



Bringing Energy  
Together

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# Response to National Infrastructure Commission Call for Evidence 8 January 2016

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## Context and Summary

The Association for Decentralised Energy (ADE) welcomes the opportunity to respond to the energy infrastructure section of the National Infrastructure Commission's Call for Evidence.

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

Our members include industrial energy users which generate their own energy on-site, local authorities which operate their own local energy generation, in addition to energy service providers and demand response aggregators.

We welcome the Commission's focus on energy infrastructure, particularly its focus on ensuring that existing and future infrastructure are used as productively and efficiently as possible.

Infrastructure should be developed with a clear aim – to deliver the best consumer value in the transition to an affordable, secure and low carbon economy. To do so, there are two key principles that should apply to reviewing infrastructure policy and investment:

- We should control consumer costs by using existing infrastructure more effectively to deliver a better value and more secure energy system. There are major infrastructure opportunities to cut waste from the energy system that remain untapped.
- New energy infrastructure investments should be considered holistically, as part of the wider energy system. There are major interactions with potential conflicts and synergies between heat, power and transport. To ensure the best value for energy users, the synergies need to be understood and exploited and conflicts mitigated. This cannot be achieved with the current siloed approach to energy policy.

By addressing these two principles, the Government could move towards more productive, better value energy, low-carbon infrastructure, for consumers' benefits.

We see the six key opportunities to deliver on these principles.

### 1. **Control consumer costs by using existing infrastructure more effectively**

#### 1.1. **Support demand side response, including load shifting and local generation.**

Demand response enables users to take control of their energy and be rewarded for helping to maintain a stable energy system. Committee on Climate Change analysis identified nearly £7 billion of reduced infrastructure investment costs as a result of seizing demand side

response in a low carbon energy system. Current policy is failing to tap this value and fails to value avoided infrastructure investment almost entirely.

**1.2. Drive network productivity.** Analysis of DECC data reveals that UK power network efficiency has improved by only 2% since 1990. If UK transmission and distribution losses were equivalent to those in Germany<sup>1</sup>, the best in Europe, customers would save £605 million a year, the equivalent of £23 per household<sup>2</sup>. However, regulators' funding to cut network losses is small at only £6.4m a year over the next five years.<sup>3</sup>

**1.3. Retain and build on the key principle of 'cost reflectivity'.** The network charges applied to users and generators should reflect the costs they impose or reduce. As the energy system becomes more decentralised, is it vital we retain the value generators receive for not using the power transmission system, known as the Embedded Benefit.

## **2. Build new energy infrastructure to deliver best consumer value**

**2.1. Invest in heat infrastructure to capture wasted energy.** The UK power generation system wastes enough heat for every home in the UK. District heating networks in densely populated areas are an ideal way to collect waste heat and move it to the points of use. This cuts unnecessary energy waste, boosts security of supply and reduces emissions.

**2.2. Look to today's energy storage solutions.** Energy users want energy services (mobility, warmth, computing), not the energy itself. Energy storage solutions should focus on the services needed. Thermal storage is far less costly than power storage. Holistic analysis of system energy needs will ensure we build the right type of energy storage rather than being enthused with the latest technology.

**2.3. Bring energy production and use nearer together.** This cuts network losses and enables wasted heat from power generation to be captured. Combined heat and power is up to 90% efficient compared to 50% for normal power generation, but needs to be located near to points of demand, such as industry.

### **Heat network infrastructure**

The Infrastructure Commission has not addressed the potential for heat network infrastructure in its Call for Evidence, but we believe this offers a vital area for its future consideration.

Any time we make or use energy, we lose some of it as heat. Power stations, the industrial sector and cities like London all waste heat, and together they waste more heat than is used by every home in the UK. By building heat infrastructure, also known as district heating, in densely populated areas we can collect waste heat and move it to the points of use. It is by investing in this form of low carbon infrastructure that we can cut unnecessary waste from the energy system and reducing emissions at the same time.

Analysis by a number of research and Government bodies, including Stratego, the Energy Technologies Institute<sup>4</sup> and DECC<sup>5</sup>, show district heating is a key form of cost-effective network infrastructure as part of the low carbon network transition. DECC has identified a cost-effective potential for heat networks to meet 14% of UK heating demands by 2030, a seven-fold increase from today.

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<sup>1</sup> The World Bank data, based on the International Agency Statistics (OECD/IEA) 2012. Electric power transmission and distribution losses in Germany represent 4% of the electrical output, and it is 7.9% for the UK and 7.1% for Denmark

<sup>2</sup> Values each lost unit of electricity at the wholesale market price.

