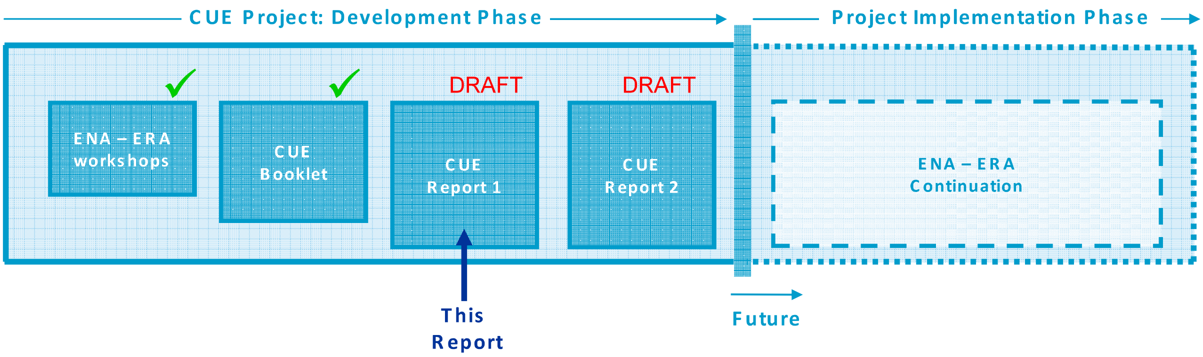
GB Demand Response

Report 1:
The Opportunities for Demand Response

Demand Response: a radical new approach to how and when we use electricity, with real benefits for Cost, Carbon, Convenience and Supply Security.

This is Report 1, an expansion of the previously issued CUE Booklet, that summarises the opportunities and challenges for Demand Response. It describes the basics in plain language and set the scene for the more detailed content of Report 2.



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1 FOREWORD: WHY WE SAY COOL

The energy landscape is changing at a quickening pace. Global warming, declining fossil fuel resources, rising world population, shrinking power capacity margins, rising energy demand and new load types are just some of the drivers requiring the energy sector to embark on a journey of transition to a more sustainable, secure, clean and affordable energy future.

In the latest DECC Business Plan (2011 – 2015, November 2010), the Coalition government reconfirmed their commitment to increase the amount of renewable energy in the UK to 15% by 2020, in line with the EU binding 20-20-20 targets. Moreover, the DECC vision is to achieve a long term transition to an 80% cut in greenhouse gas emissions by 2050.

It is foreseen by many parties in the energy sector that this transition will benefit significantly by the use of *Demand Response*. This direction of development can be observed internationally and includes proposals and trials widely in Europe, the USA and beyond.

Demand Response can be viewed as a range of new services and functions that will enable not only the reduction of the energy required during critical periods (e.g. times of peak demand), but also savings in overall annual electricity consumption through facilitating changes in consumer behaviours. One of the mechanisms that could be deployed is for consumers to vary (reduce, increase or shift) their *energy demand in response to price changes* in the market. This might be achieved by consumer 'manual action' in response to price information, or by means of automation. A characteristic of Demand Response is the *active* participation of consumers, who might be rewarded for their actions through incentive pricing or special tariffs.

Demand Response will be one of the mechanisms likely to change the way that society thinks of and uses energy. To achieve an optimal outcome, society will need to be convinced that active participation in energy, utilising demand response, is indeed the *cool thing to do*. The case to support this can be derived from the following three important pillars for the future: Cost, Carbon and Convenience. These are described in the following sections.

1.1 Cost

Demand Response will provide an important new capability for balancing demand and supply across the power system by reducing the costs needed to accommodate electricity from intermittent and variable renewable sources. These sources are of course key to the UK meeting the binding EU targets for sustainability. The development of new technologies such as smart meters, energy displays and home automation have the potential to reduce the costs associated with intermittent generation notably by decreasing the requirement for conventional 'standby generation' and by avoiding the 'spill' (constraining off) of clean energy when a surplus is available.

Important characteristics to note for renewable generation are:

- **Variability**: Reflecting unforeseen changes in intermittent generation output;
- **Unpredictability**: Recognising the limitations of forecasting intermittent generation output; and
- **Location**: Remote location of large-scale intermittent generation relative to the big demand centres.

Differing locations of generation and demand result in significant power flows across the national electricity networks, both in terms of bulk transfers (the transmission network) and also at more local levels (the distribution networks). From time to time, the required transfer capacity is not available and this results in additional costs arising from changing the generation pattern away from the optimum. One solution is to strengthen the network at the bottleneck – but this is usually a costly option; it is attractive to consider using demand response to vary the demand in a regional or local area to alleviate the excess loading on the network. This has not been possible in the past (except by 'load disconnection' in emergencies) and new opportunities arise if consumers have a Demand Response capability and this is aggregated over many properties (or electric vehicles) in a geographical area.

1.2 Carbon

Another important aspect of Demand Response is the value added in operational efficiency and CO_2 performance, and the support that it gives to the *low carbon transition*. As mentioned above, there are times when network constraints require generation patterns to be altered – this not only creates additional costs but typically results in generation being brought into service that has higher carbon content for each unit of electricity produced.

