National Grid's response to the Smart Grid Forum Work Stream 2 Consultation on the Framework for the Evaluation of Smart Grids.

15th December 2011

Background to National Grid and its role within the UK Energy sector

National Grid owns and operates the high voltage electricity transmission system in England and Wales and, as National Electricity Transmission System Operator (NETSO); we operate the Scottish high voltage transmission system. National Grid also owns and operates the gas transmission system throughout Great Britain and through our low pressure gas distribution business we distribute gas in the heart of England to approximately eleven million businesses, schools and homes. In addition National Grid owns and operates substantial electricity and gas assets in the US, operating in the states of New England and New York.

In the UK, our primary duties under the Electricity and Gas Acts are to develop and maintain efficient networks and also facilitate competition in the generation and supply of electricity and the supply of gas. Our activities include the residual balancing in close to real time of the electricity and gas markets.

Through our subsidiaries, National Grid also owns and maintains around 18 million domestic and commercial meters, the electricity Interconnector between England and France, and a Liquid Natural Gas importation terminal at the Isle of Grain

Introduction

Please find enclosed National Grid's response to the consultation on the framework for the evaluation of smart grids. We are supportive of this work and its aim of helping inform some of the strategic decisions that may need to be made with regard to realising the value of smart grid capability within GB distribution networks and the deployment approach.

We have responded to this consultation on the basis that this is primarily focussed on distribution network investment in smart grid capability but in so doing it has highlighted the need for appropriate consideration of the value and costs that fall elsewhere in the supply chain and also where alternatives might exist across the whole energy system.

This is a challenging modelling task and care should be taken in articulating the assumptions made and the inevitable limitations of the model so that the results can be appropriately interpreted. For example, combined home EV charging and electrification of heat in 2050 is a key assumption that may not hold.

There are some overarching planning and design approach considerations across the energy system, as apposed to solely electricity, that are also value drivers to smart grids which are difficult to model but are nevertheless significant. This is particularly the case for the transitional period between now and the potential mass electrification of much of our heat and transport energy use. District heating, hybrid heat solutions and EV charging away from the home (e.g. a petrol station / fast charging type model) could maintain option flexibility and allow for a postponement, reduction in or more incremental approach to network / smart grid investment out to 2050. Assumptions for this are to a large extent driven by the scenarios presented by workstream 1 however it seems appropriate that when annual energy use is translated into energy profiles (and peak values) and the network impact is derived that there should be a feedback to acknowledge credible adjustments to the scenarios.

If you would like additional information on our response to this consultation response I would be pleased to discuss further.

Michael Edgar

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Section 2: Smart grid evaluation framework?

- Do you agree with our definition of smart grids?

We agree this definition captures the main elements of what is commonly viewed as a smart grid. We agree with the focus on functionality first prior to consideration of "smart" technologies.

- Have we captured the main complexities associated with assessing the costs and benefits of smart grids?

Yes

- Do you agree with our approach to dealing with these complexities, in the overall evaluation framework, in particular:

- We propose to take a two-stage decision tree approach, rather than relying on a conventional CBA framework. Does this constitute an appropriate approach, given the need to measure differences in the "option value" that different smart grid investment strategies provide?

Yes this seems an appropriate way of capturing the benefits of various pathway solutions and their "option value" to achieve lower carbon objectives and growth in renewables.

- We propose to use the year 2023 for the decision point in our decision tree analysis. We have chosen 2023 on the grounds that this is likely to coincide with the beginning of the first price control period after the completion of the smart-meter rollout and so is likely to be a natural point for the industry to take stock and adjust its smart grids strategy if necessary. "Do you agree that the year 2023 constitutes an appropriate "break point" in this regard?"

Yes this seems a sensible point to take stock, not only because of the price control period but also this represents a point from where consumer based low carbon technologies start to become more prevalent and the actual impacts will be observed.

Whilst we agree with this hiatus, some of the consultation content e.g. table 2 and table 1 focuses on technology prevalence at 2050 and appears to over look technologies that may be more prevalent in the transitional phase for heat and transport e.g. hybrid technologies (PHEV), CHP and heat pump / gas boiler combinations. This may, in combination with the drivers identified, lead to a more and less onerous set of scenarios.

Section 3: Value drivers and scenarios

- Do the technologies set out in Table 2 constitute a sensible list of value drivers?

Yes the list of value drivers is sensible. However there are some overall energy system design aspects that could reduce the value. These are described below in the answer to the question "Are there any other technologies that could have a significant impact on the value of smart grids? "

- Do you agree with our assessment of the technical characteristics of each?

Broadly agree

- Are there any other technologies that could have a significant impact on the value of smart grids?

The identified list represents the majority of value driving priorities for smart grids; however, the impact on the networks cannot solely be determined by the number of LCT units, but also consequential load changes and the overall design of the energy system.

With regard to electrification of heat and heat pumps, there will be a wide range of load caused by heat pumps depending on the size and type of housing they are installed into and whether supplemental heat (by resistive heating or gas) is required during cold periods.

