Energy Networks Association – ENA

Response to ERGEG's Position Paper on Smart Grids

26 February 2010

Introduction

Energy Networks Association (ENA) is funded by the major licensed electricity and gas transmission and distribution companies in the UK. We welcome the opportunity to respond to ERGEG's consultation paper on smart grids. Smart grids have featured prominently in the discussions about the achievement of the 2020 targets but to date there has been little discussion about the changes to the current regulatory framework that may be necessary to support their development. The paper, in initiating a dialogue with stakeholders on the benefits that smart grids can bring to users and exploring ways in which the development of smart grids can be encouraged in a cost effective way, is therefore an important contribution to a debate the outcome of which will shape the development of the energy network industry for many years to come.

General Comments

We agree with the paper's analysis of the role of the regulators as key facilitators in the development of smart grids, identifying and removing potential barriers and encouraging appropriate innovation by the regulated network operators. Smart Grids are not ends in themselves and it is the task of regulators to encourage their development where it is cost effective and hence in the interest of customers and grid users, and the economic development of the networks. 'Smartness' needs to be delivered where it is required (and not where it is not) and the need for it should be considered alongside other energy policy objectives including security of supply, quality of supply and economic efficiency throughout the energy supply chain.

There can be no single European solution to the regulation of smart grids; differences in the nature and organisation of the electricity industries across countries mean that the best that ERGEG can do is to propose high level principles and guidance to assist national regulators. The task is further complicated by the 'unbundled' nature of the industries and the need to clarify, from the outset, the roles and responsibilities of the key players in the electricity supply chain – generators, suppliers/retailers, network companies, meter operators, ESCOs etc. This is especially important in view of the need, which ERGEG endorses, for network companies to actively engage more with these users of the networks and customers themselves to find 'optimum efficient solutions' (section 3.6.2).

In the paper ERGEG defines smart grids in a variety of ways. But its overarching definition seems to be on page 12 that 'a smart grid refers to a future grid that is needed for reaching efficiently the EU targets for the year 2020'. This leads to three problems.

First, from the UK perspective at least, the attempt to achieve the 2020 targets, will rely primarily on conventional means, i.e. large wind and nuclear connected to conventional transmission systems. The role of increasing grid smartness and innovation, at least at the distribution level, is likely to become more important after 2020, when distributed and micro generation are expected to become more widespread.

Secondly, the paper often defines 'smartness' in terms of effect, rather than in terms of the intrinsic characteristics of the network. Thus there are lists of requirements that grids will have to satisfy in order to create the brave new world but many of these are the sort of routine operations that any well-run (dumb or smart) grid would do such as provide speedy connections for new, particularly renewable generators. Indeed much of what is described is already a feature of the UK transmission system which suggests that the focus of the 'new' smartness should be at the distribution level. Similarly, it is unclear that there is a need for new 'smart' technologies in order to connect, e.g. off-shore wind, to the main transmission system (Page 20).

Thirdly, possibly because of the definition of smart grids in relation to achieving the 2020 targets, the paper also ‘strays’ into discussion of the internal market rather than smart grids per se when it refers to the desirability of boosting interconnection between member states.

ENA’s response to the questions for public consultation are contained in the attached Appendix.

APPENDIX

Questions for Public Consultation

Section 1 – Introduction

1. **Do you think that networks, transmission and distribution, are facing new challenges that will require significant innovation in the near future?**

Yes – especially with regard to growth in Electric Vehicles (EVs) and heat pumps and the need to support high levels of intermittent wind generation. Generation and demand will have to be more intelligently managed so as to limit the impact of new and very significant loads and power flows on transmission and distribution systems. Innovation will also be required in regard to the development of network diagnostics / self-healing networks as well as the integration of smart metering data into network management systems.

2. **Do you agree with ERGEG's understanding of smart grid?**

Section 1.2 discusses the increased complexity of a smart grid but omits the impact at the distribution system level of increasing electricity demand from digital appliances, heat pumps, air cooling and EVs. Furthermore, rather than simply recognise and accommodate changes in customers' behaviour, smart grids will also be expected to initiate / encourage changes to customer behaviour.