Demand Response programmes have the potential to make a significant contribution to the ability of the future low carbon generation system to accommodate new renewable generation, such as:

- **More rapid connections** (enabling a 'connect and manage' approach) so that new clean generation both at large scale and small scale can be brought into operation on existing networks as soon as it is available, with Demand Response being used to manage the network bottlenecks either indefinitely or for a period of time until network strengthening can take place.
- **Optimising demand profiles** (reducing the impact of system demand peaks, for example) which substitutes the operational flexibility otherwise required from conventional generation (e.g. nuclear, gas or coal). The use of Demand Response to re-shape the demand profile (both shaving peaks and filling troughs) will enable the maximum use to be made of the cleanest generation.
- **System management services** (new forms of generation backup 'response and reserve' provided by Demand Response), are a low carbon alternative to conventional services that are provided by conventional generation in today's Ancillary Services market. In principle, such services can be provided by any appliance that uses electricity if either its time of use can be varied, or if it has an element of energy storage in its characteristic. An example of the former would be shifting the time of use of a domestic washing machine or dishwasher (or in the future the charging of an electric vehicle), and an example of the latter might be temporarily interrupting the operation of air conditioning or refrigeration (provided there was sufficient coldness to maintain effective operation).

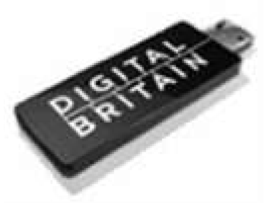
The above will maximise the intermittent and renewable power that the system can accommodate and the efficiency of overall generation operation, so minimising CO_2 emissions.

1.3 **Convenience**

Demand Response can change the role played by consumers in the power sector. This is an empowering opportunity that can save costs and carbon, bringing benefits to all parties. It also has the potential to improve the security and quality of supply by providing new forms of flexibility and responsiveness on the power system.

Demand Response will need to fit in with consumers' lifestyles if it is to be adopted widely and willingly. The implementation approach, the commercial offerings and their practical operation, will need to be carefully designed and communicated. They will need to be tailored to differing demographic and social groups (the elderly, the disabled, the fuel poor, or the time poor, for example) and will need to have levels of complexity acceptable to their users (some may favour a hands-on approach to continually optimise their energy savings, others may want a standardised and fully automated system, and some the choice to opt between the two extremes). Competitive offerings from a range of service providers can be expected to bring not only choice but also imaginative new services offerings attractive to particular groups of consumers.

The energy sector would be advised to note the lessons coming from the Digital Britain programmes (see box below). These reveal the significant difficulties that some demographic and social groups experience in adopting new technology and utilising it effectively. The good practices learnt by Digital Britain might be a helpful base point for launching a Demand Response programme.



The goal of the Digital Britain programme is to secure the UK's position as one of the world's leading digital knowledge economies.

A major force in the economy, worth over £52 billion a year, the digital and communication sectors are growing in significance as the country faces up to current financial and market challenges. Vital to underpinning global economic activity, they are critical to every business in the national economy, acting both as a catalyst for creativity and allowing efficiency gains. And they have a major impact on our culture and quality of life.

http://interactive.bis.gov.uk/digitalbritain/

Programme topics include:

- Three year plan to boost digital participation
- Universal access to broadband by 2012
- Fund to invest in next generation broadband
- Digital radio upgrade by 2015
- Liberalisation of 3G spectrum
- Support for public service content partnerships

2 WHAT'S INVOLVED IN ACHIEVING THIS CHANGE?

2.1 Overview of the traditional power sector

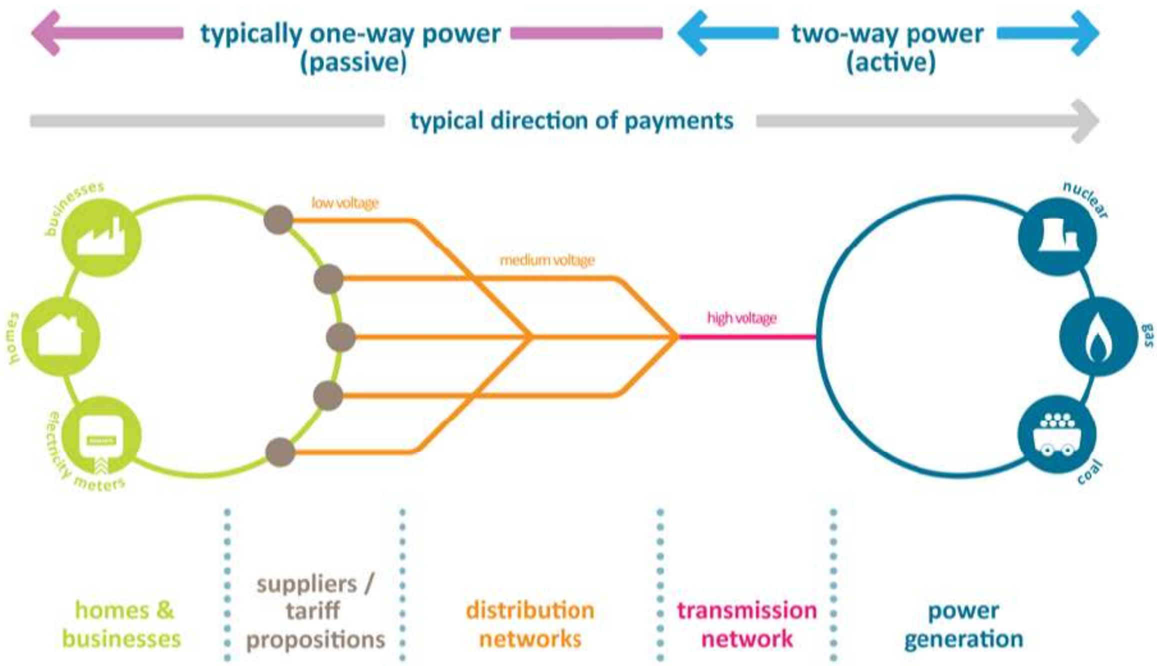
The traditional power system was designed around 75 years ago, based on a philosophy that suited the technologies and the needs of society at the time. Fossil fuels were available in abundance and generation capacity was concentrated progressively in bigger, centralised power plants to maximise the economies of scale. This required the construction of a national transmission network to accommodate bulk power flows together with distribution networks to deliver the power to consumers.

