiency Motors:** Motors are a major energy consumer; it is estimated that they account for some 65% of industrial electricity consumption.[28] The electricity consumed by motors can be reduced significantly by replacement of motors with more efficient ones and by improving the speed control of the motors through the installation of VSDs. A conservative 5% electricity saving was estimated to be possible across the sites concerned, but this does not represent the full potential of VSD and motor efficiency. Many motor and VSD projects have longer payback periods than is considered cost-effective and will also require more in-depth audits to properly identify all opportunities.
– **Compressed Air Optimisation and Upgrades:** Improvements and upgrades to compressed air systems were recommended at 73% of the sites audited. As little as 10% of the electricity supplied to compressed air systems is used for the intended purpose and so minimising waste where possible is crucial.[29] Savings of over 4% in total site electricity consumption were found on average from compressed air-related measures, with an average payback period of 1.4 years.
– **Building Energy Management Systems (BEMS) and Heating, Ventilation and Air Conditioning (HVAC) Improvements:** Eighty five percent of sites audited could have benefited from a range of measures related to heating, air conditioning and ventilation systems. Predominately this referred to the installation an automated BEMS and reviews of heating and cooling controls, but there were also recommendations for optimisation of space heating, installation of door controls and upgrade of burners. Estimated electricity savings of 2% were achievable, with average payback periods of a little over two years.

Across the 70 audited sites, a total of £7.1 million pounds of investment was

Chart 7: Breakdown of energy efficiency measures identified



Source: EEF analysis of ESOS reports

[27]Siemens (2011) *Top ten energy saving options*
[28]ABB (2013) http://www.abb-conversations.com/2013/05/motors-and-drives-for-efficient-control/
[29]Carbon Trust (2012) *Compressed Air Guide*

identified, resulting in potential annual savings of £4.2 million providing an average payback across all the projects identified of just 20 months.[30]

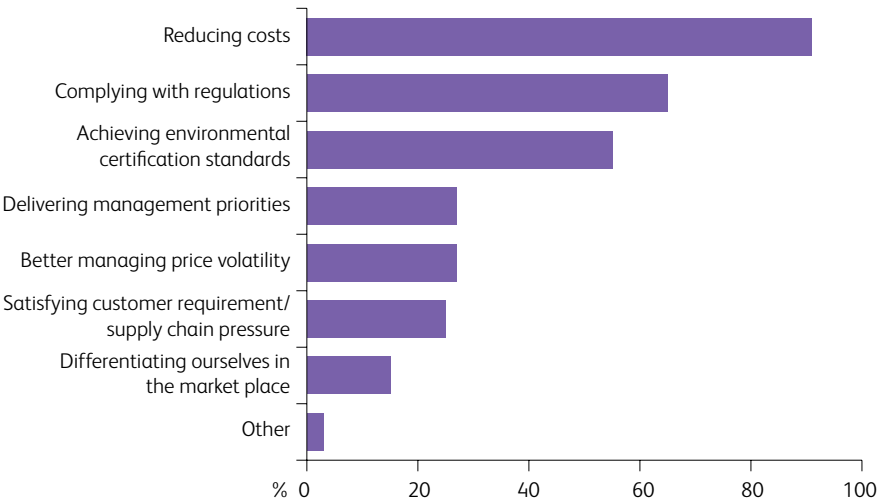
How can we maximise on this potential?

When manufacturers were asked what the key drivers are for energy efficiency, cost reduction, regulatory compliance and environment standards topped the list. Conversely, even though energy is now discussed at board level in the vast majority of manufacturing companies[31], just 27% of respondents indicated that management priorities are driving energy efficiency. Moreover, only 31% of our survey respondents indicated that energy efficiency is given high priority at board level within their companies. We know from discussions with manufacturers and the vast range of literature on the subject that the most energy efficient companies have achieved this through board level buy-in and senior management commitment. Policymakers, trade associations and energy professionals will need to think more creatively about how they can increase the levels of interest and commitment from decision makers and senior executives.

Recommendation 2:
The Government should introduce a new energy efficiency investment discount on the Climate Change Levy (CCL)

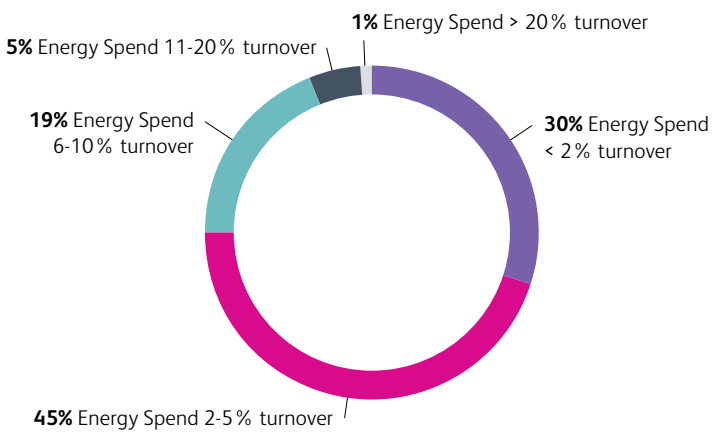
This idea was explored in detail in EEF's 2015 report "The Low Carbon Economy: Moving from Stick to Carrot"[32]. Such a tax discount would work along similar lines to that available under the CCA scheme, but rather then energy efficiency targets, would instead require participants to invest a sum equivalent to the tax discount on energy efficiency measures. Cost saving remains the biggest driver for energy

Chart 8: Key drivers of energy efficiency improvements in manufacturing companies



Source: EEF Energy, Climate and Environment Survey October 2016

Chart 9: Energy spend as proportion of turnover



Source: EEF Energy, Climate and Environment Survey October 2016

[30]These totals include spend and savings for all measures not just electricity related ones
[31]Siemens (2014) *The Future of Energy: The UK Manufacturing Opportunity* indicated that energy issues are now discussed at board level in 89% of manufacturing companies.
[32]EEF (2015) *The Low Carbon Economy: Moving From Stick to Carrot*

efficiency investment, but even this can sometimes be ignored if energy costs represent a relatively small amount of production costs or turnover.