The effect on losses of smart grid development is not straightforward and it is unrealistic to assume that they will reduce in all cases. Smart grids will enable higher levels of network utilisation and higher load factors (by filling daily demand troughs) as EVs and heat pumps increasingly increase growth in electricity consumption. Hence losses will be higher than if we simply reinforced the networks. The smart grid objective will be to optimise losses as part of maximising the overall economic (and carbon footprint) performance of the network. This comment is also relevant to the definition of a smart grid in italics on page 12.

An additional feature that will add to the complexity is the integration of local energy storage.

Subject to the comments made above, the paper's description of what a smart grid will deliver is adequate but it would be helpful to also summarise some of the characteristics of a smart grid, for example:

a. Smart technologies to economically enhance the service quality, reliability, security and safety of the electricity supply system;
b. An enhanced information communications system to provide greater end-to-end visibility of the utilisation and condition of the network;
c. The economic connection of low/zero-carbon distributed generation and energy resources - from industrial/commercial to domestic scale;
d. Smart power flow, storage, voltage and fault level management strategies to permit the higher utilisation of distribution networks;
e. Smart management of flexible/responsive demand to improve load factor, minimise losses, and create additional capacity headroom;
f. Strategies to minimise the peak network loading impact of heat pumps and electric vehicles by leveraging embedded storage opportunities.

3. **Do you agree that objectives of reducing energy consumption impose the need for decoupling regulated companies profit from the volume of energy supplied? How can this be implemented?**

This assertion within the paper is too simplistic; it is not substantiated and seems to have limited relevance to issues of security of supply, de-carbonisation or competitiveness. In fact, de-carbonisation may lead to more electric consumption through heat pumps, EVs etc. which may or may not be offset by general energy efficiency improvements and peak load reductions.

In GB there is already no direct link between regulated distribution network owners' profits (or revenues) and volume of energy supplied – since, from April 2010, there will no longer a 'volume' driver in the companies' allowed revenues.

Section 2 – Drivers for smart grids

4. **Do you agree with the drivers that have been identified in the consultation document? If not, please offer your comments on the drivers including the additional ones.**

The list under 2.4 is incomplete: the additional (and key) drivers for GB are:

a. Load growth due to EVs and heat pumps (and air cooling) – and to some extent continued growth in digital appliances;
b. The need to maximise utilisation levels and load factors for distribution networks to avoid (or minimise) costly reinforcement;
c. The need to be able to provide adequate levels of short-term operating reserve, frequency response, etc. without undue recourse to spinning reserve from fossil fuelled plant;
d. To maximise the potential for smart distribution grids to contribute to system balancing, and other ancillary services, through intelligent manipulation of daily demand profiles and dispatch of distributed energy resources;
e. The need to integrate Distributed Energy Resources (DER), including DG and storage, into the design criteria for distribution networks – including embedded storage from EVs.
f. The potential need to adapt the network itself to climatic changes.

Section 3 – Smart grid opportunities and regulatory challenges

5. **Do you agree that a user-centric approach should be adopted when considering the deployment of smart grids?**

The deployment of smart grids should depend not only on the benefits that are expected to be achieved for users/customers but also for society as a whole in its requirement for a low carbon future.

6. How should energy suppliers and energy service companies act in the process of deploying smart grid solutions?

Energy Suppliers and ESCos have an opportunity to develop their portfolios in terms of:

a. home area network services (demand management);

b. more flexible tariffs that will incentivise customers to optimise the utilisation of the whole electricity supply chain as well as responding to local network constraints; and

c. demand-side management and generator dispatch contracts to both manage their balancing risk and market price volatility risk (i.e. with high levels of intermittent generation and the consequent limitations on accuracy of day-ahead and even 4-hour ahead forecasting accuracy).

7. Do you think that the current and future needs of network users have been properly identified in Section 3.3?

Broadly – yes. It should however be emphasised that only by deploying smart metering (and communication) systems, based on a comprehensive functional specification, will all of these benefits be delivered. AMM rather than AMR will need to be the basis of the metering system with unhindered access to, and interaction with, smart metering information by DSOs as well as Suppliers (but with adequate provisions for data privacy and security, and cyber security). Home area network services and smart appliances will also play a major role in helping residential customers to become effective ‘prosumers’.