This design provided an economic and reliable solution to the increasing energy demands of the mid 20th century. Its operating design is based on the paradigm "***generate what is consumed***" i.e. consumers use power in an unconstrained way and ‘behind the scenes’ the power sector anticipates requirements and operates generating plant to meet the demand and balance the system. This paradigm has served society well but is not suited to a world where increasing amounts of generation cannot be scheduled to order (e.g. wind and solar power), or where demand cannot be readily forecast (e.g. substantial electric vehicle charging requirements).

A corollary that may be noted is that the great majority of consumers have no concept of where their energy comes from, how its price (and carbon content) varies through the day and the year, and that the power system is not of infinite capacity and flexibility. One might reasonably respond ‘and why should they?’. Indeed until now there has not been a need or incentive for consumers to be more closely engaged with the energy they use and the system that provides it – but in the future there will be increasing value in so doing, at an individual and societal level. Demand Response is a key element here and its introduction is an opportunity to establish and foster a willing engagement that brings customers and the energy system into a closer and harmonious relationship.

The diagram below represents the main elements of today’s traditional power system. It highlights the main players across the bottom, and the distinguishing characteristics of the system across the top.

Figure 1 Traditional Power Sector



The main characteristics of the traditional power system, as illustrated above are the following:

- **Two-way power flows in the Transmission network.** The bulk power flows carried by the transmission system can change direction depending on which generation is operating. The system has been designed to provide this capability in its control systems and in responding to fault events such as lightning strikes or equipment failures.
- **One-way power flow in the Distribution networks**. Electricity flow here is uni-directional, starting from the transmission exit points and delivering the energy to consumers in homes, businesses and industry. A reverse flow (e.g. created by introducing Distributed Generation at a local level) is not permissible because, although reverse flow can in principle be accommodated by the wires, it cannot be recognised by the control and fault detection systems. There are engineering solutions to this which form part of the thinking about 'smart grids'.
- **Remote generation**. Large power plants are traditionally located far from demand centres. This means that in order to bring the electricity from the power plant to the consumer there is a need for an extensive network system.
- **Little communication & automation**. Based on technologies and design philosophies from 75 years ago, the system historically has only limited

communication, control and automation capability built in, especially in the lower voltage distribution networks. This limits the ability of network operators to monitor power flows and voltages and respond to fault events. This has been a containable situation for the traditional power system, but will not be adequate for the future with increasing amounts of Distributed Generation and substantial new electrical demands to be met.

- **A mainly passive grid**. As a consequence of the limited communication and automation, the distribution networks in particular has been designed to enable the system to satisfy peak demand in a passive manner with very limited need for direct interaction to facilitate this. It is sometimes described a 'fit and forget' system. This has been a good model for the stable world of the past, but is likely to be an expensive solution if perpetuated to meet the changing requirements of the future.
- **Delivering electricity to passive consumers**. Traditionally consumers are not involved in the process of energy delivery and consider the electricity to be "on tap". This passive model has been reinforced by electricity being relatively cheap for most consumers. Changing global energy trends, sustainability imperatives and end-of-life asset renewal are projected to result in rising underlying costs, making a more intelligent and responsive system all the more important. In this regard, consumers need to be viewed as part of the system, not simply connected to it.

2.2 Overview of the power sector in a low carbon world

As addressed in the foreword, the UK's energy landscape is changing and energy is becoming an increasingly important resource. As fossil fuels get either scarcer or more difficult to source, the need is increasing to use energy more wisely and to harvest more energy from sustainable sources.

The introduction of intermittent renewable sources in the generation mix – one of the main characteristics of the current low carbon world – brings new challenges for the traditional power system and creates the need for fundamental rethinking and a willingness to embrace change.

