Summary of Smart Grids and Cleanpower 2010 by Dr J D Hayward 01223 303500

Foreword

This summary is based on comments made by speakers and sometimes other participants at the conference 24-25 June 2010. It may not everywhere be coherent, but each sentence should carry the weight of an expert opinion. Some statements may be contradict each other! All lines are to be taken in this context. We have tried to remove names of companies and obvious plugs for products or services, though the originators of some comments will be straightforward to deduce.

Conference summary

This is an interesting conference because a lot of people are talking about smart grids and this event considers the move from the slower world of utilities and energy to a pace of change like that in telecoms and internet: the energy efficiency play and how we understand and begin to focus more on the end consumer.

Smart grids defined: the blind and the elephant

The phrase smart grid is often not well understood among consumers, but even among industry players the idea is still nebulous. The smart grid involves flow of power or material in more complex ways than before, encompassing dispersed microgeneration and generation at levels above micro through to full power station scale. It also means charging structures and even disconnects that differ from past grids.

Smarter in the smart grid means being better at managing power generation and transmission.

Part of the picture involves the smart meter. Smart meters should be readable remotely, give pricing and consumption information, manage consumption, give fault details, to name some new capabilities.

Definition of the smart grid: a grid in which the usage and generation of all users is integrated intelligently to provide efficiently secure, economic, and low carbon electricity supplies.

The smart grid is the internet of energy. There will be dynamic ICT features. We need to be able to monitor energy usage in real time, and send information back to those who can increase or decrease supply, so that outages are avoided. This can't be done when you have a static grid and are not reading meters continuously and acting upon the forecast data intelligently.

There is crossover between smart grid and meters. We will be using more energy not less. Since the number of devices in the home has been and is forecast to continue to accelerate, the total energy consumption in the home is forecast to rise. The increase in energy

efficiency and lower energy consumption per new device doesn't appear to be able to keep the overall energy consumption from rising in any medium term projection.

We will need demand-side management (as well as demand response - see below). This will involve changing the load independently of the consumer. It may mean addressing millions of devices in a space of less than 5 minutes. This requires that the communications network can broadcast/multicast.

But smart grids are not just about smart meters, it is also about smart use of your networks and resources. Organisations need to meet power demand with less power generation. One can help them increase, for example, solar and wind integration features through a smart distribution management system, and in energy storage.

Smart grid market structure and market drivers

Who are the stakeholders in the smart grid market?

- Consumers;
- Governments;
- Utilities and vendors;
- Telecoms.

For governments the keys are security of supply, consumer cost and choice; and hitting CO2 reduction targets set.

For consumers rising bills, bill shock and environmental concerns. Consumers drive fantastic change through. The key ratio for them is cost of energy as a percentage of disposable income (basically). This is rising; what end users pay for electricity across industrial, domestic and others shows a sharp rise from 2003 onwards which has been tending to make the matter more politicised.
The consumer will become better informed, have more choice and become more motivated on cost and emissions. Smart metering means monitoring energy consumption and seeing how to cut bills; it also means accurate bill payments and avoiding visits to read meters; credits for sending back power to the grid from home generation, e.g. solar PV. Smart meters can be made the consumer's friend with good planning; there is a risk of increased complexity. There is a lot going on in the smart home over the next decade: online connectivity, smart appliances, smart meters, microgeneration, home energy storage, eVs. This has the potential to make the consumer's life better more convenient simpler and cheaper.

For utilities, commoditised business and ageing infrastructure; business model; customer loyalty and ARPU; smart meter expectations. Smart meters mean managing peak loads, dynamic monitoring, peak pricing, load forecasting improvements, billing accuracy, CO2 reduction demands met, providing a better service: in short an opportunity and a threat to their market share.
Consumers and utilities interact very little at present, and they broadly do not monitor or manage energy consumption. Through what we are discussing here, we will usher in the 'engaged consumer'.

For telecoms, agile players, finding the unique proposition, adding value and keeping customers, broadening customer relationships into new services.

Smart meters are the key to a single smart grid which has a dedicated spectrum and channels, according to Arqiva, DECC and others. Cost of digging up infrastructure of from GBP 750mn to GBP 20bn according to an Imperial College and ENA study quoted. What is the benefit of smart metering? From GBP 480mn to GBP 10bn.

The wireless network is not believed able to get inside houses and control meters, therefore a dedicated, secure and reliable infrastructure is recommended. A single team or group should look after the network. The network should be universal and the installation process needs to be very simple, avoiding repeat visits for maintenance and upgrade (over at least the life of the metering equipment to be installed.)