As our research suggests, energy prices as a whole are already sufficient to make a wide range of energy efficiency measures cost effective in the strictest sense. But in low-energy intensity companies, the price signal may require a 'boost' to engage decision makers and get capital allocated more readily. The provision of a new tax discount would essentially create a ring-fenced budget for energy efficiency within organisations and make investment decisions more of a 'no-brainer'. Companies are faced with a simple decision: pay the full tax or retain some of it to invest in their own facilities.

Using the published 2019/20 CCL rates, we calculated that an 80% exemption would free up £1.8 million annually for energy efficiency investments amongst the ESOS participants we examined. This would have provided sufficient capital to pay for all the energy efficiency measures identified by ESOS within four years, stimulating investment far more effectively than simply using the CCL as a straight forward price signal.

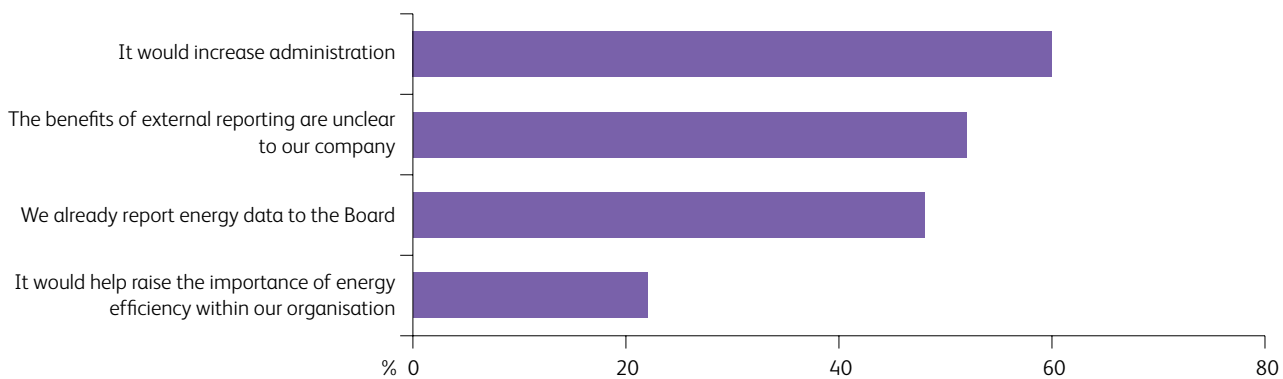
Recommendation 3:
The Government should undertake a comprehensive assessment of the ESOS scheme and its effectiveness ahead of the 2019 compliance deadline, and implement reforms to ensure it adds value to all participants on a long-term basis.

We asked for manufacturers' views on the ESOS scheme nine months on from the December 2015 compliance date. The first thing to note is that 60% of manufacturers do not take part in the scheme due to not meeting the company size thresholds. If Government wants to capture the full energy efficiency potential in the sector, it will need to consider measures that can help SMEs. The tax break explored above could be a useful starting point if open to all sizes of company.

The second finding was that, of those that did participate, some 58% felt the scheme was just a repetition of what had already been carried out compared to just over a third of respondents who felt it had provided new information. Given the relatively basic level of audit ESOS requires, it is highly likely that those organisations that gained most from the scheme were those that have engaged least with energy efficiency to date. When companies come to repeat the exercise in 2019, it is likely that the numbers finding it genuinely informative will have diminished.

Furthermore, just 13% of respondents said ESOS had helped develop the business case for energy efficiency investment. So even if the scheme is providing valuable information to some companies, that doesn't necessarily appear to be translating into positive investment decisions. Again, the introduction of a more effective tax discount could help boost the potential of ESOS to drive investment. It is of course too soon to draw any final conclusions on the scheme, but at

Chart 10: Manufacturers' views on the introduction of a new energy reporting scheme along the lines informally proposed by the Government



Source: EEF Energy, Climate and Environment Survey October 2016

this stage it appears that it may have limited long-term potential to drive investment without some reform.

Recommendation 4:
The Government should re-evaluate the validity of the proposed introduction of a new energy reporting scheme.

Earlier this year, the Government announced the scrapping of the CRC Energy Efficiency Scheme and its intention to launch a consultation on the design of a new energy efficiency reporting scheme. This consultation is still to be published but the initial thinking was that the scheme would be applied to current ESOS participants and would require companies to record and report energy use internally to boards and, possibly, externally to the Environment Agency. It was also mooted that energy data would be published publically.

EEF asked manufacturers' opinions on the introduction of a scheme along these lines. Only 22% thought that such a scheme would raise the importance of energy efficiency within their organisation and only 26% felt better designed energy reporting schemes in general would increase their company's investment in energy efficiency.[33]

The Government needs to seriously consider what benefit the introduction of a new reporting scheme would bring to the policy landscape. A more regimented and coordinated reporting regime could be of benefit to companies but it must be closely aligned with, and build on, what is already in place if it is to have real value and not simply add to the pile of regulation manufacturers must already deal with.

Recommendation 5:
The Government should develop a fully-fledged electricity demand response (EDR) scheme, building on the lessons learnt from the two pilot schemes and, in particular, the US experience.

