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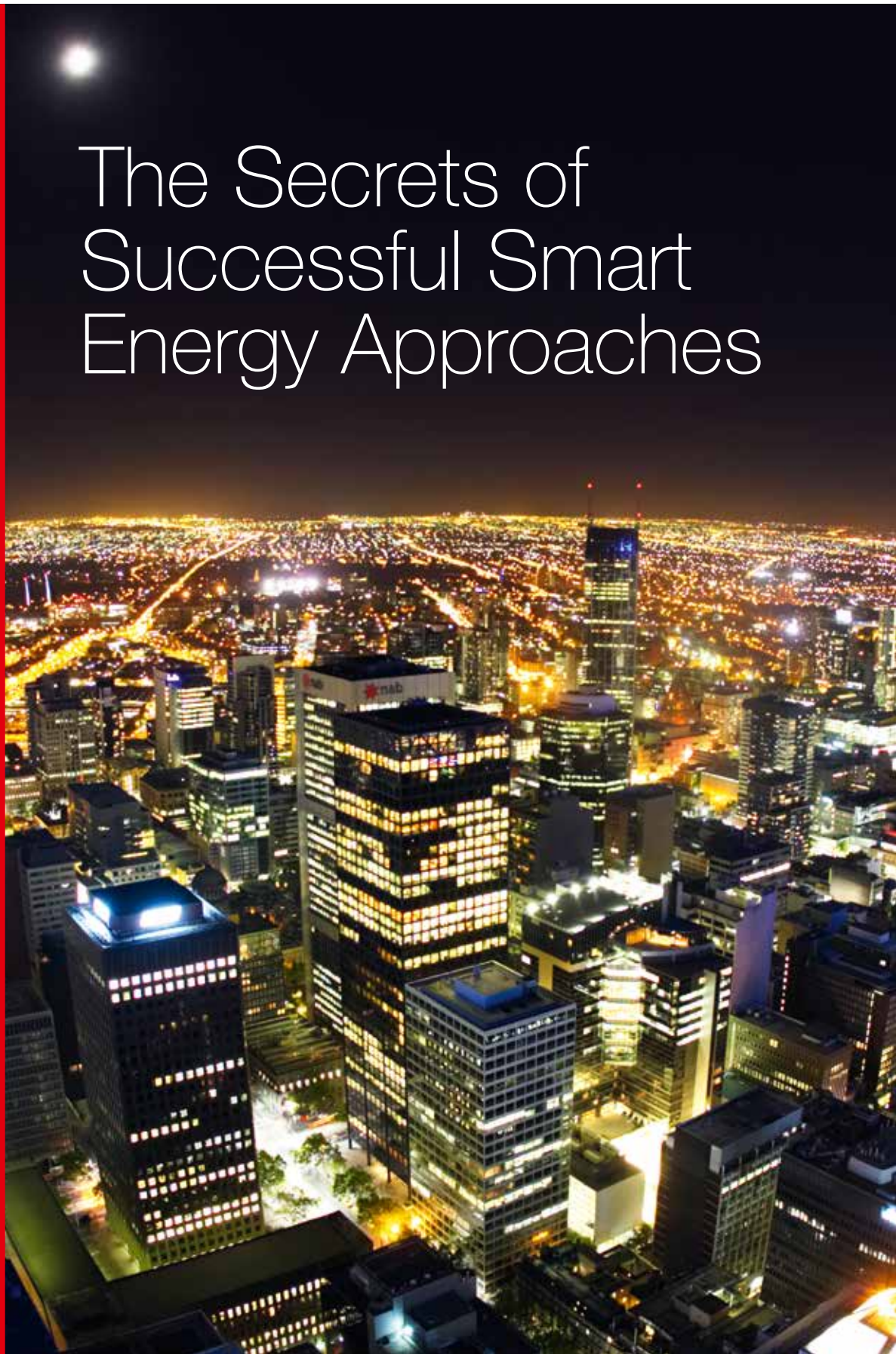
EUROPEAN ENERGY REVIEW

Special Report #1

The Secrets of Successful Smart Energy Approaches



Explaining the secrets of success
Exclusive interviews with the world's foremost experts

Which approaches work and why
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In-depth policy overview
The drivers, the changes, the chances – where smart energy is headed in Europe

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EUROPEAN ENERGY REVIEW

A revolution from above

The transition to a smart and green energy future that the EU is hoping to make over the next decades is certainly revolutionary. It represents a radical change in the way we produce, transport, distribute and consume energy. And since our energy system is fundamental to our entire economy and society, it represents a radical change in our way of life.