Smart grid business models, economics and value propositions

Business models for smart energy services can be segmented into walled garden and open models. The walled garden is secure and private but may require change of meter, may limit innovation and investment in it, and cause market distortion or slow roll-out. The open business model opens up the market, promotes competition and investment, but may have security and privacy issues. It may also not exclude walled garden models needed in some remaining areas.

Smart meters will drive the smart grid, but they are really just the beginning.

The suppliers of home energy management products and services can range from simple displays through to full home automation even when there is a lot of supplier pricing data to react to from the future, smart grid.
There will be energy services in homes that happen under the bonnet like engine management systems. The controls can switch between entertainment or savings modes! It still needs something in the home to give that information. How do you get the consumer to buy that equipment, just as they will pay for TVs etc? There may be a feeling that it should be free like Google.

Channel partners can help raise awareness: trusted brands.

The broadband market shot up when the telcos subsidised the GBP 40 connection fee and gave away the modems. The barriers were removed. In turn, the energy and metering market needs hardware subsidies, easy installs and service bundling.

Installation should be simple and done by the customer, and data should be available anywhere.

New companies need to be where the customer is - online and open.

Smart phones are a major opportunity. Apps are great because they mean suppliers can get

their DNA into a lot more places very quickly.

Coming from the telecoms gateway to the (smart) home, these companies, rather than trying to retail energy, could be exciting the customer with energy information about and control of their home, and thus increasing average revenue per user.

Value is where the information is, how data converts to useful info. Telling a consumer that changing the temperature to a given level on the washing machine would save a given amount of money.

We are in the early market stages: we need to know what is home energy management.

The market is going to change alot. It is going to get more complex for the customer. Time-of-use tariffs, grid microgeneration and feedback and FITs etc are part of this. The utilities can help with this complexity, as well as new entrants and partners.

Everything, anywhere is good: a given customer will want to transact in a given way. If we do not provide this then they may disconnect. What are my priorities therefore? We should be putting effort into understanding and engineering the routes to customers because that is where the value is.

We have multiple touchpoints through the buying cycle.

What we are talking about here is changing behaviour: the barriers to change are addressed in two ways: by product design and by services.

Segmentation tells us where the potential value is.

We're in this interesting shift from producer-efficient supply chains, which bring down cost, over to customer-effective demand networks, which is about value generation and management.

We optimise how we spend our money by segment, offer, channel, by buying cycle stage.

DECC says that major changes to the way power is generated, transmitted and consumed are taking place now. The real value is in understanding the consumer.

Background and recent history

What has focussed attention on change towards the smart grid?

- Poor customer service perceived - the super-complaint allowed.
- Concern about security of power supply.
- Pollution connected to global warming.
- We are not alone (Other EU nations similar problems).

Billing accuracy improvements would need smart metering, which could cost more, argued the suppliers. A benefit of this is improved energy efficiency. But a public information

campaign was thought to be cheaper than smart metering installations in achieving this. Still, the ball was rolling for smart meters.

The price shock in 2005 for gas did not alleviate by trading around the region as planned for (Russia-Ukraine issues; financial hedging issues). Prices went up by a factor of 5 and electricity went up as a result by a factor of 2.5. So the problem of energy security came to the fore. We need a much better and more flexible energy budget.

Surprisingly, of about 1000 TWh of electrical energy produced by the UK annually, about 60% is lost.

The grid includes the national as well as local area and private ones. Mean electricity consumption rate is about half a kW.

CHP, has been around for some time, and works well in terms of efficiency. Heat doesn't travel well and tends to work better on local scales. This fact may shape the grid in the future.

We hope to learn how to recognise good solutions as and when they become available.

Alarm bell of virtual power plants and virtual storage. This looks like the banking system in some ways!

The government-sponsored, powerful report from Nicholas Stern suggested strongly that the sooner you act on climate change and environmental degradation, the less it costs you (to do what you can to reduce human impact towards it). Is the energy supplier the right party to be helping us reduce energy use and emissions. But some of our bill is earmarked for reinvestment in work on greater efficiency and lower carbon economies.

We need a way forward that allows us all to participate in the planning. Without this there are greater risks of losing buy-in.

The keys to the smart grid are

- appropriate communications
- data security

. The three core aspects of the smart grid are

- improved performance
- new architecture
- new applications

to obtain the types of power transmission and distribution with smart metering needed.

Network storage is part of the solution.

What the smart grid equipment vendors are doing

A million smart meters deployed in USA with an investment of USD200 mn. (Ed. This implies an investment of $200 a smart meter).

Management of smart resources - smart crews. Logistics of installing many meters in short time. Software enables MRO and installation workforce to be smart and save 10-20% of costs while smoothing and destressing processes for users and workers.

We could upgrade infrastructure and layer new technology (internet) on it without compromising lifestyle.