To date, the Government has run two EDR pilot schemes looking at the potential of a concept known as electricity demand reduction. The basic principle is a good one, paying energy consumers to free up capacity through efficiency measures. It provides companies with funding to invest in energy efficiency, reduces participants' energy bills and cuts the overall cost of providing capacity. It is a 'win, win, win' if it can be made to work effectively and has been shown to elsewhere. Notably, in the New England Capacity Market auction, held in the US in 2014, EDR measures provided 4%, or 1,961 MW, of capacity.[34]

The two UK pilot auctions in 2014 and 2015 produced clearing prices of £229/kW and £203/kW. This is significantly higher than the £18/kW a year delivered in last year's Capacity Market auction but this comparison does not reflect the fact that energy efficiency projects are receiving a one-off payment for measures that will continue to deliver capacity for many years whilst Capacity Market contracts continue to pay for the same capacity year after year. So, for example, an LED lighting project that may deliver demand reduction for 10 years is actually providing capacity at more like £20/kW/year which, as Capacity Market prices increase to deliver new gas plant in the years ahead, will start to look extremely competitive.

However, there are a number of adjustments and considerations that the Government will need to make if EDR is to deliver its transition into an enduring scheme. Most obviously, the pilots proved the scheme to still be too complex to attract significant interest and most of the money available was not taken up. Morevoer, given the complexity of taking part in the main Capacity Market, which remains a barrier to much DSR activity, it is likely any EDR scheme will need to remain a separate entity.

Secondly, excluding projects from any Climate Change Agreement participants to avoid any double incentives ruled out most of the manufacturing industry and therefore limited the scheme's potential. The US experience has shown that the vast majority of EDR bids have been made by energy suppliers or by state quangos with a responsibility for achieving savings. In short, most EDR bids come from those with a legal responsibility for delivering efficiency measures and who are already provided with significant funds for doing so. If EDR is to take off in the UK, the Government may need to accept some overlap with other incentives.

[33]EEF (2016) Climate, Energy and Environment Survey
[34]Enerknol (2014) New England's Eighth Forward Capacity Market Design Concerns.

DEMAND SIDE RESPONSE

What is Demand Side Response?
Demand side response (DSR) is the general heading given to a series of changes to consumption patterns that energy consumers may engage in to help balance the electricity system. Perhaps most commonly, this is thought of in terms of reducing demand from the grid at peak times during the winter. Media portrayals of this form of DSR often present it as a last resort or an emergency measure taken by governments, paying factories to stop production.[35] Whilst DSR can provide an emergency back-up function, this picture is largely misleading.

Returning to our electricity security hierarchy, DSR is far from a last resort and should increasingly be one of the first options we look to in achieving electricity security. Continuing to be over-reliant on supply side options and leaving DSR options untapped is rather like having the heating on at home, deciding it's too warm and then opening a window rather than turning the heating down. Both actions will achieve the intended outcome but the former wastes energy and money. DSR participation is a voluntary activity for manufacturers, helping balance the system to reduce their own, and everyone else's electricity costs.

DSR takes many different forms. What can be termed 'clean' DSR refers to making adjustments to power demand to match electricity supply; either by consuming less when supply is short or by consuming more when there is excess supply, for example on a unusually windy day. Alternatively, what we can term 'generation' DSR refers to energy consumers reducing the amount of electricity they take from the grid by using on-site generations such as CHP or back-up diesel generators. Whilst 'generation DSR' may not have the same environmental benefits as 'clean DSR' it is still able to reduce the costs of balancing the system.

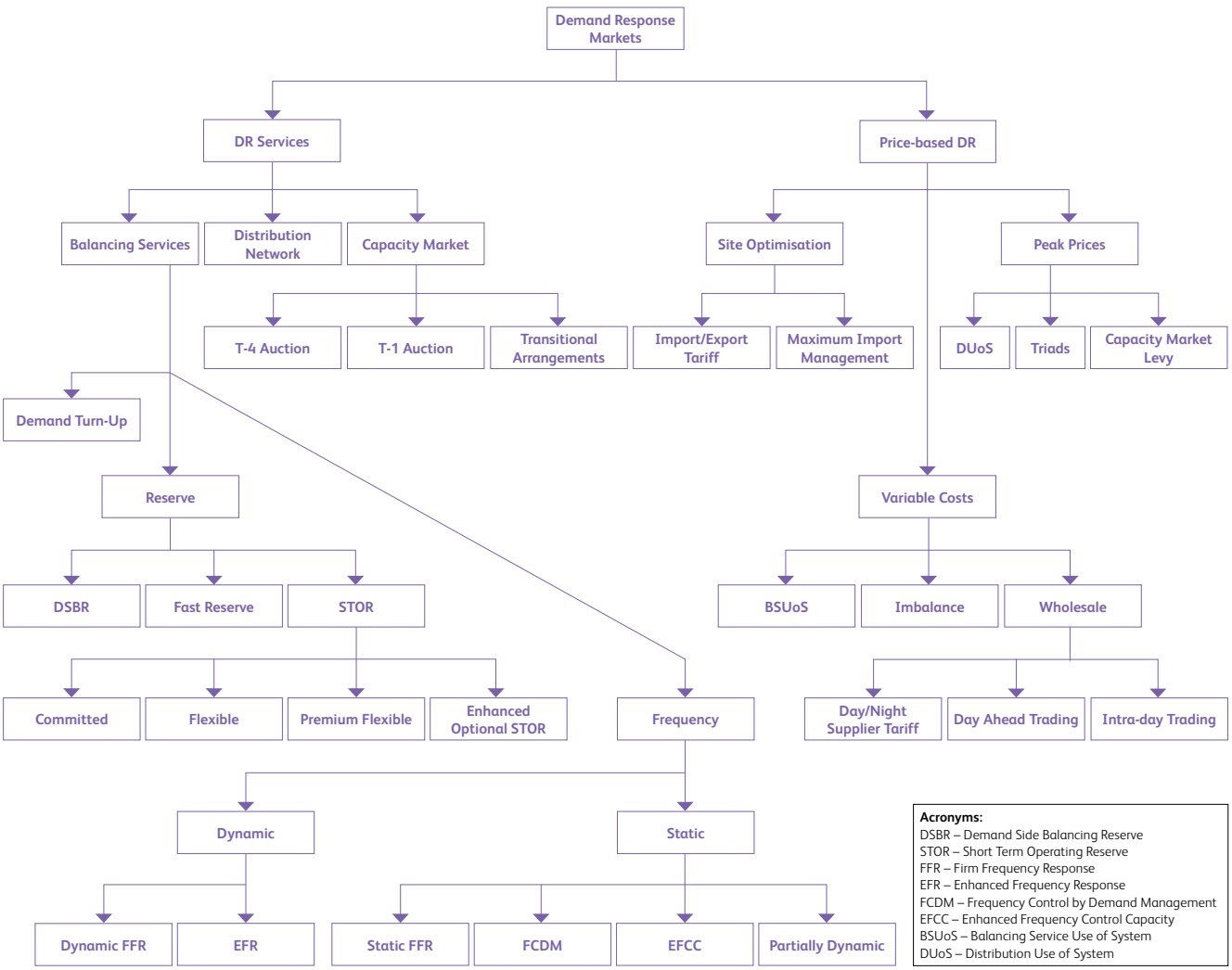
The range of DSR options and products out there is vast, complex and often bewildering to those not already participating and well versed in these activities. Figure 2 illustrates this point with some 24 different products, policies and mechanisms through which consumers can participate in DSR.