<sup>3</sup> Ofgem, 2015. *Losses Discretionary Reward Guidance Document*. - Change in response to March 2015 consultation.

<sup>4</sup> ETI, 2015. *Heat Insight – Decarbonising heat for UK homes*.

<sup>5</sup> DECC, 2012. *The future of heating: meeting the challenge*.

With the support of the Government's Heat Network Deployment Unit (HNDU), more than 150 local authorities are now investigating local heat infrastructure investments, with a value of more than £2 billion. These innovative schemes capture waste heat from power stations, industrial sites, and tube stations to make our energy system more productive and alleviate fuel poverty.

Government has now committed £300m to heat network development over the course of this Parliament. This investment is welcome and will help bring a number of schemes forward. However, a longer-term regulatory and market framework will be necessary if the UK's full heat infrastructure potential is to be reached.

Unlike gas and power networks, heat networks do not have an investment and regulatory framework underpinning them. The absence of such a framework excludes potential investors as the risks around district heating investment are considered to be significantly higher than for other network infrastructure projects. Government can take steps to reduce investment risk for this network infrastructure and secure larger, better-value schemes into development at low cost to taxpayers.

### **Bring energy production and use nearer together**

Currently 54% of the energy used to produce electricity is lost by the time it arrives at a UK home or business. This lost energy is worth £9.5 billion a year to the UK economy. Put another way, it is the equivalent of £354 per household. It also represents carbon emissions equivalent to every car in the UK.

Combined heat and power (CHP) is a form of energy production infrastructure which produces energy close to customers, providing them with both heat and electricity. By producing electricity closer to its demand, CHP cuts network losses. If half of current centralised thermal generation was instead directly connected at the distribution level near demand, the avoided transmission losses would save energy users £135 million annually<sup>6</sup>.

CHP also enables wasted heat from power generation to be captured and used by manufacturers, businesses and homes. CHP is up to 90% efficient compared to a maximum of 50% for normal power generation, but needs to be located near to points of demand, such as industry. The cost effective potential for CHP is more than three times the current capacity<sup>7</sup>, and the potential captured heat could be worth more than £2 billion a year<sup>8</sup>.

Currently the Capacity Market incentivises new power generation infrastructure that is largely inefficient and does not capture its heat. In the 2014 Capacity Market auction, nearly 2.6 GW of new generation included only 3 MW of new CHP capacity but about 800MW of gas and diesel engines which waste their heat. With limited new CHP capacity participating in the 2015 auction, results are not likely to differ significantly.

### **Responses to consultation questions**

#### ***1. What changes may need to be made to the electricity market to ensure that supply and demand are balanced, whilst minimising cost to consumers, over the long-term?***

If the UK is to be successful in cost-effectively balancing supply and demand, a transparent, accessible electricity market is essential, shifting away from subsidies to market-focussed measures. A more market-based approach would decrease political uncertainty and enable

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<sup>6</sup> See [lesswastemoregrowth.co.uk/report](http://lesswastemoregrowth.co.uk/report)

<sup>7</sup> Ricardo-AEA, 2013. Projections of CHP capacity and use to 2030. Report for DECC. Cost effective potential based on a discount rate of 15% over 10 years.

<sup>8</sup> See [lesswastemoregrowth.co.uk/report](http://lesswastemoregrowth.co.uk/report)

market participants to construct sensible economic models to justify new investment when the market deems it cost-effective to do so. However, any changes made to the electricity market must recognise the economic value of distributed generation and demand response in reducing system costs by reducing the necessity for costly network infrastructure.

Three key changes need to be made within the electricity market to ensure that supply and demand are balanced, while minimising cost to consumers, over the long term. These changes are to ensure that:

- Business energy users who provide demand side services can access and receive value from the wholesale and balancing markets.
- Demand response and on-site generation are treated fairly in a simplified, more user-focussed Capacity Market
- Balancing services are made more user-focussed, easy to navigate, and support the most cost-effective solutions, including generation, demand response and storage.
- Protect cost reflectivity for distributed generation and DSR in network charging

All three of these areas need to be addressed if the UK's full demand response potential is to be reached. Unfortunately, to date the UK's approach has been to address each of these three areas in silo. The DECC Energy Security team designs the Capacity Market, National Grid designs balancing services, while Ofgem and DECC design the wholesale and balancing market arrangements.

We see an opportunity for the National Infrastructure Commission to draw all three of these areas together into a comprehensive and cohesive policy to fully unlock the potential of distributed generation and demand response. We have outlined the key measures needed in each of these areas in further detail below.