However, intermittency is not the only issue that the sector is facing today. The list below describes some of the other aspects that increasingly need to be addressed.

- **Scarcity and rising cost trends.** Observers such as the International Energy Agency (World Energy Outlook 2010) forecast that fossil reserves are going to be inadequate to satisfy the world's increasing energy requirements. In a world market, this implies an increase in the costs of that source and less stability in forward prices that makes investment decisions problematic.

- **Substantial new demands of Electric Vehicles and Heat Pumps**. These are but two examples of technologies that will result in a considerable increase in the demand in the coming years, accelerating the need for new network capacity. Their introduction will bring benefits for decarbonisation of domestic heating and transport, and for improvements to urban air quality near busy roads; therefore, the challenge will be to meet these new electrical load responsively and at least cost.
- **The high cost of generation/infrastructure.** In order to have an effective and secure system based on the traditional design there is a need for an increasing level of investments in the connections to new generation locations (including off-shore), in the transmission and distribution main networks, and in standby 'response and reserve' to balance the system and facilitate the increase in intermittent sources.
- **Different drivers for networks and energy suppliers.** Demand Response clearly offers many potential benefits to the system, but those benefits may not coincide in time or location when viewed from the perspectives of differing market players. For example, an energy supplier may wish to increase demand to balance their market position, while the network operator may be experiencing high network utilisation and need to reduce demand to prevent over-loading.
- **Significant underlying infrastructure investment.** The issues and opportunities discussed in this report should be viewed against a context of rising investment in the energy sector. In the National Infrastructure Plan 2010[1], the UK Government has planned important investments including the Green Investment Bank, up to £1 billion for one of the world's first commercial scale carbon capture and storage demonstration projects, and the provision of grants to increase the uptake of electric vehicles. Moreover, the third special report from the Energy and Climate Change Committee[2] reinforced the vision of strategic leadership from the Government delivering a vision for the future that engages actively both consumers and the energy sector (through important investments).

These changes are being driven by other factors such as end-of-life asset renewal and demand growth, and in the future are likely to be influenced by climate change

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[1] For more detail of the National infrastructure Plan 2010 please visit: http://www.hm-treasury.gov.uk/d/nationalinfrastructureplan251010.pdf

[2] "*The future of Britain's electricity networks: Government Response to the Committee's Second Report of Session 2009–10*". (http://www.publications.parliament.uk/pa/cm201011/cmselect/cmenergy/629/629.pdf)

adaptation and national infrastructure resilience considerations. While these are beyond the scope of this report, they are significant matters that will require an integrated approach.

The challenges listed above will be resolved most effectively by designing and introducing new thinking to the power sector. Thinking that addresses all of these issues, manages the trade-offs, and provides the necessary market and settlement arrangements.

In this new model power flows will no longer be unidirectional in the distribution networks and added communication and automation will be required to manage the changing generation and demand characteristics. There will be significant advantages in the consumer being actively involved. The system paradigm will change significantly towards "***consume what is generated***" rather than “generate what is consumed”. This change of approach is being addressed internationally and is commonly referred to as the move to Smart Grids.

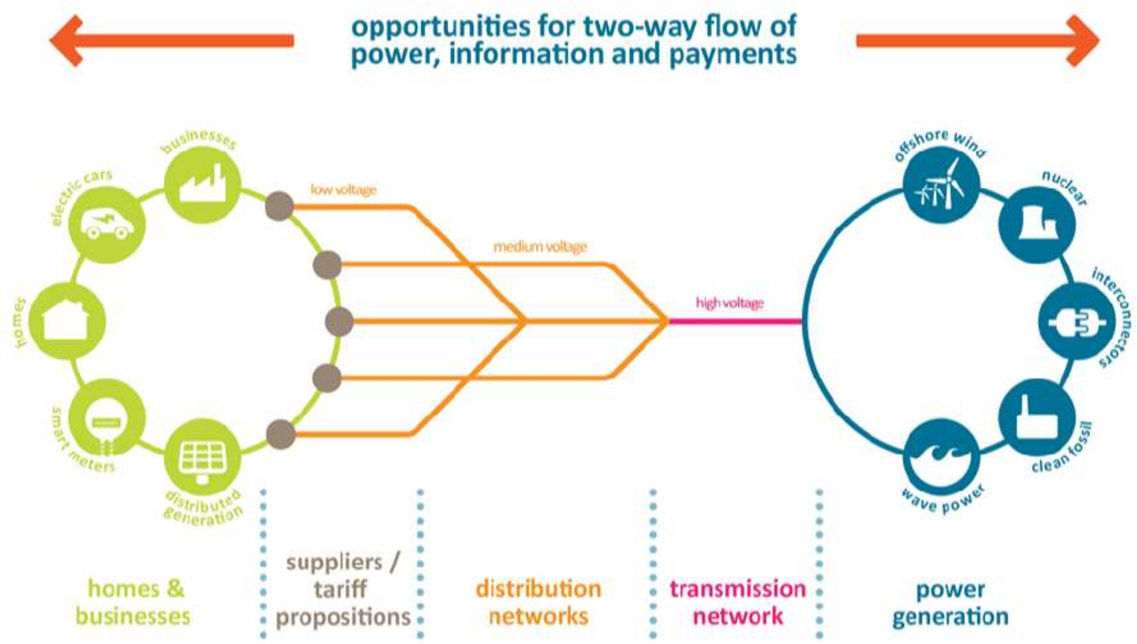
The technologies to enable this change are fortunately largely available and fundamental Research & Development (R&D) is generally not seen to be necessary for the first stages of change (say to about 2020). Beyond this there are many unsolved challenges and R&D has a major role to play. While, in these first stages of Smart Grid implementation, R&D may not be essential there is nevertheless a significant engineering challenge to integrate and deploy the new technologies listed below:

- Smart metering and displays
- Demand Response
- Home automation
- Intelligent appliances
- Power electronics
- Smart vehicle charging
- Active networks
- Network automation
- Real time ratings
- Intelligent voltage control
- Fault Current Limiter devices
- Asset condition monitoring
- Storage, small and large scale

These technologies will be the enablers for the power sector to switch from a *traditional* to a *smart, low carbon* sector. They will also require development of associated commercial and regulatory frameworks, and the engagement of consumers as previously discussed.

The following diagram illustrates these considerations. These new technologies will bring opportunities to take advantage of better information, smarter automation, faster communication and aggregation (summing micro to macro) and will enable new markets and services, bringing competition and choice to consumers.

Figure 2 Power Sector in a Low Carbon World



3 WHY MAKE CHANGES NOW?

Starting these changes now could not be more timely, as the Government's Low Carbon Economy is gaining momentum and a number of related projects are commencing. The latest DECC business plan reconfirmed the need to generate 15% of all UK electricity by renewable sources by 2020.

This opportunity is further strengthened by the emergence of new technologies such as smart meters and in-home displays which are becoming available now. Furthermore, new energy demands are likely to appear in the next 12 months coming from sources such as electric vehicles and heat pumps. The government's incentives (Feed-In Tariffs) are now stimulating increased penetration of renewable sources (notably solar power) at a domestic level and this Distributed Generation is likely to have a progressive impact on the operation and costs of distribution networks.

These emerging technologies might not pose an immediate challenge as they will be small in power system terms; however as penetrations increase and in locations where concentrated 'hot spots' arise, their impact is likely to become material. The response from the power sector still remains urgent owing to the lead times to implement changes. The key matters to be resolved are as follows:

- **Building consumer engagement**. To allow the transition of consumers from a "passive" to an "active" role, new service offerings, incentives and information will need to put in place. Consumers will need to be persuaded of the benefits and the new commercial and technical arrangements will have to be attractive to them.
- **Developing markets and services**. New services and commercial offerings will require commercial frameworks and appropriate licences/regulations. These will be both B2C (i.e. services seen by individual consumers) and B2B (aggregated services from many households, summed to a service offering for distribution network operators, transmission network operators and the transmission system operator). The operation of new services will require timely access to data and decision mechanisms to resolve the conflicts that will arise from time to time from the different parties who could utilise Demand Response services.
- **Security & privacy**. As part of service development and roll-out to customers it will be necessary to satisfy requirement for cyber data security and for data privacy.

- **Time needed to implement the change**. It is not only the consumers who need time to "digest" the changes, but the entire sector will need time to implement and apply the new technologies, develop new commercial offerings, and integrate new services in their policies for secure and effective business operation. New skills are likely to be needed in the traditional companies and new partnerships will most likely need to be forged as part of an overall delivery approach.

4 THE CHOICES AHEAD

4.1 For consumers

Consumers will have many new choices ahead following the large scale introduction of new technologies such as home automation, smart vehicle charging, distributed generation and the new offerings that the Demand Response will create.

Consumers will have greater choice regarding their current use and services, such as how they buy (and in the future sell) their energy, e.g. they are likely to have the possibility to choose the tariff which will best fits their needs, with the possibility to sell back to the grid what they produce in surplus from domestic renewable energy sources. They might choose how clean their energy is from different energy offerings and make informed decisions about time of use and the cost of energy. Domestic-scale storage is also likely to feature in the future.

It can be anticipated that consumers will play an increasingly central role in overall system energy balancing, turning demand down or up on request, perhaps based on price signals or by direct messages (e.g. turning down in peak times when the system is under pressure or turning up when there is a surplus of renewable energy) and receiving rewards for so doing.

An indirect and wider societal benefit of Demand Response solutions is that they will eliminate or minimise the physical disruption that Business as Usual solutions will create in strengthening network capacity. For example, avoiding the need for installing larger capacity service connections in homes, for digging up the streets to increase distribution cable capacity, and creating sites for additional local substations.

Even with smart solutions there will be some need for traditional reinforcement, but this will be deferred in time and reduced in scale if Demand Response is utilised effectively. One of the challenges to the sector will be to develop the forecasting, tracking and decision tools needed to optimise the use of Demand Response and make informed decisions about when and how more traditional reinforcement should be undertaken.

4.2 For the industry

The power industry as a group of stakeholders is faced with a demanding choice. It has the opportunity to engage in significant changes to the way the system operates, or to opt to continue with a Business as Usual path.