DSR activity amongst manufacturers in general remains fairly limited, even if more energy intensive manufacturers have been participating in DSR for some time now. Our survey revealed that just 9% of respondents took part in some form of DSR activity. The reasons for the lack of participation, or inability to participate further, were varied, ranging from insufficient financial incentive to those that had utilised all of the available flexibility on their sites. However, by far the most cited reason was the complexity of the system and resulting lack of understanding within manufacturing companies.

Discussions conducted for this report revealed that even manufacturing companies well versed in the DSR markets find the system bewildering and unwelcoming to new entrants. One company commented that "*it is genuinely stressful to be in a regulatory environment alongside the big six*", further noting that energy companies have entire departments to deal with these markets, whilst even a large manufacturing company may have only one individual covering energy.

[35] http://www.dailymail.co.uk/news/article-2741039/Blackout-alert-Offices-factories-undergo-1970s-style-electricity-rationing-winter-stop-households-plunged-darkness.html and http://www.telegraph.co.uk/finance/newsbysector/energy/10145803/Risk-of-UK-blackouts-has-tripled-in-a-year-Ofgem-warns.html

Figure 2: The Demand Side Response Market



Source: Open Energi

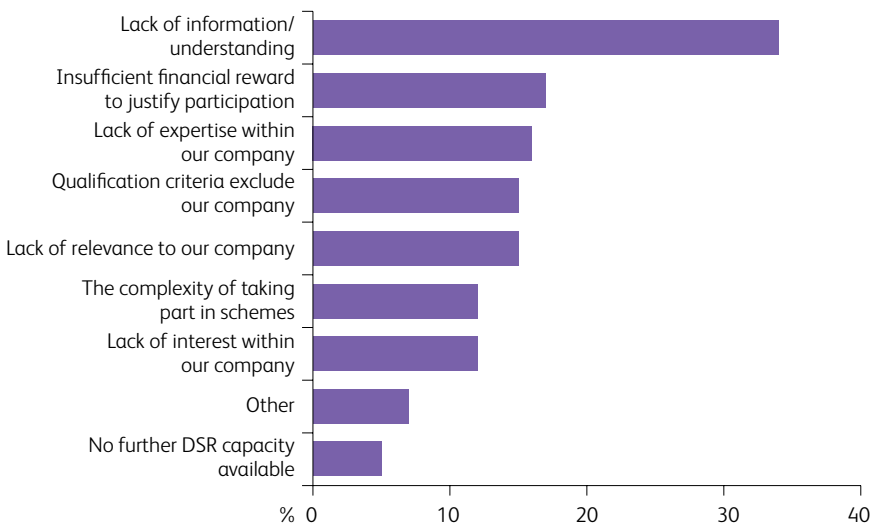
The Association of Decentralised Energy (ADE) has estimated that a total of 9.8GW of DSR flexibility could be available in the UK with correct policies in place. This includes 2.8GW of 'clean' DSR from industrial users, as well as 2.3GW from on-site CHP and 3GW from on-site back-up generation.[36]

If the Government is to maximise this potential, it should first increase the number of businesses acting on straightforward price signals through time-of-use tariffs (see below). Beyond this the Government, National Grid and Ofgem must look at what can be done to reduce the complexity of specific DSR services and regulatory barriers to entry.

DSR aggregators[37] also have a key role to play in enabling manufacturers to participate in DSR services. These companies allow many energy consumers to pool their DSR capacity and meet the minimum thresholds set, while also making participation simpler by avoiding the need to deal with National Grid directly. Creating a market that also works better for aggregators will be important, as will improving the view manufacturers hold of aggregators and the confidence they have in them. The forthcoming ADE code of conduct for aggregators will be an important step in this.

However, it is also important to note the limits of DSR. Whilst it will be a crucial tool in delivering a more flexible and low carbon electricity system, there is simply no conceivable way it will entirely offset shortfalls in generation from weather-dependent renewables. The Energy Research Partnership noted that to balance recent significant

Chart 11: Barriers to DSR participation amongst manufacturers



Source: EEF (October 2016) Climate, Energy and Environment Survey

and long-lasting dips in renewable generation would have required consumption to be cut by an average of 15 GW over three weeks. This exceeds total average industrial demand.[38] Moreover, for many manufacturers reducing consumption is not always an option. Many industrial process have to operate on a continuous, 24/7, basis and reducing consumption regularly is simply not possible or practical. DSR is a one tool amongst many, not a panacea.

Maximising the benefits of DSR

The case for DSR at a system level is clear: using all the tools in the box to create a more flexible and responsive system to ensure we have a cheaper, lower carbon and more resilient electricity system. This wider 'system benefit' alone would be insufficient to incentivise manufacturers, and other companies, to take part in DSR but there are also clear financial returns for those that do participate.