That's fine of course. Radical changes are sometimes needed. There is just one little problem here. This transition is very much a revolution from above.

Not that businesses, households, researchers, NGO's, and so on, are not involved. They certainly are. But first and foremost the smart energy transition is driven by policies and policymakers. No one can be certain that, if policymakers weren't driving this, it would happen spontaneously, or in the same way. Indeed it is very well possible that without policies there would *be* no transition.

This does not mean that the smart energy transformation is wrong or doomed to failure. One could well argue that governments are doing what is right and necessary to make this change happen. What it does mean, though, is that it is a tricky and complex matter. Nothing in this process can be taken for granted. Policies can be reversed. Regulations can be changed at a moment's notice. Rules can be bent to serve vested interests. Financing can evaporate. Incentives can get screwed up.

To some people, all this makes the transition an exciting adventure. Others may prefer less rocky roads to the future. But regardless of what we may wish for, until and unless our political leaders change course, everyone in and around the energy sector has to deal with the changes implied by the smart/green transition.

In this special report, *The Secrets of Successful Smart Energy Approaches*, we have tried to provide, to the best of our ability, an overview of how smart energy policies are currently working out and how they may be expected to influence the energy field as they create opportunities and throw up obstacles for market players. At the same time, we have tried to show how businesses are positioning themselves in this complex field, exploring new methods of producing and distributing energy, measuring energy use, and finding ways to save energy. We have done so, as always, with a critical eye and from an independent perspective.

We hope you will find the result useful, or better still, inspiring. Needless to say, if you have any questions or comments, please do not hesitate to contact us.

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The drivers, the changes, the chances

EER correspondents Sonja van Renssen and Hughes Belin spent many days talking intensively with stakeholders in Brussels. They put together an overview of where smart energy is (and is not) headed in Europe. They discuss: the drivers – especially the policymakers themselves. The changes – in the product energy. And the chances – which come from unexpected places.

| *by Sonja van Renssen and Hughes Belin*

What came first in Europe: smart meters and grids or the policy framework to regulate them? It's a bit of a chicken-and-egg story. There are many "smart" drivers, such as:

- the general trend of decentrali sation (meaning more wind and solar in the power sector)
- the global trend towards a gree ner society (and rising energy prices)
- new applications such as electric vehicles and heating
- the growing sophistication of information and communica tion tools
- plus, let's not forget the so-called 'empowerment of customers' who are supposed to make more decisions than ever before in their lives.

These trends have certainly had an influence, but EU law, notably through its energy and climate goals as well as its energy market li-beralisation, was probably the cata-lyst for industry to mobilise "smart technologies" a few years ago.

EU member states have set three goals for 2020: a 20% cut in CO_2 emis-sions compared to 1990 levels, 20% renewables in the EU energy mix and 20% energy savings compared to energy demand projections. The three goals are interlinked and "the

EU targets on renewables and energy efficiency require a thorough modernisation of energy networks", according to Jean-Arnold Vinois, acting Director for Internal Market at the European Commission. There is unanimous consensus on this across the energy value chain, from regulators to network operators.

Challenge of renewables

As renewable energy sources are connected to the grid, this poses a challenge to transmission system operators (TSOs). In addition, many distributed generation units, mainly fed by renewable energy sources such as photovoltaic power and cogeneration are being integrated into distribution networks. Distribution system operators (DSOs) therefore also face the challenge of integrating renewables into their grids.

But traditional systems are not designed to operate with such variable resources. With renewables to increase on average from some 12% to 20% of the energy mix by 2020, they will increasingly destabilise the power system. Grid operators need real-time information about consumption and weather in order to better anticipate demand and plan the integration of the renewables. "Right now, from the substation to the point of consumption, the network is blind", says John Harris, Vice President and Head of Governmental Affairs for Europe at smart meter maker Landis+Gyr. "Most DSOs know there's a power outage because people call up and say there's no electricity."

SAP has launched a new technology that enables it to read ten million meters in less than half a second

This is where smart meters and grids come in: to get an insight into this last mile. Smart meters will enable two things: 1) operational optimisation and 2) better investment decisions. If you know the consumption patterns in two villages, in one of which capacity is tight, you might decide that an interconnector between them makes more sense than grid reinforcements in the first.