CHP, Smart Energy Systems and EV Infrastructure

As well as the identified key drivers, overall energy system design for heat, transport and electricity will also have a bearing on the value of smart grids.

In the transitional period leading up to 2050, CHP in domestic and commercial applications could be used to mitigate peaks in demand and offer flexible resources to the electricity supply chain – CHP load profiles tend to behave in a network sympathetic way. Whilst this may not be prevalent in 2050 because of CO_2 emissions, this technology does offer options and deferred network investment opportunities which could be utilised as part of the transitional pathway to 2050. For example, Greater London Authority are encouraging CHP and district heating solutions as part of their lower carbon objectives. This leads on to the broader view of Smart Energy Systems, where hybrid technology solutions such as heat pump/ gas heating combinations matched to property types could present affordable options at the design stage for achieving carbon targets in 2020 to 2040 timescales and on to 2050.

With regard to EV charging; certainly for 2020, EV residential charging will be most common, however this may well be uncertain in 2050 as the electrical heating load becomes more prevalent. Heating load is inextricably linked with buildings, whereas EVs are inherently mobile and can alleviate domestic network loadings by changing the point of charging. Essentially, building a network for fast charging petrol station type model could be regarded as a Smart Energy System solution.

- Our analysis suggests that the most important factors to vary across the scenarios will be:

  - the pace of electrification of heat and transport;
  - the increase in distributed generation; and
  - the increase in intermittent and inflexible generation.

  Do you agree? Are there any other variables that we should look to vary across the scenarios?

Yes we agree. In addition, the level (MW) of Demand Side Response and willingness to respond to time of use tariffs will also be a factor.

Section 4: Smart grid and conventional investment strategies

- Out of the options presented, which set of assumptions should we make on smart meter functionality?

This is a key question to make a clear distinction between the DSR value that will be provided as a base case from the smart meter role out and the value that will emerge from further smart grid and communications investment.

Whilst this is a relevant question, the option that most closely corresponds to the current smart meter proposals (including smart meter functionality; Industry Draft Technical Specification as corrected and updated through the ENA on behalf of DNOs) seems an appropriate point from which to start. On this basis, Option 2 appears to be appropriate but it is not clear.

Which ever option is assumed, it is important to recognise the investment that will be required by transmission and distribution networks in harnessing smart grid capability presented through smart meter deployment. Due consideration should also be made on investments required to harness non smart meter based DSR.

The types of DSR identified are appropriate however the triggers appear to be based on pre fault conditions. If this is the case, consideration should be extended to include post fault action.

Communication latency

The assumptions of half hour latency are not consistent with the current SMIP assumptions. It seems most appropriate that the SMIP assumptions (latency range 30, 300 and 600 seconds as appropriate to the application) should represent the base point from which any analysis is undertaken.

As already noted, smart meter enabled DSR is an important consideration; however DSR from non smart metered customers should also be considered. Currently, this class of customer has proven to be the most suitable and available source of DSR across a range of timescales spanning seconds response timescales onwards.

- Do you agree with our proposed approach of including smart appliances in the business as usual?

In general, the approach of including smart appliances in the business as usual seems a credible assumption; however the critical driver is the emergence of TOU tariffs following the commencement of smart meter role out rather than the role out of smart meters themselves. The type of appliances identified are likely to be purchased on failure of equipment so the typical product lifecycles need to be taken into account.

As noted earlier within this response, DSR will also emerge from non smart meter consumers (industrial and commercial). Whilst this will not help with alleviating many suburban and urban constraints, it will alleviate DSR price pressures and therefore should be included.

Whilst we agree that smart home automation will elicit more reliable and sustained commitment to DSR, some account needs to be taken on manual driven off peak tariff decisions on discretionary load (e.g. washing machines).

On a more general point, smart appliances can be categorised into new and existing appliances. It is important to maximise the potential from existing appliances however the greatest opportunity for DSR will arise from new appliances and existing electric heating; for example electric vehicles and heat pumps. These appliances are typically high load, long operating cycles, (and therefore lower diversity in use), have apparent levels of storage and can be interrupted for relatively short durations without any appreciable loss of amenity.

From a network perspective, for new appliances and heating, most DSR benefit will be derived by limiting winter (or summer) peak conditions and so any approach to DSR should start from this axiom.

- Do our proposed smart grid strategies capture the main deployment options?

Broadly yes. In addition, there is a hybrid solution where enabling infrastructure (for example communications) could be deployed top down with the 'last mile' of delivery done on an incremental basis. This approach could maintain options without full commitment of costs ahead of need.

- Have we provided an accurate overview of the main services that smart grid technologies can provide?

Yes, in relation to DNOs.

- Do you agree with our proposed assumptions on the characteristics of these technologies?

Yes, in relation to DNOs.

Section 5: Value chain analysis

- Are there any other groups in society that we should consider in the value chain analysis?

None that are apparent.

- Do you agree with our conclusions regarding the distribution of costs and benefits?