Accurate billing and monitoring enables the supplier to save money.

The energy sector as having high growth in use of energy efficient electronic chips. Two-thirds of electrical power is currently wasted. Such chips can help reduce the energy loss section of increased energy demand and they are key to greening technology, especially in electricity. Efficiencies come from designs at the core, not just system level. Zero load should mean zero power.

$44 bn is spent on powering servers - energy efficiency in this, not just in direct smart grid tech is important.

Demand response

For demand response, you tell the customer what they are paying now and will be paying over the next hour or day or more for their power. Then, smart or any devices under watch, can be told to go on only when electricity is cheapest or cheaper.

On markets, an investment bank has said in 2009 that the Advanced Metering Infrastructure market will be worth $30bn by 2030, and that the demand response market will be worth $30 bn, and smart transmission and distribution will be worth $50bn. Today in 2010, all these areas put together are worth $20bn.

At either end of the transaction, the energy supplier will automatically send digital data to the consumer about pricing. The smart consumer will have programmed settings to act upon this information. The result will be the varied usage behaviour of the consumer. This is the theory! The sending of such data to the consumer may become mandatory in the coming years. In this scenario, the consumer can actually decide to reduce their own bill in various ways that could be automated, rather than by manually changing behaviours.

There is also the case where the supplier can actually dictate whether certain appliances can be used at certain times (hours of the day or night). This eventuality was actually not one of the original goals for the UK grid, but in any case, has been an area which energy-intensive industrial users have been familiar with for some time. This ability would also help the suppliers do forecasting, through tracking, iteration and intelligent-learning.

Further, the supplier would also be able to take automated prepayment or crucially, disconnect the consumer without their permission, on failure to pay. This latter obviously has political and social implications and will need more piloting and discussion.

Smart meters save energy by encouraging off-peak energy use, and by helping the consumer know which appliances use what amount of energy. Appliances will also be linked up.

There are fundamental drivers to the disconnect market: the smart grid depends on them.

Smart meter roll-out challenge

DECC will mandate a GBP 8bn roll-out of smart meters in all homes in the UK by 2020, starting late 2011.

Some early installment players are British Gas, npower and First Utility. These are set to reach several hundred thousand by the end of 2011.

In Holland, they tried to mandate the use of smart meters in the home and it failed. There was resistance and it was voted down. The plans must be trusted; the consumer must know what is going to happen with their data.

Funding for smart meters

Since 2001, private funding of $3.6 bn for smart meters. US stimulus of $3.4bn for smart grid initiatives. ENEL in Italy doing mass deployment now of smart meters. There are projects in the UK, France, Germany, Spain, Netherland; Taiwan, and to follow are: Brazil, China, India, Japan and the Philippines.

Getting new consumption off-grid through 'DC micronets'

We expect high loads to be monitored and controlled in the home. DC micronets will become common, taking 'offgrid' parts of new consumption, such as lighting and electronics. These DC micronets will also drastically reduce installation costs for microgeneration such as solar PV. An example of a partial offgrid solution, is the home-office, whose lighting, computing power and other electronics could be provided for by a small, inexpensive solar PV with DC micronet installation.

DC has the advantage of not needing an adaptor. These are the heavy, often hot blocks that are attached to the plug cable. They can use up an extra 50% of the power being consumed. DC fridges were cited as using about 15% of the energy of DC-AC fridges (standard ones). There is potential to expand DC systems to incorporate more appliances as more power is produced and or efficiencies improve.

The point was made that this should lead to persistent change, or in the jargon, the Return-To-Drawer period goes to infinity, the end of the product life. The controls and advice on smart meters and new systems should have content, be easy to understand, reprogramme

and should match lifestyle (have market focus).

Long-lasting batteries for energy storage could play a role in offgrid and or DC based solutions.

Standards for the smart grid

Are there too many or too few standards for the smart grid to meet? We need them to enable good markets and competition was contended. As of 2010 the telecoms and utilities worlds are not communicating very well in this area (and perhaps others).

As well as the Battle of the Gateways (to the home) there will be the Battle of the Standards which should enable not only the utilities to get a share of the market.

In the US, some 2000-3000 companies are involved in the smart grid at some level. Standards are essential. If not you have more complexity. This shift is already a complex problem. People want to sell equipment and services in all markets.

The energy suppliers have suggested that the internet is not reliable enough for some aspects of the smart grid. There is a huge gulf between electricity and telecoms service providers.

The EU M/411 smart metering mandate is to recommend interoperability standards on smart meters, so that the consumer can know what their consumption is, but to ensure that smart meters in different markets work to the same standards. The timescale is to set this by September 2011.

The machine-to-machine standards which would operate on a generic platform does not yet have the buy-in of the energy service providers.