Efficiency as a driver

Energy efficiency is a second powerful driver for smart grids because it enables optimal grid management and lower network losses. "Smart means managing the network at lower cost than traditional network expansion methods i.e. business as usual," explains Gunnar Lorenz, Head of Networks at Eurelectric, the European power industry association. "Energy is not a commodity anymore. We need to optimise it," says Maher Chebbo, Vice President of Utilities and Communication Industries for Europe, Middle East and Africa at software giant SAP.

It wasn't always like this. In Italy, one of the first EU countries to see widespread deployment of smart meters, energy giant Enel took the initiative, not to save energy, but to ensure consumers actually paid for it. In Sweden, another smart meter forerunner, the parliament imposed monthly billing based on actual energy use rather than estimates. Instead of sending round a meter reader to every household every month, the energy industry turned to a technical solution that was more cost-effective: smart meters. "[Today] Sweden is trying to find out how to upgrade its metering so it can help people save energy," says Jessica Stromback, Executive Director of the Smart Energy Demand Coalition (SEDC), a lobby group that promotes demand side programmes in Brussels.

Consumers are facing a huge change. For the first time, they will be able to follow their actual electricity consumption. "This provides them with strong incentives for energy saving," says the European Commission. It estimates that consumers with smart meters installed can reduce their annual energy consumption by around 10%. And the Commission quotes some pilot projects suggesting savings can be even higher: up to 40% in the UK-based AlertMe project which allows customers to turn off appliances by web interface or mobile.

Yet technology enthusiast Ray Pinto, Senior Government Affairs Manager at Microsoft Europe, warns that it's not all as easy as it looks. Microsoft, he says, invented an algorithm enabling people to calculate their energy usage. But pick up rates were low. "It all sounded great," he says. "But what we began to realise is it's only so interesting to see your energy. People care about their energy usage and its cost, but what they care about more is their comfort." It's when a technology makes life easier that it really takes off, he believes – think of downloading music – that wasn't done to save the planet and yet it contributes. The smart meter is necessary but insufficient to deliver energy savings.

Consumer engagement |

The EU recently finalised its most ambitious ever energy efficiency directive. This includes a chapter on smart metering. In the Commission's original proposal, this set out fresh provisions on consumer information provision. But most of these were thrown out by member states during the negotiations. "It's a missed opportunity," says Harris from Landis+Gyr. According to Gérard Magnin, Executive Director of Energy Cities, a European association of local energy agencies, all information today resides with the DSO, and there is little appetite to change that.

But the new EU energy efficiency directive does introduce for the first time a regulatory framework for 'demand response'. 'Demand response' and 'dynamic' or 'time-of-use' pricing for electricity allow customers to buy electricity at constantly changing prices. It therefore helps cut demand at peak times and results in less need for peak capacity. Companies like EDF are interested because they have a close relationship with their customers and specialise in nuclear – a baseload, not peakload, source.

> *Public money isn't the driver in first instance*

Smart meters can lower the cost of demand response. And demand response, in return, helps pay for the smart meters, says Stromback from SEDC. She estimates that industrial and commercial demand response could net companies some €2bn a year in direct earnings. "If you charge consumers for technology and you don't enable them to benefit from it you just rip them off. Programme development, be it demand response, feedback, smart bills or however it ends up being, is what makes it worthwhile to European citizens to have this done."

Patricia de Suzzoni, Advisor to the Chair of French energy regulator CRE and Chairperson of CEER's Customer and Retail Markets Working Group, is concerned that new massive demand response programmes have not been rolled out in great numbers. "There are many market actors ready to implement demand response programmes," she says, but the EU has to set a framework for retail market data management, including the formats and interfaces for energy service companies (suppliers, distributors, aggregators etc) to interact in a safe and secure manner.

Potential participants are fine with this idea as long as they are involved in shaping the framework, says Dusan Jakovljevic, Policy Director at Energy Efficiency in Industrial Processes (EEIP), a lobby group representing European industries. Demand response is on their radar and he envisages a two-way process that will optimise how and when energy is used. "It is unfortunate that the current draft network code [into which demand response is being integrated] seems to plan for our cooperation with TSOs only 'when necessary' and only reflects their immediate priorities," Jakovljevic warns.