Smart metering functionality to support smart grids should include:

a. Demand profile modelling at a level of super-granularity (i.e. down to individual LV network sections and spurs);

b. Voltage profile modelling at a similar level;

c. The early identification of ‘load creep’ and of potentially overloaded branches (for example LV branches likely to give rise to LV fuse operations during a cold snap);

d. Evaluation of capacity headroom to enable the effect of planned new connections or the impact of prospective demand augmentations to be assessed (e.g. heat pumps and EVs);

e. 4-quadrant metering enabling real/reactive import/export profiles and overall power factor to be individually monitored (essential with increasing levels of DG and non-linear loads - including CFLs);

f. The assessment of ‘latent’ demand due to ‘FIT’ generators (i.e. hidden demand that will present itself to the network with the DG disconnected – e.g. upon re-energisation of a network following an interruption);

g. Two-way communications to enable advance notifications of potential network constraints and arranged shutdowns, and to support meter status, alarm and alert functions;

h. Consumer appliance load switching (for example for ‘off peak’ or TOU controlled appliances);

i. Optional automatic cut-off to prevent excessive demand;

j. Mapping of smart meter data to the LV network (i.e. ‘network connectivity’ to enable upstream modelling of power flows);

k. Power quality data (i.e. voltage waveform distortions) – of increasing relevance with increasing levels of DG, heat pumps and EV charging systems;

l. Time-stamped interruption / restoration information enabling accurate assessment and reporting of Quality of Supply performance (and 'rogue circuit' identification);

m. Detection of serious under-voltage and dangerous over-voltage conditions (the former typically associated with unbalanced or overloaded networks, AVC malfunctions, and open circuit faults; the latter typically associated with 'lost' neutrals or AVC malfunctions) – including an optional automatic disconnection function to prevent damage to appliances;

n. Power outage detection (either through alarm signals or via meter polling) – of particular value in managing system emergencies with characteristic 'masked' downstream faults;

8. Do you think that the main future network challenges and possible solutions have been identified in Sections 3.4 and 3.5 respectively? If not, please provide details of additional challenges / solutions.

Losses (para 3.5.2) will not confer a significant carbon impact once electricity production becomes decarbonised. Moreover, for the reasons stated under 1.2 above an absolute reduction in losses is unrealistic; the smart grid objective will be to optimise losses as part of maximising the overall economic (and carbon footprint) performance of the network while supplying greatly increased demands due to heat pumps and electric vehicles. Networks help facilitate overall carbon reduction.

The list under 3.4 could legitimately include:

a. Planning for higher levels of DG at all voltage levels through HV/MV connected onshore wind farms, waste incineration, landfill gas, biogas, sewage gas, biomass, energy crop and CHP plants, down to MV/LV connected community energy schemes and micro-generation.

b. Planning for demand growth from heat pumps and electric vehicles by establishing load management policies which will include:

- Limiting demand taken at times of high network loading - initially through time-control of EV charging or, if necessary, real-time controls if volatile price signals promote perverse behaviour (e.g. negative energy prices);
- Encouraging optimum EV charging profiles by promoting intelligent systems (which for example take account of residual charge and anticipated duty);
- Encouraging the adoption of heat storage in conjunction with heat pumps (for example through lower connection charges reflecting avoided upstream reinforcement) which will permit time of day or real time controls of heating load;
- Monitoring of smart meter information to highlight emerging network loading or voltage issues.

c. Deploying new active network management technologies which will permit deeper penetrations of DG while avoiding the need for extensive network reinforcement, for example the selective application of:

- Enhanced automatic voltage control (AVC);
- Dynamic line ratings (recognising in particular the synergy between wind farm output and the effect of air cooling on overhead line conductor ratings);