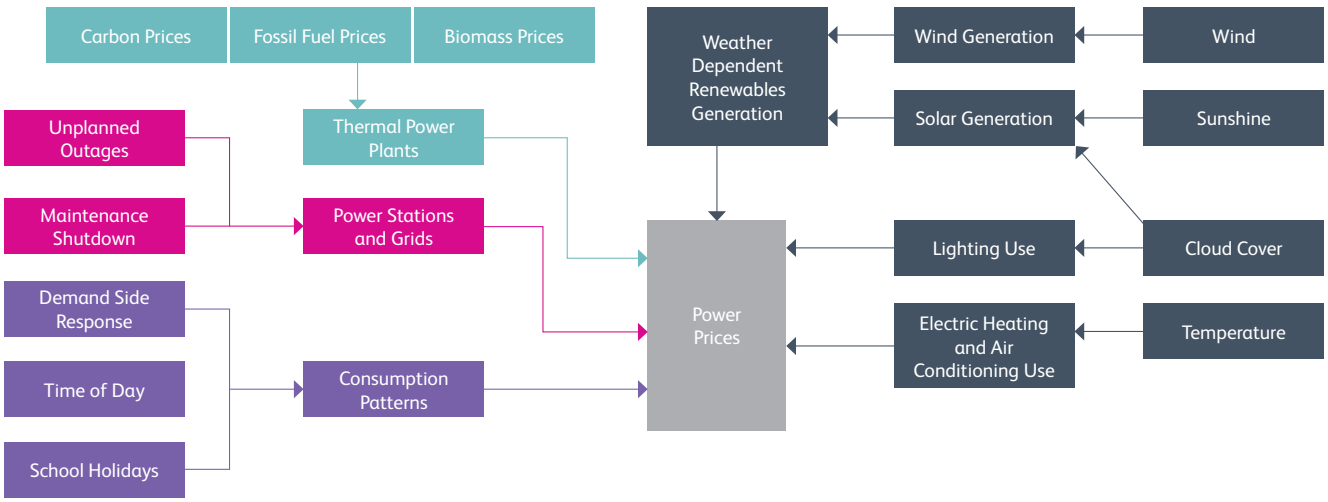
Our discussions with manufacturers already engaged in DSR activities indicate they adopt a common approach and hierarchy to maximise potential savings and revenue streams. Where possible, companies will seek out opportunities to reduce exposure to higher power (wholesale) prices first, followed by minimising their network costs (Triads and red zone avoidance) and finally participate in specific DSR products.

Market Price Optimisation

The price of electricity, like other products, is determined by supply and demand. But because electricity supply and demand must always be balanced and there are very limited storage options, the impact on prices

[36]The Association of Decentralised Energy (2016) Flexibility on demand
[37]DSR aggregators are companies that pool DSR capacity from a number of energy users and deal directly with National Grid on their behalf. This allows companies not able to meet the minimum capacity thresholds for DSR products to participate as well as reducing the complexity of participation for them.
[38]Energy Research Partnership (2015) Managing Flexibility Whilst Decarbonising the Electricity System

Figure 3: Factors Impacting Power Prices



of any fluctuations is instant. On the supply side, things like fossil fuel prices, wind speed, power station outages and maintenance shutdowns all have an impact on prices. The factors on the demand side include time of day, time of year, temperature and DSR.

Some industrial consumers will be exposed to these fluctuations in power prices on a half-hourly basis though 'floating contracts'.[39] Others may have time-of-use tariffs, with varying prices during the day or year. These encourage them to plan their operations to avoid, where possible, peak price periods. Whilst the situation is changing, the majority of consumers, even in the manufacturing sector, do not have such time-of-use contracts, and either have a single fixed-price tariff or, at best, a 'night and day' tariff. This places severe limits on the amount of power price-avoidance DSR that occurs. The role out of smart meters and transfer of certain meter types to half-hourly settlement by April 2017 will massively expand the opportunity for this type of DSR but barriers still remain.[40] Firstly, there is a preference amongst all but the largest and/or most electricity intensive consumers for simplicity in billing. Secondly, there is a perception that, for all but the very largest electricity consumers, the benefits of time-of-use tariffs wouldn't be worth pursuing due to relatively small wholesale price differentials.[41]

Recommendation 6:
The Government should investigate how to maximise the DSR benefits for manufacturers of smart meters, half-hourly settlement and time-of-use tariffs.

Building on the evidence gathered in the Government's current call for evidence on a smart and flexible power system, the Government should work to gain a greater understanding of the perceived barriers to the widespread uptake time-of-use pricing and how to tackle them. Importantly this should include an investigation of the financial benefits to consumers of time-of-use pricing, the level of DSR that could feasibly be realised through it and the benefits this could deliver to the power system.

Network Cost Reduction:
Network costs make up some 25% of electricity bills and relate to the cost of building, maintaining and running transmission and distribution systems, plus National Grid's costs as the system operator.[42] For consumers with half-hourly meters, and already billed via

[39]A 'floating contract' is one where the consumer's electricity prices follow the day to day fluctuations in wholesale prices. This contrasts with a fixed contract in which the consumer pays one standard rate for each unit of electricity consumed fixed over a certain period of time.
[40]Half Hourly Settlement (HHS) refers settlement (charging) on a half-hourly basis using real time data rather than using estimates based on the consumption profiles of other similar electricity consumers. All consumers with meter class 05-08 will be moved to HHS by April 2017.
[41]BEIS & Ofgem (2016) *A Smart, Flexible, Energy System: A call for evidence*
[42]DECC (2014) *Estimated impacts of energy and climate change policies on energy.* Estimates network costs to represent 24% of a medium energy consumer's electricity bill and 25% of a large energy consumer's.

half-hourly settlement, network costs are charged in a manner specifically designed to act as price signals to reduce demand during peak times.