There is a new ITU focus group on smart grids; trying to produce global standards, and identify the impact on standards development.

Displays

Analogue displays more important than digital ones. There are two kinds of displays - direct and indirect feedback. Push displays: simple, direct feedback, always on - like the clock on the wall. Pull displays: Indirect feedback - something has to pull you in to get that extra information to understand what is going on.

Try the so-what test on what info the display is giving you.

Field trials are expensive but important. Push displays looked at more than pull displays; nag factor of whether or not hitting targets. Backlights for displays important (being able to read them easily).

Top-down, the low-hanging fruit for macro government issues around energy and

emissions is energy efficiency in the home. How do we get there?

Smart appliances that, e.g., turn on automatically when the sun is shining for a home with PV will be ideal as the consumer doesn't have to think or even do.

If a consumer's consumption is trending much higher than usual at that time, then an alert and a suggestion as to what it might be, would be useful.

A simple dashboard that brings together all this for electricity, water and gas where used, is important: interoperability.

Big Retail and smart grids

A large retailer carbon footprint for its sphere of influence splits up into 3 contributory factors. The footprint of the supply chain is ten times that of the direct footprint. And the footprint of customers is ten times greater again than that of the supply chain, dwarfing the direct footprint. So the responsible thing to do is to work with customers on emissions and the environmental questions. It also helps with regulation and with energy security. And of course, it saves money. It is normal now for such a large retailer to state that it wants to lead in the transition to a low carbon economy. Achieving this has three parts. They could aim to reduce direct footprint by 50% by 2020; to reduce supply chain footprint by 30% in the same time and to help their customers reduce their footprint by 50% by 2020. (Ed. When we look at the relative importance in terms of emissions saved for these three areas, if the first, direct saving is worth 1 unit, then the supply chain aim is worth 6 units and the customer aim is worth 50 units. But putting one's own house in order probably makes much of the second aim happen and some of the third, if the company is outgoing enough about its efforts in stores and in marketing.) The overwhelming trend is that people / consumers are concerned about emissions and environment. Overcoming the price barrier for green is key; the example large retailer sold more energy saving light bulbs in a week than it had done in a whole year when the price was artificially reduced to a low level. The next barrier is information: carbon labelling can be important although this perhaps only speaks to the most engaged consumers as of now.

Meeting energy demand as a nation (or not…)

GBP 200bn needed in investment in energy infrastructure by 2020 for secure, affordable and sustainable supplies. About 20% of this is needed for new energy network infrastructure.

New network energy companies need to be focused on resource productivity to support the Ofgem core mandate.

About a fifth of the consumer's energy bill today is attributable to network costs.

The grid in its current form is now seen as not being fit for purpose.

'It is likely that the UK will need around 30-35GW of new electricity generation capacity over the next two decades and around two thirds of this capacity by 2020. This is because many

of our coal and most of our existing nuclear power stations are set to close. And energy demand will grow over time, despite increased energy efficiency, as the economy expands.' UK Government.

Renewables in 2010 produce 5% of capacity and apart from tidal, which is a fraction of renewables, this does not replace base load anyway.

There is a disconnect between the capacity deficit, opening up to over 20GW in the late 20-teens and continuing to grow to over 40GW by 2024, and the statements of government confidence that all will be covered.

If you have planning permissions and funding etc for new nuclear, it would take somewhere between 5 and 10 years, but 10 years is safer, to bring significant power on stream.

We heard that EOn is planning new nuclear to be begun now for production start around 2017: 7 years.

If we got out of coal completely, it would be made up by China and India in 6 months, through their usage increases.

The government suggests we shall build 3000 windmills in the North Sea by 2020, which corresponds to one every day until 2020. But current installation rate is 1 every 22 days.

In the home, emissions fell by 4% between 1990 and 2005, despite home numbers and home electronics increasing their contribution to emissions by 12%. Targets are for a 20% reduction by 2020. But where is the evidence of increased effort in this direction?

The speaker suggested that keeping the power on nationally is a higher priority than climate change targets.

We can't wait for CCS to be installed on new coal stations; the technology is not ready at scale yet. Fusion experts at JET have said that there is no chance of a contribution from fusion before 2050.

Demand reduction across all sectors for 2050 targets will be essential.

Turning the theoretical emissions reduction targets into reality will require more than political will: it will require nothing short of the biggest peacetime programme of change ever seen in the UK.

This is a fairly bleak picture; in 2018 when we run into large scale brown-outs, it will have been the practical engineers, not the theoretical physicists, who will have to admit they were too quiet in the period before that time.

All the more reason to push forward strongly with consumer engagement at all levels, smart grids, smart homes, energy efficiency, and clean power.