Applications of the future |

Telecoms and data management companies are a strong driver of the "smart" movement because they see huge business opportunities thanks to the number and quality of data gathered

through smart meters. Software giant SAP has launched a new technology that enables it to read ten million meters in less than half a second – the possibilities for new customer services are endless.

According to the European Commission, electric vehicles are also a driver for smart grids. Today the network would not be capable of loading a large number of cars over short periods during the day. Smart grids would make this possible by optimising charging and lowering prices. "Charging systems will be able to cope with the demand only if there is an intelligent and balanced management of the system," the Commission notes. But few industrial stakeholders talk about electric vehicles as a key driver.

None of the above – with the exception of demand response for industrial and commercial consumers, which has its own business case – would be possible if Europe's 3rd energy market liberalisation package had not set up the first hard legal provision for rolling out smart meters. Australia is the only other country in the world to have done this. Under EU law, at least 80% of consumers in the EU have to be equipped with smart meters by 2020. Member states may carry out a cost benefit analysis if they wish, but are not required to do so.

This is the basic piece of legislation for all discussion in Brussels on rolling out smart meters and grids. Lawmakers added this provision on the grounds that consumers should participate in the

Common functional requirements of smart meters

Based on 11 cost-benefit analyses of smart meter roll-outs received from member states by October 2011, the European Commission's DGs Energy and Connect have drawn up a list of minimum functionalities for smart meters. There are ten and they are backed by regulators. The Commission hopes the remaining member states have used them in any other cost-benefit analyses submitted by 3 September.

For the Customer:

- Provides readings from the meter to the customer and to equipment that he may have installed;
- Updates these readings frequently enough to allow the information to be used to achieve energy savings;

For the Meter Operator:

- Allows remote reading of meter registers by the Meter Operator;
- Provides two-way communication between the meter and external networks for maintenance and control of the meter;
- Allows readings to be taken frequently enough to allow the information to be used for network planning.

For commercial aspects of energy supply:

- Supports advanced tariff systems;
- Allows remote ON/OFF control of the supply and/or flow or power limitation.

For security and privacy:

- Provides Secure Data Communications;
- Fraud prevention and detection.

To allow distributed generation:

- Provides Import / Export & Reactive Metering.

energy market and there should be more competition at the retail end. And of course consumers can only get involved if they have the means to know their consumption. It is thanks to this legal basis that the European Commission has been able to take action to boost the rolling out of smart grids and smart meters.

The Commission has created a central forum for discussion on smart grids and meters called the Smart Grids Task Force. It gathers all stakeholders (regulators, industry and consumers) except member states. When it was first launched in November 2009, it aimed to answer the question: "is the current regulatory framework sufficient to roll out smart meters and grids as envisaged by the third package?" The conclusion in mid-2011 was "No". The task force was re-launched in February 2012 to decide how to accelerate the process. It will run for two more years and is focused on four issues: standards, data protection and privacy, market models, and EU funding assistance. It's not a law-making body but issues recommendations that member states are encouraged to take up.

So far, the task force has issued a definition of the basic functionalities a smart meter should have (see box). Based on its work, the Commission has also issued a mandate for smart meter and smart grid standard development to European standardisation organisations and created an inventory of smart grid projects and lessons learned in the EU.
EU money

There is a consensus among stakeholders that no new legislation on smart meters and grids is needed at European level. "It's more about implementation now," says de Suzzoni. So what else can the EU do? Inject some more seed money into the sector, perhaps. The fourth working group of the Task Force is dealing with smart grids in the context of the so-called 'infrastructure package', or how the EU will boost the modernisation of its cross-border energy infrastructure.

Smart grids are one of the twelve priorities listed in the package. Some smart grid projects may therefore be labelled 'projects of common interest' (PCIs) and benefit from faster permitting rules and eligibility to apply for EU funds through a special mechanism proposed as part of the next EU multiannual budget (2014-2020). This is the Connecting Europe Facility (CEF), where €9.1bn is earmarked for energy.

To get the EU label and become eligible for EU financing, projects have to fulfil certain criteria. But for smart grids "these criteria are nonsense", Lorenz says. Like most EU-financed projects, smart grids must be cross-border and as a general principle replicable elsewhere. But other criteria insist they involve 10kV lines and bring together at least two TSOs and two DSOs – from different countries – something which on the ground is "very difficult for DSOs to do", Lorenz adds. The deadline for applications is set for September 30, 2012 but very few projects are expected to apply.