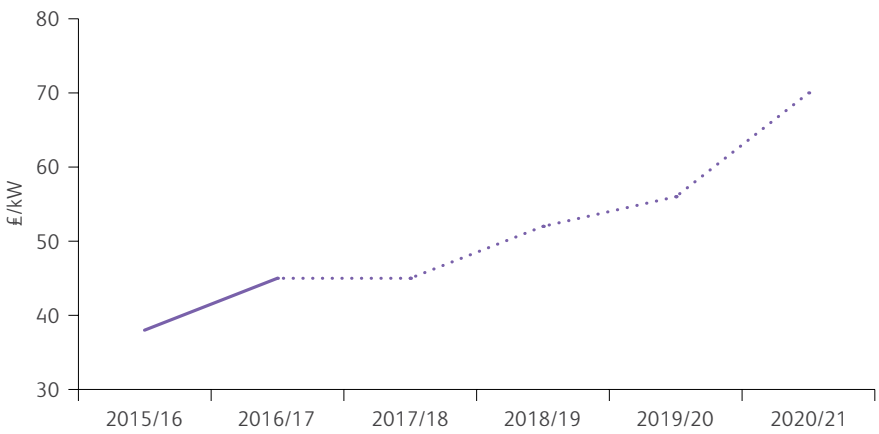
The transmission element of this is done through the Triad charging system. This calculates charges based on a consumers' peak demand (kW) during the three half-hour periods of peak consumption from November to February. Triad charges account for perhaps a quarter of the total £2 billion in transmission charges all electricity consumers pay each year. Consumers that reduce consumption during these periods can make considerable savings, and the value of these savings will grow, with Triad unit costs projected to increase by 54% over the next five years. Triad charging is estimated to deliver average load shifts of 1,200 MW, and sometimes as much as 2,000 MW.[43] That is the equivalent of one to two nuclear power stations.

Avoiding Triad costs relies on industry being able to project accurately when these peak periods will be in advance; they do not know for definite when each of the Triad periods were until after the winter period. In the past, industry has been very successful at doing this but it is proving increasingly difficult to do as more and more consumers manage their demand to try and reduce costs resulting in the flattening of demand peaks.

The Triad system has undoubtedly been a huge success in delivering DSR at peak times and could continue to do so for a number of years. Indeed, as noted above, the gradual move of more businesses to half-hourly and smart meters, and half-hourly settled bills, will increase the potential number of Triad DSR participants. However, there are emerging problems with the system that cannot be ignored forever. The costs of inaccurately predicting a Triad, and reducing consumption accordingly, will keep on increasing under the current system, whilst the chances of making those projections accurately is decreasing. Ultimately the system may become so hard to predict that avoiding Triad periods becomes a matter of chance rather than careful planning, eroding the benefits of acting over these periods and undermining the system itself.

Moreover, the Triad system's direction of travel could have a serious impact on the competitiveness of electricity intensive users who rely on avoiding Triad charges to lower electricity costs. It is imperative that the system is reformed in a manner that retains its DSR benefits but addresses the growing uncertainty of the mechanism.

Chart 12: Average Triad Costs (£/kW) 2015/16 to 2020/21 actual and projected



Source: National Grid data[44] and EEF analysis

Recommendation 7:
National Grid, as part of its charging review and in consultation with industrial energy consumers, should seek to reform the Triad charging system to deliver greater predictability for industrial energy consumers.

Manufacturers also have the opportunity to reduce distribution charges; these relate to the upkeep of overhead lines, underground cables and substations owned by regional distribution operators. These charges account for an estimated £5.5 billion a year and account for some 16% of an electricity bill.[45] For half-hourly metered and settled consumers, distributions

[43]National Grid (2015) *Winter Review & Consultation*
[44]National Grid (2016) *Forecast TNUoS tariffs from 2017/18 to 2020/21*
[45]Major Energy Users Council (2016) Profiting from Demand Side Response

charges are based on published tariffs graduated across three time periods, red, amber and green. With distribution costs for electricity used in the red period (typically 16:00hrs to 19:00hrs Monday to Friday) some 159 times more expensive[46] than during green time periods (typically 00:00hrs to 08:00hrs and 21:00hrs to 00:00hrs) it is abundantly clear why manufacturers with the ability to do so, should try and reduce electricity consumption during these 'red' periods.

As noted above, even as more consumers have the ability to reduce electricity costs through power and network cost avoidance many are still likely to not do so. As with energy efficiency, even though a business case exists a number of barriers persist; most obviously a full understanding of the financial benefits available and what action should be taken to realise them. Additionally, for less-energy-intensive consumers, the perceived disruption of altering consumption patterns may be considered to outweigh any financial benefits of DSR activity. As with energy efficiency policy, the Government needs to start thinking of ways to address these barriers where appropriate.

Recommendation 8:
The Government should explore the incorporation of DSR aims and related electricity cost reduction strategies into energy efficiency schemes such as ESOS.

Ancillary Market:
Beyond the price-based DSR covered above, there are a number of products which energy consumers can take part in to earn additional revenue and help National Grid to balance the system. Collectively these products are known as the 'ancillary market'. Most of these products are open to both supply (generators) and demand side measures but are currently dominated by the former. However, as the level of intermittent renewables on the system increases so too will the need for these balancing services. Relying exclusively on conventional generation to provide these services could increase balancing costs by an estimated 10 times.[47] National Grid is already spending over £1 billion a year on balancing services and this is expected to double over the next five years.[48] This could increase the pass though cost of balancing charges to some £6/MWh.

Such an increase in the size and value of the ancillary market increases the potential for DSR participation but also the need for reform to ensure such DSR providers are able to realise this potential. National Grid has set itself an ambitious target of sourcing 30-50% of balancing services from DSR by 2020. Achieving this target, coupled with the growth of balancing services, would create a potential DSR revenue stream for industrial and commercial energy consumers of around £1 billion.