- Active generator constraint systems to provide economically viable connections (recognising the relatively low likelihood of conflict arising from intermittent wind generation maximum export occurring during times of minimum demand);
- Inter-tripping to control fault currents to levels consistent with existing plant and equipment ratings in order to mitigate the impact of higher fault levels due to induction machines (motors and generators);
- Superconducting devices – including fault current limiters to permit higher levels of penetration of DG – particularly in urban areas where fault levels may already be approaching switchgear short-time ratings, and especially synchronous generators which will impact on circuit breaker fault-breaking as well as fault-making duty;
- Lower impedance distribution transformers with on-load tapchangers and higher speed LV protection (and/or) in-line voltage regulators to counter the voltage rise effects of DG on LV distributors;
- Power / reactive flow control through use of SVCs and phase-shifting transformers to control and optimise power flows on HV interconnected networks;
- Series compensation of long AC transmission systems to reduce reactive flows and increase real power capacity;
- Use of VSC technology-based DC systems to supplement existing AC transmission systems and, through multi-point applications, the economic connection of offshore wind farms to the transmission system;
- Storage / power electronic conversion technologies - including battery, super capacitor, superconducting magnetic energy storage (SMES), flywheel energy storage (FES), compressed air energy storage (CAES).
- Advanced / adaptive protection systems to accommodate higher levels of DG, maximising fault ride-through capability to maintain adequate system angular stability while ensuring reliable in-zone fault clearance;
- Self-healing networks (real-time network optimisation) using autonomous control systems which will respond, independently from the central SCADA system, to step changes in power flows, unplanned outages and active condition monitoring alarms - and redirect power flows as necessary to retain system integrity.

d. Contracting for demand-side services - to alleviate network constraints, in particular dispatch of responsive demand and standby generation including through:

- System ‘nodal’ distribution use-of-system price signals (i.e. prices set to reflect constraints and marginal reinforcement costs at specific network nodes – such as at a distribution substation);
- Direct control of demand, curtailment / constraining-on of generation, and dispatch of embedded storage;
- Bilateral demand management contracts (supported by appropriate communications systems as appropriate to the speed of response required).

e. Acting as Technical Aggregator - taking actions as necessary to maintain network efficiency and security, and manage network constraints, including:

- Optimising network configuration to minimise electrical losses (but please see our comments regarding optimising technical losses under 1.2 above);

- Maintaining plant and equipment loadings within thermal ratings, including appropriate application of continuous, emergency and dynamic ratings as appropriate (noting that as load factors improve, cyclic ratings might need to be reviewed);
- Maintaining network design security standards.
- Direct control of demand (i.e. through radio tele-switching or similar) as necessary (where Suppliers' tariff price signals may be insufficient or possibly in conflict with local network constraints).

f. Playing a leading role in enabling electric vehicles - facilitating trials and (potentially) financially 'pump-priming' a national electric vehicle charging infrastructure – recognising the generally lower cost of capital that is available to regulated businesses.

9. Do you expect smarter grid solutions to be essential and/or lower cost than conventional solutions in the next few years? Do you have any evidence that they already are? If so, please provide details.

As we have mentioned in our opening remarks the need for the widespread development of smart grids is unlikely over the next few years. However, during this time opportunity needs to be taken to conduct trials and deployments of smart grid solutions involving prototype (but not necessarily yet fully commercialised) technologies - while continuing to research and develop new technologies. This will result in incremental costs over and above investments using conventional technologies to address more immediate network reinforcement and asset replacement drivers.

However, while the costs of deploying smart grids have yet to be fully understood, studies have already shown that in the longer term smart grid solutions will have the ability to very significantly reduce the costs of supporting the expected growth in low carbon heat and transport alternatives, in particular heat pumps and electric vehicles.

10. Would you add to or change the regulatory challenges set out in Section 3.6?

ENA agrees that the key role of regulators is as facilitators to help the achievement of the objectives that are set whilst balancing the needs of all stakeholders. Priority given to each will depend on the objective itself – whether it is in terms of maximising user benefits or considering the benefits to society as a whole. In every case regulators will need to encourage companies to spend money on innovation and to take decisions that will be for the benefit not just of today's but also future customers and users. This may require a change in behaviour not just from the companies but also the regulators themselves. Innovation by its nature is risky and the optimal development of smart grids in a timely way will be very uncertain. Arrangements must be put in place that recognise this uncertainty by, for example, offering companies a higher rate of return in exchange for managing this extra risk and establishing clear ground rules for the treatment of assets that become stranded because of unexpected developments.

Section 4 – Priorities for Regulation

11. Do you agree that regulators should focus on outputs (i.e. benefits of smart grids) rather than inputs (i.e. the technical details)

We support the incentivising of outputs rather than inputs to achieve appropriate behaviour but many of the outputs listed on page 33 of the document are only loosely connected to actions by networks, e.g. share of electricity produced by renewable resources.