### **Access to wholesale and balancing markets**

Currently distributed generators, energy demand users, and aggregators are not able to access either the balancing market or the wholesale market. This creates two barriers which limit demand side management.

The first barrier is that the dispatch of a customer's demand response by a third-party aggregator changes the supplier's balanced position, creating costs or benefits for the supplier depending on their position.

The second barrier is that demand side services can only receive value for the demand response in the wholesale market if the energy user or their aggregator have a contract with the customer's licensed supplier. This currently limits the growth of the demand response market and adds a significant transaction cost and barrier for demand response providers.

These issues are addressed in further detail on Page 7 in response to the question: *Is there a need to further reform the "balancing market" and which market participants are responsible for imbalances?*

### **Fair participation in the Capacity Market**

The Capacity Market was largely designed for large, centralised generators, and this has limited the competitiveness of distributed generation and demand response.

The Government's commitment to reform the Capacity Market to ensure it brings forward new gas power plants carries a significant risk that the reforms unintentionally damage both on-site generation and the growing UK demand response market.

It is important that the Capacity Market increases, not decreases, fair treatment across different technologies and approaches. This includes equal contract lengths between all Capacity Market participants, as currently new build generators can receive 15 year contracts while existing generators and demand response participants are limited to one year. This difference in contract lengths results in very different support levels for different capacity types, and results in uncompetitive outcomes.

The focus on new build generation may risk missing the already sizeable potential capacity from existing resources. For example, while 4 GW of CHP and autogeneration successfully cleared the Capacity Market in 2015, there is more than 7 GW of autogeneration capacity listed in the Digest of UK Energy Statistics. These figures indicate that more than 3 GW of existing generation did not participate in the Capacity Market. In addition, as addressed later in this consultation, the potential demand response market is several gigawatts. Therefore measures to facilitate the participation of existing generators and demand response are arguably just as important as measures to stimulate investment in the Government's preferred technologies.

### **Access and participation in balancing services**

There are a number of hurdles which can commonly arise and prevent demand response from providing the balancing services that are procured by National Grid. These include over-sizing minimum bids, requiring fixed quantities to be available for long periods, activations that are too frequent or have unnecessarily long maximum durations, and requirements for symmetric bids.

The launch of National Grid's Power Responsive campaign in 2015 was a positive step in bringing attention to how the System Operator can facilitate a cost-effective demand response market through its balancing services. Current work by National Grid to develop both a new Demand Turn Up service and a new demand response service are very welcome progress, especially as the only dedicated demand response balancing service currently available is the recently-introduced Demand Side Balancing Reserve, which is expected to end by 2018.

However, over the longer term there will be a need for National Grid to look at its suite of balancing services in the round and ensure they are simple, customer-led, and focussed on securing least cost services, whether from generation, demand response or storage. This will include considering whether the common barriers outlined above can be mitigated or removed across its balancing service offers.

### **Protecting the embedded benefit and the principle of network 'cost reflectivity'**

Key to keeping costs low for consumers is to ensure 'cost reflectivity' that is the prices charged to users and generators should reflect the costs they impose or reduce on the system. Without such signals there is a significant risk that overall costs for consumers will rise. There are two areas where cost reflectivity is a current issue:

As distributed generators do not use the transmission system, they do not pay for its use. This recognition is termed the 'Embedded Benefit' and allows generation to avoid the cost of Transmission Network Use of Systems (TNUoS) charges. National Grid reviewed the Embedded Benefit in 2013 and decided to retain the Embedded Benefit following a clear response from every major energy association that the proposals would make the energy system less cost-reflective and risked overall higher costs for consumers.

In those cases where increasing local generation causes electricity to 'spill upwards' onto the transmission networks, new infrastructure investment may be needed<sup>9</sup>. It is right for National

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<sup>9</sup> This is termed an 'exporting grid supply point (GSP)'

Grid to ensure cost reflectivity extends to this issue, but it must implement changes so they recognise the future more actively managed local network. As such it will be important for National Grid to consider the future distribution system in its consultation.

***What role can changes to the market framework play to incentivise this outcome:***

***Is there a need for an independent system operator (SO)? How could the incentives faced by the SO be set to minimise long-run balancing costs?***

We recognise there is a conflict of interest within the current arrangements, where the System Operator is also earning a return from investments in system assets. We would agree with the benefits of having an independent system operator to ensure consumers do not pay for unnecessary infrastructure investments.

However, we are unconvinced the creation of an independent system operator is the most urgent step at this time, with a number of other more vital changes to the UK electricity market and network arrangements. There is a substantial risk that the creation of an independent system operator distracts Government and regulators from making these important changes. We also think it important to recognise that the current balancing services offered by the System Operator are some of the only avenues available for most demand response providers to secure revenue for their services.