However, greater participation in these markets by DSR participants is currently hampered by its overly complex nature, the existence of policy overlaps and unnecessary barriers to entry. For example, National Grid recently had to cancel its Demand Side Balancing Reserve Product[49] due to apparent lack of interest in the full service window. Discussions with manufacturers showed that the low take up was actually caused by their DSR capacity already being utilised by Triad avoidance or other schemes.

Recommendation 9:
National Grid, in collaboration with energy consumers and the Government, should seek to reform the ancillary market to reduce complexity and create greater transparency.

The ancillary market is largely still designed for a system in which balancing services were exclusively provided by large power stations. In the future we need a market that allows all technologies and services equal access. Ultimately we could move towards a single platform or market akin to the US where balancing services are procured through regular and transparent auctions rather than the complex series of monthly tenders and bi-lateral agreements National Grid currently operates.

Balancing Mechanism:
Electricity is traded in half hourly periods on the wholesale market. Trading stops an hour in advance of delivery at which point all suppliers and generators must send their final position (how much energy they will be generating or supplying to consumers) to National Grid which then tallies them all up to see if the system will be in balance. However, due to the vast range of factors that can impact on electricity supply and demand (see figure 3) a mechanism is required to

[46]Ibid
[47]University of Cambridge: Energy Policy Research Group and Imperial College London (2016) *Delivering future-proof energy infrastructure*
[48]http://www.telegraph.co.uk/business/2016/06/26/balancing-demand-could-cost-national-grid-2bn/
[49]Demand Side Response Balancing Reserve was intended to procure back-up capacity for winter via DSR.

manage unforeseen and unpredictable imbalances. This is known as the Balancing Mechanism which essentially sees suppliers and generators send in bids/offers to alter their position in exchange for payment.

At present the Balancing Mechanism is very much a closed shop with only suppliers and generators taking part. Only those with a supplier licence are able to participate and obtaining one is prohibitively expensive for the vast majority of companies.[50] As such the current regulations present an almost insurmountable barrier to DSR activity in the Balancing Mechanism. DSR, particularly that which can respond at very short notice, would increase the flexibility and resilience of the system, reduce National Grid balancing costs and ultimately reduce electricity prices for consumers.

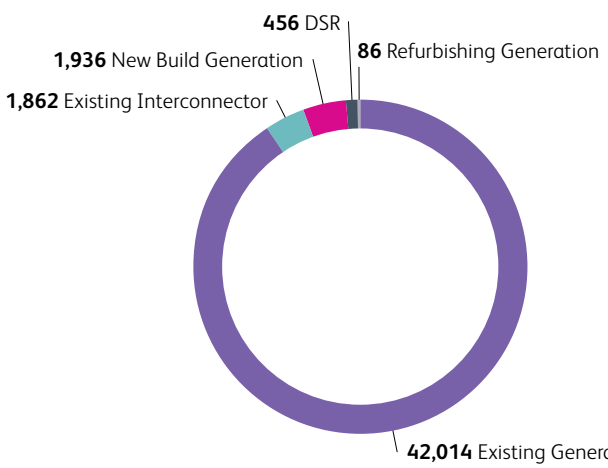
Recommendation 10:
Ofgem should amend the Balancing Settlement Code rules to allow participation of DSR in the balancing market.

One alternative to direct participation of DSR providers in the balancing mechanism is being explored by some electricity suppliers and their customers. Dong Energy's Renewable Balancing Reserve comprises of individual agreements between Dong and its customers who agree to reduce consumption or turn-up on-site generation in return for payment, thus helping Dong balance its own supply and demand portfolio. Importantly there are no penalties for non-delivery, customers can participate all year round and set the price at which they can offer a service.[51] This straightforward model is likely to prove increasingly attractive for industrial energy consumers in the future.

Capacity Market:
The Capacity Market is the Government's central policy mechanism for ensuring there is sufficient electricity capacity across the system. Essentially ensuring we have enough electricity to meet demand. Capacity providers, either generation, DSR, interconnectors or storage bid into annual auctions to provide a specified quantity of capacity for a contracted time period between 1 and 15 years. The principle auction is held four years ahead of each delivery year with a smaller auction also held one year ahead of each delivery year in order to 'top-up' capacity requirements closer to the delivery date.

The first two full auctions in 2014 and 2015 saw 49,259 MW and 46, 354 MW delivered at a cost of £19/kW and £18/kW respectively. The 2014 auction saw 174 MW, 0.35%, of contracts awarded to DSR providers whilst the second auction saw this increase to 449 MW representing just under 1% of capacity procured. This compares to the US where many regional capacity markets

Chart 13: Breakdown of capacity procured in 2015 T-4 Capacity Market auction



Source: National Grid (2015) Final Auction Results T-4 Capacity Market Auction for 2019/20

[50]Policy Exchange (2016) Power 2.0 Notes that Tempus Energy and Limejump both obtained licenses at a cost of over £1 million.
[51]Dong Energy (2016) *Flexibility Options A Users Guide*

are now relatively mature and are delivering up to 15% of peak capacity from DSR.[52]

Whilst the UK Capacity Market was designed to be technology neutral, attracting interest from many different forms of capacity, it is evident from these two early auctions that that barriers remain within the scheme design preventing full participation of DSR providers. Under the "transitional arrangements", aimed at preparing DSR and small generators for full participation in the Capacity Market in later years, an auction was held in January 2016 which saw 475MW of the total 803MW capacity contracts awarded to DSR. Some of this DSR capacity will join the full Capacity Market which will improve DSR representation slightly but it is unlikely to be a game changer. Furthermore, discussions conducted for this report indicate that some participants in the transitional arrangements would still find it extremely difficult to transfer to the full Capacity Market even after taking part in this transitional 'trial run'. Reform is required if DSR is to become a major player in future auctions.