Yes

- Do you agree with our proposed approach to assessing the costs and benefits for the transmission network?

We appreciate this analysis is focussed on distribution network investment in Smart Grids and that the value of this investment needs to reflect the benefits, costs and value that could fall elsewhere. The following comments are made recognising this focus and are intended to help establish representative transmission related cost drivers that could influence Distribution Network Smart Grid investment value.

As noted within our response to section 4, DSR is not a homogeneous product and could fall into a number of categories; a further distinction could be made between those that are energy related (i.e. MWhr / per half hour) and those that could be activated in post fault circumstances. The extent to which these services can compete or can be accessed separately will dictate whether the DSR value for distribution networks is set by the wholesale market and transmission, or can be set differently.

From a wholesale market and transmission asset perspective, benefits accrue from the potential use of DSR to minimise the maximum demand peak that generation and the transmission network needs to meet. The same can be true for Distribution Networks but there is a greater probability of local peaks occurring at non national peak periods and hence a tension in value. This benefit of minimising peak is slightly different to the cited benefit in section 5.2.2 of "flattening GB-wide demand". In a similar vein, Figure 13 should state the peak transmission flow with and without DSR rather than Smart Grid.

As a result of this alignment, the benefit of DSR to transmission network investment and generation could be approximated to an overall wholesale level. Which ever way Transmission peak capacity costs are modelled it is worth noting that the transmission load-related investments described within section 5 are primarily led by the connection of 25.5GW of generation in England and Wales to replace closing plant, rather than growth in demand (which, in our scenarios, is relatively flat out to 2020). There will also be Scottish Transmission investments. The replacement generation includes 18GW of renewable and low carbon generation, much of which is sited further away from demand centres, consequently much of the 60% of noted investment will not be affected by smart grid led DSR to reduce peak demand.

Tension however arises between the wholesale market and the TSO for the provision of Balancing Services within shorter timescales. Balancing Services such as Short Term Operating Reserve (STOR) are exclusive of services offered in the Balancing Mechanism and energy market. Typically this type of service is higher in value and therefore this aspect will need to be modelled separately.

For the purposes of this assessment, it is important to make distinctions between alignment of DSR and tensions across the supply chain. It is also important to clearly articulate assumptions, for example currently, we assume that DSR used for STOR is exclusive. This assumption could be challenged in the future as STOR and Distribution post fault DSR may well prove to be partially or wholly compatible.

Overall, it would be sensible to include Transmission related balancing services into the analysis as this is where tension will arise between the TSO, Suppliers and DNOs. Transmission asset avoidance could be aligned with peak generation capacity therefore a proxy could be made for the overall national DSR value that DNOs will potentially need to compete with.

Section 6: Proposed model specification

- How suitable is the proposed network modelling methodology which use representative networks, with headroom used to model when network investments should be made on feeders?

This is suitable to derive generic perspectives on the value of smart grids

- Are the voltage levels (from 132kV down to LV) being considered by the model appropriately, or should the model be limited to focus on any particular voltage levels?

This seems appropriate with an emphasis on greater detail for the LV network where low carbon technologies and diminishing diversity of load are likely to have the greatest impact.

- For each of the voltage levels we are considering, are the current methods sufficient to recognise available headroom and the cost of releasing additional headroom in these networks? If not, is the proposed approach considered to be too simple or overly complex?

The proposed approach should prove sufficient, but it is dependent on the development of a suitable number of representative network types. It is important to engage DNOs appropriately with this process.

- Is our approach to estimating the clustering of low-carbon technologies appropriate? Is any other evidence available in this area?

The proposed approach seems to be overly simplistic and does not adequately capture the different drivers for PV, EVs and Heat Pumps.

PV installations are driven by socio-economic factors and available roof space / orientation and local social housing policies;

Heat Pumps are likely to be driven by off gas (economy 7 resistive heating or oil) or new housing with adequate insulation; and

EV estimates are more complex but will include driving behaviour, daily mileage, and availability of charging points; most commentators believe EVs will have more urban applications.

- Are the proposed generation model assumptions (a simple stack of generator types, no technical dispatch constraints, half-hourly demand profiles for summer and winter, and representative wind profiles) suitable?

This is suitable to give a generic value of flexibility / Demand Side Response

- Should a simple representation of the interconnection be included in the model?

The proposed treatment of interconnection seems reasonable given the goals of the work to establish a value for flexibility / DSR available to the wholesale market. This is however based on the assumption that interconnector flows are based on today's market price differential drivers with low emphasis on shared reserve across Europe.

- Does the model represent demand side response appropriately?

It is worth noting that DSR will also be available from Industrial and Commercial customers who do not have smart meters installed. The assumptions regarding latency described in section 6.5.1 do not appear to recognise the services that larger customers can provide to DNOs and the TSO. E.g. DSR is provided today for frequency response and reserve services ranging from an automatic response time (seconds) to an instruction 20 minutes onwards. These tend to be infrequent services and therefore there may not be exposed to competition from Suppliers who are likely to seek more regular service call off.