In fact, most smart grid projects will probably apply for EU money from the CEF's telecoms pot. This is similar in size to the energy pot but the only requirement is partnership with ICT, Lorenz says. "The aim is to foster synergies between energy and telecoms," explains Mercè Griera-i-Fisa, from the European Commission's Smart Cities and Sustainability Unit, DG Connect. After all, "the smart grid is a power network with a telecommunication network associated with it", she says.

But "public money isn't the driver in first instance", Harris from Landis+Gyr notes. Nor are demonstration projects – there are plenty of pilots supported by the European Electricity Grid Initiative (EEGI), an initiative of the Strategic Energy Technology Plan, that have served their purpose in showing that the technology works. What's needed now is getting it out there to consumers. If policymakers ultimately kicked off this revolution, it's up to policymakers to see it through. ■

People care about their energy usage and its cost, but what they care about more is their comfort

Photo: Thinkstock

Interview Jessica Stromback, Smart Energy Demand Coalition

'Progress has been significant. It's starting to add up'

Demand side programmes could net consumers in Europe €4 billion a year, yet they remain in their infancy. According to Jessica Stromback, Executive Director of the Smart Energy Demand Coalition, Europe is lagging behind, but she feels we have turned a corner. She notes that the new EU energy efficiency directive and the electricity network codes that are being prepared will give the smart energy market a boost.

by Sonja van Renssen and Hughes Belin

What exactly is a demand side programme?
Anything that requires participation on the part of consumers. A smart meter without a programme would be one that simply feeds back a meter reading to the energy company. It's when the metering company says 'how can we explain to Jessica what her consumption means', when there's a communication between the industry and the consumer that engages the consumer in some way, that it becomes a programme. Today most utilities don't even know if a meter is attached to a house or a business, never mind who's in the house.

What is the policy framework in place today for demand response in Europe?
Right now Europe is one of the least developed markets globally for its level of technology. For what we have the technical possibility to do, we should be doing all kinds of interesting things. There's no reason why industry and commercial buildings across the board shouldn't be trading in the energy market right now. They could trade and earn from their savings. Hotels could do it, office complexes could it. With our level of technology we should be up there with New York but we're actually competing neck on neck with Brazil, which is ridiculous. That's no one's fault, there's no finger to point. The market is very complicated and that's really held it back.

When you say complicated, do you mean fragmented?
Yes, it's fragmented. You have many small markets; you don't have a unified European market. That of course makes it complicated right away.

The other thing is that investment has gone into creating very strong interconnections between countries and markets, taking good care of networks and building lots and lots of generation. That's where

the focus has been. And the public backing has always been there for that in Europe. We really do a very good job, which is why we have such reliable electricity. It's not a bad thing; it's just that we haven't focused on seeing demand as a resource rather than something you just feed.

Why hasn't Europe seen demand in this light when other countries have?

The countries that have, haven't done it because they're better, they've done it because they haven't been able to keep up with their own consumption the way Europe's managed. Europe's done a good job of keeping up and so the drivers just haven't been there to say 'we're running out of electricity we have to make this effort'. In countries like the US, China and Australia this was a real issue.

> *Today most utilities don't even know if a meter is attached to a house or a business, never mind who's in the house*

So Europe's been a victim of its own success?

Yes, in a way. The other side of it is when we have been looking at enabling demand we've looked at the small consumer like residential consumers and excluded the larger ones. Of course it's very good to help households, I'm definitely not against that, but you can't ignore your biggest consumers. You should not look at it [saving energy] as a social good but as in 'how do we develop markets?', 'how do we develop a real business that people want to invest in?'.

Having said that, the steps forward that have been made in the last two years and this past year especially, really have been very significant. It's definitely a before and after stage.

What has been the big shift?

First, although smart metering has developed slowly, there is getting to be enough experience in the market that it's starting to add up. For example, when Sweden and Italy rolled out their smart meters, there was little idea there of saving energy. Now, that would be unheard of. Finland's rolling out its meters very much with the idea that these will help people save energy. The UK's doing the same thing. Sweden's trying to find out how to upgrade its metering so it can help people save energy.

The other thing that's happened is there's been a realisation that we need to look at this as a business. And that's been on the part of policymakers. So, for example, we at the SEDC came in and said, look, consumers are shut out of the energy market while there's billions of Euros spent every year on peak generation; if you made those billions available to consumers to be able to buy and sell savings on the market that would go directly into local economies. And it would fund the [demand response] programmes themselves.