Recommendation 11:
The Government should reform the Capacity Market to allow easier access for DSR assets in future auctions.

Discussions with manufacturers who have examined the potential of Capacity Market participation indicate three key reforms are required;

i. DSR providers should be able to bid for longer contracts then the current three years. Whilst manufacturers will not be interested in full 15 year contracts awarded to new generation capacity, capital expenditure is often required and as such contract lengths up to three years would be beneficial.
ii. The current exclusion of DSR assets participating in Firm Frequency Response provides an unnecessary regulatory barrier to further DSR participation in the Capacity Market. This exclusion should be removed.
iii. The Government should seek to simplify the qualification criteria for DSR participation; the testing and metering rules have been highlighted as a particular concern unnecessarily ruling out flexibility available from certain industrial activities due to particular consumption patterns.

[52]The Association of Decentralised Energy (2016) *Flexibility on demand*

CMR VIEWPOINT

Improving how people think about and use energy lies at the very heart of our organisation, making sure every kilowatt hour of energy is used as effectively and efficiently as possible is what drives us. As we decarbonise our economy and fundamentally alter how we produce and use energy, achieving this ambition is only going to grow in importance.

As we move from a system of large centralised power stations to one with many players and where renewables and distributed generation play increasingly important roles, energy consumers need to play a more active role. Reducing their energy consumption and being smarter about when they use it. This will provide all consumers with cheaper more secure electricity. Just as importantly, in times of rising costs and increasingly fierce competition, it reduces manufacturers' bills and increases profitability and productivity.

As this report shows; there remains significant potential in the manufacturing sector to improve energy efficiency; an impressive 14% reduction in electricity use is still available through cost effective measures paying back in less than four years. Indeed, the average payback period for the measures identified was just 20 months and significant savings can even still be made without capital investment. Manufacturing organisations aren't known for throwing money away, so why are these easy wins still out there? Common sense says this 'low hanging fruit' should have been plucked long ago.

Our experience in dealing with hundreds of companies over the years shows that even for the 'low and no cost' measures, such as energy management policies or monitoring and targeting, there remains a high level of organisational inertia. For example, monitoring and targeting energy consumption may not require capital investment, but it's not simply a case of installing a system and waiting for energy savings to appear. It's an ongoing process that needs internal commitment or external assistance. This requires a change of attitude within organisations and that can be difficult to achieve.

Most organisations still require that extra nudge to overcome this inertia. Whilst the current suite of energy efficiency policies has had some impact, it is also true that policy makers need to be creative in how they approach the subject. Information provision and price signals are evidently falling short in delivering our objective; this report shows that manufacturers are often aware of the energy and financial savings they could be making but the current policy framework is still not quite pushing the right buttons for everyone.

Moreover, this report makes clear that the Government is likely to come up against the same barriers in trying to drive higher levels of demand side response. Manufacturing sites are complex operations and there will need to be a clear and compelling case for most to start changing consumption patterns. Information, technology and policy changes all have a role to play here and the Government needs to start thinking about how these can be used to most effectively increase uptake. Employing and adapting some of the structures already in place for energy efficiency would be a useful starting point.

The benefits to all consumers of a cleaner, more efficient and more flexible power system are clear for all to see. We simply cannot afford to leave these opportunities untapped. This report is a valuable addition to the policy debate and provides us with an important industrial view of the topic. I hope its findings and recommendations are taken on board by policy makers and manufacturers alike.

The need for intelligent energy management solutions is becoming an ever higher priority for manufacturing organisations. Through an established partnership, CMR work with EEF to offer a strategic approach to managing energy and water consumption and associated cost and risk.

CMR Consultants is an independent energy, water and carbon management consultancy working in partnership with organisations across all sectors. We take a holistic and pragmatic approach to all projects and provide cost effective support and advice to our clients.

With many years of experience and engineering skills at the core, our professional team of Certified Energy Managers, Lead Assessors and Auditors are dedicated to identifying opportunities and delivering solutions to reduce energy and water consumption, carbon emissions and cost. We also support compliance processes such as CRC and ESOS and implement/audit ISO50001 Energy Management Systems (EnMS).

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Open Energi is a clean technology company working with businesses to unlock the value of their demand-side flexibility and create a new energy economy which is cleaner, cheaper, more secure and more efficient. Our Dynamic Demand technology platform connects sources of demand-side flexibility – from batteries and industrial equipment through to cogeneration – and applies cutting edge techniques to intelligently optimise their use in real-time, maximising value for end users without disrupting business processes. To date we have connected over 3,000 assets at over 350 customer sites UK-wide, including Sainsbury's, Aggregate Industries, United Utilities and Tarmac.

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The manufacturers' organisation

EEF is dedicated to the future of manufacturing. Everything we do is designed to help manufacturing businesses evolve, innovate and compete in a fast-changing world. With our unique combination of business services, government representation and industry intelligence, no other organisation is better placed to provide the skills, knowledge and networks they need to thrive.

We work with the UK's manufacturers from the largest to the smallest, to help them work better, compete harder and innovate faster. Because we understand manufacturers so well, policy-makers trust our advice and welcome our involvement in their deliberations. We work with them to create policies that are in the best interests of manufacturing, that encourage a high growth industry and boost its ability to make a positive contribution to the UK's real economy.

Our policy work delivers real business value for our members, giving us a unique insight into the way changing legislation will affect their business. This insight, complemented by intelligence gathered through our ongoing member research and networking programmes, informs our broad portfolio of services; services that unlock business potential by creating highly productive workplaces in which innovation, creativity and competitiveness can thrive.

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Our energy specialists there to help you understand your legal obligations, the risks to your business, and the measures you need to put in place to ensure compliance and best practice in energy efficiency and energy management. Whether you need to resolve a short-term issue or develop a long-term strategy, our knowledge and experience are invaluable.

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The manufacturers' organisation

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