In the longer term concentration on outputs rather than inputs will be appropriate although care will need to be taken to ensure that this does not lead to an intrusive and complex regulatory framework involving a very large burden of data provision. Also the companies must have the ability to influence the outputs chosen if they are to be incentivised on this basis. In the short term the net impact of innovative (unproven) technological and commercial initiatives will be uncertain. Hence a complete focus on output measures with inadequate recognition of the risks associated with them would be inappropriate and might lead to risk-aversion. The consequence could be to delay innovation (please see also answer to question 13).

12. Which effects and benefits of smartness could be added to the list (1) – (7) presented in Section 4.1, Table 1? Which effects in this list are more significant to achieving EU targets? How can medium and long term benefits (e.g generation diversification and sustainability) be taken into account and measured in a future regulation?

Important additional benefits include:

a. Reduced market price volatility – through closer real-time matching of demand and intermittent renewable generation. Studies have indicated that unless demand can be much more closely matched to generation output in real time, high levels of intermittent (especially wind) generation will give rise to very high price spikes during low wind conditions and peak demand periods, and even negative prices during times of high wind output and low demand. Mitigated price volatility could therefore be an important performance indicator while, in terms of carbon benefit, closer real-time matching of demand and intermittent generation will also reduce dependency on fossil fuelled plant at times of peak demand;

b. Improved grid stability – by leveraging the benefits of flexible demand to provide short-term operating reserve and frequency response in order to cater for short term demand and especially generation forecast errors and unexpected losses of generation. Performance indicators would be reduced requirements for spinning reserve provided by fossil fuelled plant and hence reduced costs (and carbon costs) of system residual balancing;

c. Accommodation of significant growth in electricity demand as a result of policies to decarbonise (i.e. by electrification of) heat and transport while avoiding major investment in distribution and transmission systems. Smart grids will control the charging cycles of electric vehicles and heat pumps, leveraging the benefits of embedded storage (batteries and hot water storage respectively) to minimise the impact on daily peak electricity demands and hence the need for reinforcement. Performance indicators would include distribution network utilisation factors and load factors;

d. Intelligent voltage control to accommodate higher levels of DER, and electric vehicle and heat pumps demand, exploiting the acceptable voltage bandwidth of LV networks (based on appliance compatibility limits) to minimise network reinforcement. As with c above, the benefit would be avoided distribution network investment; performance indicators would include utilisation of voltage bandwidth and avoidance of voltage transgressions;

e. Smart distribution grids will be able to make an important contribution to residual balancing of the transmission system (especially with a largely islanded transmissions system such as GB). For example DSOs could provide balancing support as an ancillary service, controlling import (or export) levels at the transmission-distribution interface. As with b above, a performance indicator would be avoidance of spinning reserve provided by fossil fuelled plant and hence reduced costs of system residual balancing;

f. In planning timescales, smart, optimally utilised, distribution grids will support more granular charging regimes, potentially even nodal charging, to provide true cost-reflectivity of distribution grid constraints and capacity margins. Such price signals might also be used to support network investment decisions. In operational timescales, smart grids will enable more flexible price-reflective tariffs, such a multiple time-of-use (TOU) and critical peak pricing (CPP) – and even real-time dynamic pricing. A performance indicator would be effectiveness of locational cost-reflectivity (in terms of matching demand and/or DER growth to available network capacity).

13. Which output measures should be in place to incentivise the performance of network companies? Which performance indicators can easily be assessed and cleansed of grid external effects? Which are suitable for European level benchmarking and which others could suffer significant differences due to peculiar features of national/regional networks?

The performance indicators suggested in our response to question 12 above, and those included in Table 1 of section 4.1, should provide the basis of a future output measure regime. However, it is early days in the evolution of smart grids and if innovation is to be encouraged then it will be important to construct an interim output regime that rewards well managed research, development and deployment, and well-managed risk. Please see our response to question 14 below;

14. Do you think that network companies need to be incentivised to pursue innovative solutions? How and what output measures could be set to ensure that the network companies pursue innovative solutions/technologies?