**The increasing management role for distribution networks**

Current energy security policy and operation is approached from a national, centralised perspective, rather than a local one. National Grid is not able to model overall the optimal investment in the electricity supply system, or the optimal location of generation. There are future cases where there could be a surplus of supply on one local area and its distribution network, while other areas have a shortage. The Capacity Market's focus on securing national electricity supply without regard to local demands exacerbates this issue.

As the energy system becomes more localised, with local generation meeting local demand, there will be more of a need for local network management solutions. Ofgem recognised this year that to achieve a more flexible, responsive system it will be important to see Distribution Network Operators transition become Distribution System Operators. Therefore either the Infrastructure Commission or an independent system operator would need to consider both the transmission network and the distribution networks, and an independent system operator at a national level must support innovation at the distribution network level to deliver more localised active management solutions.

Consideration should be given to the distribution network's planning standard, known as P2/6<sup>10</sup>. The Energy Networks Association is leading a revision of this planning standard<sup>11</sup> which will determine the approach distribution networks take to new infrastructure investments. It will be integral this review is ambitious in supporting and driving innovative solutions in distribution networks to reduce the cost of distribution infrastructure to consumers.

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<sup>10</sup> P2/6 defines the required levels of security of supply in terms of the time to restore supplies to customers affected by a circuit failure.

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<http://www.dcode.org.uk/assets/files/Working%20Groups/May%201%202015/DCRP%20P2%20WG%20Wider%20Stakeholder%20Engagement%20Workshop%20presentation%201%20May%202015%20FINAL%20FULL.pdf>

***Is there a need to further reform the "balancing market" and which market participants are responsible for imbalances?***

Yes. Under the current GB market framework the dispatch of a customer's demand side response by a third-party aggregator changes the supplier's balanced position, creating costs or benefits for the supplier depending on their position. Since the trigger for the change in balance position is based on external actions, the supplier should neither be penalised nor rewarded for the change in their position. The demand response action may also risk changing the supplier's energy position, where they purchased a certain amount of electricity for a half hour period which they now did not sell.

The solution to this problem is to allow for the settlement of the energy position between the aggregator and the licensed supplier. The aggregator would therefore buy the sourced, but not consumed, energy in the case of demand reduction. By doing so, the balancing position of the supplier will be corrected and the supplier will receive fair payment for their open energy position.

However, we would caution that just reforming the treatment of imbalances created by demand side actions is insufficient to secure increased demand response in the GB market.

The current electricity market arrangements do not allow direct access by energy customers to the market, and this issue is the critical barrier to the development of demand response. There are no provisions for a market participant who is not a supplier or a generator to participate in the balancing or wholesale market, and it will likely require a new category of participant to be defined with proportionate requirements.

Therefore, under current market arrangements, a customer or their demand response aggregator must have a contract with a supplier to access the wholesale market. This currently limits the growth of the demand response market and adds a significant transaction cost and barrier for demand response providers.

Energy suppliers can give customers the ability to provide generation and demand side services, but this approach requires a customer to both receive supply and provide demand response through one agent. This limits competition by preventing the customer from shopping around separately for the best, supply and demand response deals separately, even if it is more economic to have different agents for each service (purchasing supply and providing demand response).

The evidence from other energy markets shows that, for these services to be successful and lead to market growth, it must be possible for consumer flexibility to be unbundled from the sale of electricity: markets with mature levels of demand-response participation have all unbundled the purchase of demand-side flexibility from normal supply. In fact, the evidence indicates it is not possible to reach efficient levels of participation without doing so. The examples are the large US centralised markets, such as PJM, the Western Australian capacity market, and the New Zealand ancillary services markets.

***To what extent can demand-side management measures and embedded generation be used to increase the flexibility of the electricity system?***

The Association for Decentralised Energy is currently developing a bottom-up analysis of the potential for demand side measures and embedded generation to increase flexibility of the electricity system. We expect our analysis to be completed by March 2016.

It is important to note that there is already a significant amount of demand response and embedded generation in use in the UK contributing to flexibility. The Digest of UK Energy Statistics lists nearly 7 GW in autogeneration in 2014. Currently, there is currently estimated to be 1 GW of demand response in the Industrial and Commercial sectors (defined as an action to reduce a customer's metered consumption)<sup>12</sup>.

Almost all of this existing embedded generation and demand response is located in the industrial, commercial and public sectors. However, we still see a significant potential energy resource from these sectors. For example, there is a total of 30 GW<sup>13</sup> of industrial and commercial peak demand. Securing 10% of this demand, as occurs in other international markets such as Belgium and the US, would result in 3 GW in demand response capacity.