However, with the latter choice, simply extending the development and operation of the system as we know it, is likely to incur substantial increases in costs, compared with a smart grid philosophy that incorporates Demand Response. The business case for change clearly needs to be understood and all industry parties, including government and regulator, will wish to see quantification of this. Work is in hand in a number of areas, but a recently published ENA report[3] shows the benefit to the LV networks of demand response to be between £0.5bn and £10bn, depending on the levels of penetration of Electric Vehicles and Heat Pumps

However, under the first option, rethinking and modifying the way we generate, deliver and use energy, opens the door to a new view on investment and innovation. Smarter grids will give the opportunity to change the power system and to interact with consumers using modern technologies and new service offerings to deliver best value for money in the longer term.

New partnerships and services can be expected to stimulate beneficial change in the industry. This would appear to be consistent with Ofgem's expectations as outlined recently in their RIIO model for the future of network regulation[4].

There is wider benefit here potentially for the UK economy as the interest in smart grid techniques is international. Early proving of new approaches to Demand Response here in Britain would form a strong platform for the export of technical and commercial solutions, regulatory frameworks and implementation know-how. There are numerous parties around the world offering theory and demonstration developments; it would be significant differentiator to be able to show Demand Response deployed commercially and at scale.

Ofgem's Low Carbon Network Fund projects might be used as a stepping stone here.

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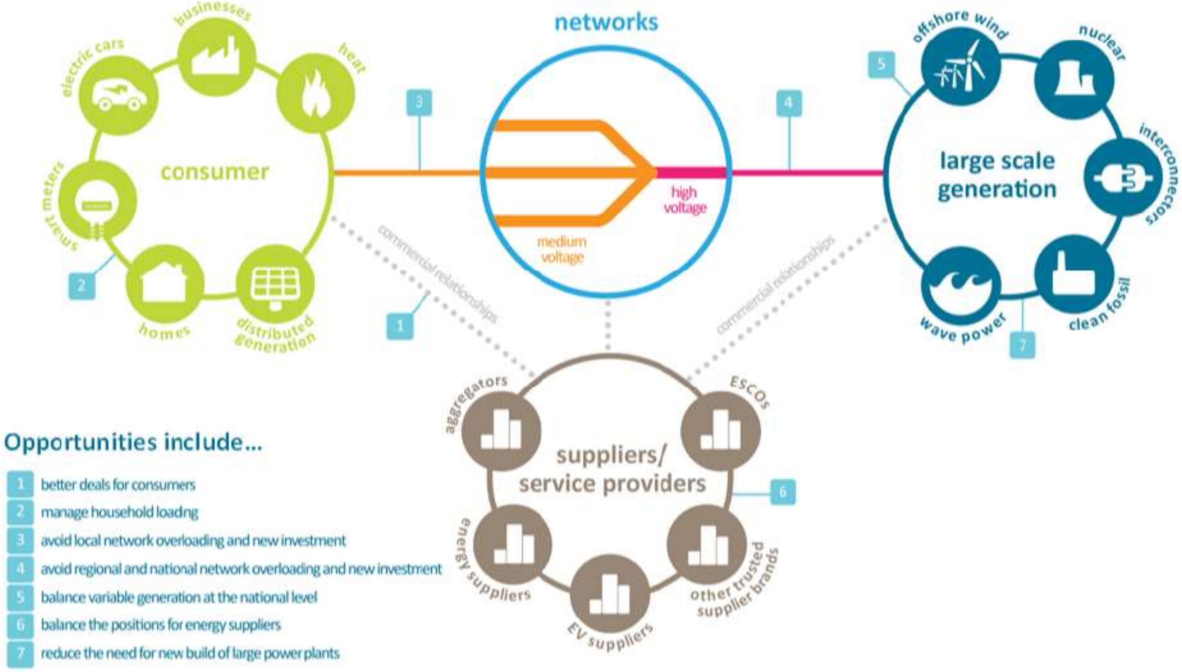
[3] "*Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks*", ENA, Imperial College and SEDG, April 2010 (http://www.cts.cv.ic.ac.uk/documents/publications/iccts01392.pdf)

[4] For more information please visit Ofgem's web site: http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=116&refer=Networks/rpix20/ConsultDocs

5 THE SEVEN OPPORTUNITIES FOR DEMAND RESPONSE

As introduced in the previous sections, the implementation of demand response can provide a range of foreseeable benefits. After closer observation of the four main groups in the power sector (the consumers, networks, suppliers/service providers and large scale generation,) 7 unique benefits can be identified. Each one of these benefits is summarised separately below.

Figure 3 The seven opportunities for Demand Response



5.1 Better deals for consumers

Today's customers have become familiar with switching between suppliers, but any switch is largely determined by price (from one flat rate tariff to another flat rate tariff). Demand Response, combined with smart meters, displays and home automation enables possibilities for new service differentiators in addition to price. It would be expected that attractive offerings will become available, tailored to each consumer's own energy use characteristics and preferences.