Regulated companies are creatures of the regulatory framework in which they operate. It is recognised that traditional forms of price regulation have concentrated on incentives to reduce short term costs, particularly operating costs. The result has been large increases in operating efficiencies but also evidence that spending on R&D has reduced. In the future this emphasis will not be appropriate if the longer term EU and national energy policy objectives are to be achieved. Instead companies should be encouraged to consider longer term network solutions through new performance incentives.

A valid (and valuable) output of RD&D, and trials of innovative technologies and commercial instruments, is learning; this includes learning from failure. During the RD&D phases of the evolutionary path of innovative technologies and commercial instruments, it will be important to construct outputs that reward well managed projects. Projects should therefore clearly state their learning objectives - as well as costs and delivery timescales - to enable an objective ex-post review. Clarity about cost recovery will also be necessary if companies are to engage fully in this process.

15. Do you consider that existing standards or lack of standards represent a barrier to the deployment of smart grids?

Existing standards (including ICT standards) provide a valuable foundation for developing the necessary open ‘smart grid’ standards to ensure interoperability and integration (for example: ‘interoperability’ of smart meters, home area networks (HAN) and smart appliances; and ‘integration’ of smart meter data with network power flow data). Rather than developing new standards, the focus must be on identifying, and addressing, any barriers to interoperability and integration that existing standards might give rise to. This will be of particular importance in designing smart meter and communications systems – and ensuring smart grid compatibility.

16. Do you think that other barriers to deployment than those mentioned in this paper can be already identified?

It is important to understand that 'smart grids' have the potential to beneficially impact the whole of the physical electricity supply chain – from generation, transmission, distribution, metering, and including the home area network. In that context, the unbundling of the market, and the resulting number of market players makes it very difficult to ensure that optimisation is achieved throughout the supply chain. For example, with high levels of intermittent generation, system balancing will become significantly more complex (and risky) both in terms of trading positions and residual balancing risk.

Market players will quite reasonably seek to optimise their positions and minimise their individual risks. However, this might not always minimise the overall system risk and hence costs to customers. For example, the unilateral actions of a supplier, distributed generator, virtual power plant operator, or aggregator, might give rise to either transmission or distribution constraints. Conversely, unilateral actions by a DSO (for example dispatching demand reduction or storage) to balance the distribution network could affect suppliers' balancing positions. It will be important to review existing regulatory and commercial frameworks to minimise any adverse impacts of a fully liberalised market in terms of achieving a secure, affordable and low (and ultimately zero) carbon electricity system.

17. Do you believe new smart grid technologies could create cross subsidies between DSO and TSO network activities and other non-network activities?

The risk of cross-subsidy needs to be assessed in the round; in particular if an element of cross-subsidy results from smart grid actions and a more complex market, this might be an acceptable consequence of achieving the wider societal benefits of a secure, affordable and low carbon electricity system. Cost-reflective pricing across all elements of the electricity supply chain, including in real time where appropriate, should minimise cross subsidies. A controlled level of cross-subsidisation through socialisation of some costs (for example renewable generation and heat incentives) might be appropriate.

18. What do you consider to be the regulatory priorities for electricity networks in relation to meeting the 2020 targets?

Over the period to 2020, the regulatory priorities for electricity (transmission and distribution) networks should be to foster the transformation from the current grid system into one which is appropriate to meet future challenges and hence help achieve EU and national energy policy objectives. They should include:

a. A predictable and transparent regulatory framework allowing an appropriate return to companies to reflect the risks involved and to ensure adequate investment is forthcoming in a timely way.

b. A regulatory framework based on a business model that acknowledges all parts of the energy supply chain from generators to consumers and seeks to optimise societal benefits at minimum cost.

c. Providing effective incentives for innovation, in terms both of direct incentives (as discussed under 14 above) and regulatory returns that properly reflect higher levels of risk;

d. Recognising the workforce renewal and skills challenge, in terms both of replacing an aging workforce and the need to assimilate new technical and commercial skills;

e. Ensuring that unbundled markets do not create barriers to smart grids and the societal benefits they will deliver. For example, smart metering (including communications system) strategies must be fully compatible with the delivery of smart grid objectives, irrespective of the chosen ownership / roll-out model.

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