A 2014 Imperial College and Element Energy study for the Committee on Climate Change found that by deploying smart voltage regulation and demand-side response around on distribution networks, £5 billion of reinforcement costs to enable decarbonisation could be avoided. This is in addition to £300m in avoided transmission infrastructure costs. A September 2015 analysis of the UK's demand response potential produced for DECC showed that there is currently more than 18 GW of peak demand which could participate in demand response, given the right market and regulatory framework.

## **2. What are the barriers to the deployment of energy storage capacity?**

### ***Are there specific market failures/barriers that prevent investment in energy storage that are not faced by other 'balancing' technologies? How might these be overcome?***

We agree with the Commission's focus on the importance of energy storage, but would caution that a systems approach to new infrastructure can ensure that we are able to take advantage of synergies between heat and electricity, specifically in securing cost-effective energy storage. Fossil fuel systems, such as coal and gas, can store significant amounts of energy, and a move to a more renewable system will require that such existing energy storage to be secured in other ways.

Thermal stores are a large version of a household hot water tank, and heat is cost effective to store. Thermal stores can reduce the cost of balancing the electricity system, and heat network efficiency. These both cut consumers' bills. When the electricity grid is over-supplied (e.g. high wind and solar), instead of paying turbines to stop thermal stores can turn on electric boilers absorb the electricity and release it as heat when customers need it. When the electricity grid does not have enough power, a heat network or home can use highly-efficient combined heat and power to generate electricity and store the heat for when users need it.

Analysis by the UK Energy Research Centre (UKERC) found that heat networks supplying 100,000 heat customers with large-scale heat pumps could provide the equivalent of 8 GW battery storage. Their analysis also found that heat storage costs as low as £25/m<sup>3</sup>, which translates to the equivalent of £31/MW of electrical storage capacity<sup>14</sup>. European analysis has found that the price differential between gas and liquid storage; thermal storage; and electricity storage is

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<sup>12</sup> National Grid, Future Energy Scenarios 2015 and associated tables

<sup>13</sup> ADE analysis based on NG data for overall power demand in 2014 and peak power demand profile

<sup>14</sup> Eames, Phil, et al, November 2014. The Future Role of Thermal Energy Storage in the UK. UK Energy Research Centre.

1:100:10,000. This means that while thermal storage is 100 times more expensive than gas and liquid storage, thermal storage is also 100 times cheaper than electricity storage<sup>15</sup>.

Despite being available today, thermal storage struggles to participate in an electricity market designed for large, centralised generators. Such challenges are also faced by battery storage. The market failures and barriers faced by storage technology providers are similar to those faced by other distributed generators and demand response providers. These include:

- Limited ability to access and receive value from the wholesale and balancing markets.
- Difficulty accessing the Capacity Market due to complicated and unfair scheme design.
- Ensuring balancing services are customer-focussed, easy to navigate, and support the most cost-effective solutions, including generation, demand response and storage.

***What is the most appropriate scale for future energy storage technologies in the UK? (i.e. transmission network scale, the distributed network or the domestic scale.***

The determination for the most appropriate scale for energy storage technologies should be based on cost-effectiveness, allowing market solutions to come forward. This will likely result in a mix of solutions at the industrial and commercial scale, as well as at the network scale.

***3. What level of electricity interconnection is likely to be in the best interests of consumers?***

*Is there a case for building interconnection out to a greater capacity or more rapidly than the current 'cap and floor' regime would allow beyond 2020? If so, why do you think the current arrangements are not sufficient to incentivise this investment?*

*Are there specific market failures/barriers that prevent investment in electricity interconnection that are not faced by other 'balancing' technologies? How might these be overcome?*

The ADE has no comment.

***What can the UK learn from international best practice in terms of dealing with changes in energy technology when planning to balance supply and demand?***

Switzerland is the best case example of a European country on delivering cost-effective balancing of supply and demand. Demand response aggregators are 'Balance Service Providers' (BSP) and contract directly with the Swiss Transmission System Operator to access the market. The Neither aggregator as BSP or the supplier as a 'Balance Responsible Party' (BRP) are charged for imbalances caused by load curtailment, and any commercial loss to the BRP is reimbursed.

For further examples, we would recommend *Mapping Demand Response in Europe Today* by the Smart Energy Demand Coalition.

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<sup>15</sup> EU Heating and Cooling Strategy Consultation Forum Brussels, 9 September 2015, "[Issue Paper IV Linking heating and cooling with electricity](#)".