For example, a new offering might be targeted at bringing benefits to the fuel poor, or being suited to those who are away from home most of the day, or aimed at good value for those who wish to charge electric vehicles at home. Other commercial attractions might arise from the export of surplus power from domestic micro-generation.

Consumers will also benefit indirectly from the cost savings identified in the six other benefits that follow below, as the costs of networks, centralised generation, and system operational balancing all appear in customer's bills eventually (although not itemised as such). At a broader societal level customers will also benefit from the more rapid achievement of sustainability goals such as lower carbon energy, and from air quality improvements brought about by electrified transport.

5.2 Manage household loading

The total electrical demand within a home is likely to increase above the traditional growth rates seen in recent years. This will arise from the use of heat pumps, air conditioning and electric vehicle charging. Setting aside the potential impact this has on the local and national networks and on national generation capacity, it may also have consequences for the service capacity into the property. Demand Response can be used to manage total loading to remain within power flow and voltage quality limits, avoiding the need for expensive and disruptive reinforcements and likely conversion from single phase to three phase supplies.

5.3 Avoid local network overloading and new investments

Demand Response, aggregated across a group of customers in a local area (perhaps ranging from a single street to approximately a Post Code Area) could be used to overcome network bottlenecks, defer the expense and disruption of traditional reinforcement, and enable new demands to be connected more rapidly. Demand Response also opens up new opportunities for additional network operating services such as voltage support and local balancing and potential applications for domestic-level storage. Aggregation might in the future comprise a combination of Demand Response actions, Distributed Generation and local storage actions.

5.4 Avoid regional & national network overloading and new investments

By aggregating services over whole towns, counties or regions, similar benefits as those identified for local distribution networks will also apply at higher voltage levels for the transmission networks. In practice it is likely that not every customer in an area would be called to take simultaneous action, the preference being to have a rolling programme that seeks to ensure that aggregated Response can, if so needed, be maintained over an extended time period.

5.5 Balance variable generation at national level

As described earlier, the national power system has to be kept in balance minute by minute as there is in effect little energy stored within the system (hence generation must match demand at every moment). The consequences of this balance not being met are severe and lead rapidly to large area power failures, as are experienced somewhere around the world about once every year. This critical aspect has both operational and commercial consequences as it puts a significant value on services that can be used by the grid operator to rebalance the system when, for example, there is a surge in demand or a failure of a generator.

Demand Response offers the potential to provide cost-effective and zero carbon balancing services; these would be expected to have material commercial value within the Ancillary Services market operated in Britain[5]. It is an attractive alternative to meet an unforeseen fall in wind output by varying Demand should the problem arise, in place of having fossil fuelled generation waiting in standby mode in case it is needed. A direct implication of the above attributes is a reduction of losses, energy conservation and fewer emissions.

Other than facilitating demand/supply balancing (both at a national and regional level), there are several other ancillary services opportunities such as black start capability[6] with high levels of distributed generation, black start management utilising Demand Response, improved reserve response and the management of reactive power/losses. It is conceivable that ancillary services in active distribution networks might be best managed locally by an ESCO or DSO activity.

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[5] The cost of balancing services in the UK electricity market in 2009/2010 was £512m. For more details please visit National Grid's web site: http://www.nationalgrid.com/uk/Electricity/Balancing/transmissionlicensestatements/PG/

[6] Black Start is the procedure to recover from a total or partial shutdown of the GB Transmission System which has caused an extensive loss of supplies. This entails isolated power stations being started individually and gradually being reconnected to each other in order to form an interconnected system again. In the UK system, the costs for black start capability for the year 2009/2010 was £14,49m.

5.6 Balance the position of energy suppliers

Demand Response applications can bring benefits relevant to balancing the trading positions of suppliers and service providers. Improved balancing enables more attractive commercial offers to be made and for the savings in the commercial costs of managing risk, to be shared with consumers.

The benefits of reducing risk, in both trading and balancing positions and the creation of a range of new products from suppliers, linked to new brokering deals from the wholesale market, can be expected to create attractive opportunities for established and new commercial players. These could interact favourably with other products and services offered for gas and heat. Product differentiation would enhance competition, and suppliers could increase their competitive capability to grow and maintain both profitability and market share. Furthermore, it could enable the greater engagement of small suppliers.

5.7 Reduce the need for new build of large power plants

Combined with improving network flexibility, Demand Response applications that shave peak loads and fill demand troughs can be seen to facilitate more efficient use of available generation capacity and so minimise the requirement for additional national generation capacity. This driver not only reduces the cost and amenity impact of new generation (and its transmission connections), but has the associated benefit of reduced emissions and savings from better utilisation of thermal capacity, including nuclear, and better utilisation of variable renewables such as wind power.

6 THE CHALLENGES OF DEMAND RESPONSE

The identified opportunities will not materialise of their own accord, in the sense that there are some issues and challenges which will need to be addressed in a co-ordinated manner in order to implement Demand Response on a national basis in Britain.

Firstly, there are issues concerning the GB market structure. Implementing demand response in the GB market will require "harmonising" the requirements of different stakeholders who may have conflicting objectives and drivers. Network companies and suppliers for example may have differing strategic aims or operational requirements (e.g. a request for increase in demand by a Supplier to absorb a surplus of wind energy whilst a network company is requesting a demand reduction to offset high network loading); Demand Response implementation will need to take into account these factors and create tailored answers for each sector. In this context, the development of technical and commercial standards will be crucial to ensure open systems and competitive opportunities.

Connected to the market structure, there are also challenges related to the coordination needed to implement new services smoothly and efficiently. Demand Response implementation will involve multiple stakeholders and policy makers and this will require a well defined and effective planning and resourcing approach, clarity and co-ordination will be of primary importance noting the several actors with different objectives.

Thirdly, where new technical and commercial services are involved, there is a need to avoid the risk of expensive and complex lock-ins for consumers to bespoke solutions. Open standards will enable greater consumer choice.

Moreover, the low carbon targets will increase the level of complexity across the sector, both technically and commercially.

Finally, consumers need to be persuaded to start playing a central role. Their willing engagement in the process will be a crucial goal to achieve. Failure by the sector to engage consumers is the ultimate ‘show-stopper’. Consumers will need to be assured in terms of data exchange security (avoiding any sense of being "watched and controlled") and, more in general, their data privacy will need to be one of the first issues to be addressed.

With such an important role for consumers, it is important to pay attention to wider social inclusion of these new technologies. Research indicates that new technologies can pose a threat for some significant groups of society; IT has become a no-go area for many people especially the older age group. This could threaten the commercial and technical viability of the demand response initiatives and those who are not engaged are likely to be financially disadvantaged.

Consumers will not only need to find the level of complexity acceptable and the added value to them attractive, but also be part of granting a wider 'licence to operate' by ensuring, for example, that no segments of society are left behind.

The multi-faceted aspects identified above reveal the complexity of the task; they also indicate that a solution will not be forthcoming as a simple market response alone. There is an evident need for a co-ordinated approach, involving all the stakeholders – yet working with the grain of the markets and the bringing out the benefits of a competitive environment.

7 SUMMARY AND NEXT STEPS

Demand Response is expected to bring benefits for cost, carbon, convenience and security to consumers in the future low carbon power sector. Timely action is a major challenge as all the stakeholders involved need to act with focus and some sense of urgency in view of the timescales and challenges involved.

The ENA and ERA have undertaken a number of joint workshops and developed a list of requirements that can be considered as the Key Tasks to transform the traditional power sector. These can be grouped under the following headings:

- Continuing and expanding the joint working between sectors
- Building societal acceptance for Demand Response
- Modifying the regulatory and commercial frameworks
- Designing and implementing processes and operational systems
- Establishing an energetic, structured project programme.

To achieve these objectives, the ENA and ERA identified the following enablers:

- Build on DECC/Ofgem/ENSG Vision and Roadmap publications and on supplier requirements to develop a *Demand Response implementation plan*
- Ensure the *national smart meter programme* recognises Demand Response developments
- Develop further the quantification of the business case for Demand Response
- Ensure that cyber security and data privacy are addressed in the plan
- Integrate with other *Low Carbon Transition* initiatives including Ofgem's Low carbon Networks Fund projects and the Joined-Cities Plan[7].
- Add impetus to the work programme through government and regulatory endorsement and facilitation.

The ENA and ERA will bring forward a project plan that includes *clear deliverables, indicators, timescales and reporting mechanisms and enables effective multi stakeholder participation*.

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7 http://www.energytechnologies.co.uk/Home/Technology-Programmes/Transport.aspx

The diagram that follows sets out a mapping of the engagement needed by the various principal stakeholders.

Table 1 DR Implementation map

This map indicates the dgree of engagement needed to achieve delivery of the seven DR benefits

HIGH	MEDIUM	LOW

Stakeholder group	1 *Retail Energy Deals*	2 *Household loading*	3 *DNO constraints*	4 *TNO constraints*	5 *SO services*	6 *Supplier Balancing*	7 *Less new generation build*
Network DNOs		HIGH	HIGH				
Network TNOs				HIGH			
Network SO					HIGH	HIGH	
Suppliers - existing	HIGH	LOW				HIGH	
Suppliers - new	HIGH	LOW				HIGH	
Consumers/Consumer groups	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	
Regulators/Government	MEDIUM		MEDIUM	MEDIUM			MEDIUM
Smart meters	HIGH						
Smart Meter communications and DCC	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	
Home Automation	HIGH						
Network connectivity parties	HIGH		HIGH	LOW			
Evs and EV charging							
DR operation/optimisation parties			HIGH	HIGH	HIGH	HIGH	

Final comment

Both The ENA and the ERA have a shared conviction of the value of Demand Response and are keen to quantify the business benefit and bring forward a work programme that will benefit consumers, industry players, export opportunities, and the government's sustainability objectives for society at large.

This is an exciting and ambitious prospect and one that forms a landmark in the evolution of Britain's electrical power system.

Comments on this report will be welcomed and should be emailed to:

Alan Claxton and Jason Brogden
at the ENA at the ERA

Alan.Claxton@energynetworks.org

Jason.Brogden@engage-consulting.co.uk