The new energy efficiency directive has legislation in it that makes this possible. For the first time it sets the framework that consumers should be treated equally in the energy market and they should have equal access, as generators do, to buy and sell. That tackles one of the main regulatory challenges. Until now it hasn't even been legal to do demand response in over half of Europe.

Where do we go from here?

It's going to take a long time, that's obvious. One of the things that's also been very good though and that I think will speed things up, is that it just so happens that at the same time [as the energy efficiency directive was being negotiated] ENTSO-E [the European association of Transmission System Operators (TSOs)] was trying to create a unified set of [network] codes for Europe. Because demand response was already on the table when they got kicked off, they're putting it into the codes. That means that demand response is going straight from political document into regulatory code and that speeds it all up. It's the backside of all the politics, the realisation of the politics. If it's not in the network codes, it doesn't happen. Of course if ENTSO-E get these codes wrong (and they might) – they will put the markets back for years. This is why we are highly engaged in the consultation process there.

So is that it from Brussels or do you need other things to happen at European level?

Yes, we would need a couple of other big things to happen, to really make it work. One of them is how energy is priced. One of the issues – and this is not just for us but for the whole future of the market – is that right now electricity is priced in kilowatt hours. But as consumption fluctuates more and wind comes in, what becomes much more valuable is the ability to turn on turn off quickly and cleanly. It would be very beneficial to the market – and demand response programmes – if capacity and flexibility were priced and paid for.

Is this what we expect the European Commission's internal market communication in October to tackle?
That's the kind of thing we would hope they start to tackle next: how electricity is priced. We're starting to take part in these discussions on capacity and flexibility markets.

Also, after its current code work, ENTSO-E will move on to cross-border balancing market codes and that's what we're also looking to get into. You could use demand as a way of relieving congestion.

What's the potential of demand response?
For commercial and industrial demand response I would say the potential now is probably approximately €2 billion a year in direct revenues. That's over and above saved infrastructure. So the savings are actually much larger than that because you don't need [as many] power plants and network investments.

If you then include residential consumers and you include things like savings on infrastructure, you're looking at more, you're looking at anywhere between €4 and 5 billion.

There's a positive business case for it now and it's going to grow. Energy use is going up and so is the use of wind. Wind is very expensive to balance with power plants – it makes more sense to balance it partially through demand. The other thing is that Europe's infrastructure is ageing and over the next ten years there's huge investment needed there.

Where is demand response taking off in Europe?
In the UK, it's very much a business and it's growing. It's also starting in France, Germany and the Nordic countries. In total, the market is probably worth some €50-100 million today – and that's thanks to the UK. For markets ten years down the road, the US is the best example, even though it has a different market model.

And finally, what's the relationship between this business and the hardware, the actual meters and grids?
The relation is that this is how it's paid for. If you roll out the technology and you don't enable consumers to benefit from it you just rip them off. And programme development, be it demand response, feedback, smart bills or however it ends up being, is what makes it worthwhile to European citizens to have this done. The infrastructure needs to be rolled out in cooperation with the programmes.

You can roll out smart meters, but if dynamic pricing isn't legal, if those meters can't communicate into homes, if the retailer doesn't have access to the data, if prices are kept artificially low, whatever – and all of those are very real things that happen today in European markets – you will have those meters and they will do nothing. For consumers, at least. They'll still be good for the network companies. But almost all business models require the consumer to pay part of that metering! ■

> *It would be very beneficial to the market – and demand response programmes – if capacity and flexibility were priced and paid for*

Who is Jessica Stromback?

Jessica Stromback is Executive Director of the Smart Energy Demand Coalition, a not-for-profit industry group that promotes demand side programmes in Brussels. She is also Senior Partner at the Global Energy Think Tank VaasaETT.

Interview Christine Hertzog, Smart Grid Dictionary

'The Smart Grid is at the heart of a paradigm shift in the energy market'

We should not be over-optimistic about the willingness of households to get involved in smart energy solutions, says long-time Silicon Valley consultant and smart grid expert Christine Hertzog. Nevertheless, says Hertzog, the smart grid heralds a paradigm shift: "It enables a number of game-changing innovations: the integration of renewable energy generation, new methods of energy storage and the transformation of large and small consumers into (part) producers of energy."

I *by Karel Beckman*

Few people have thought more about the implications of the smart energy revolution than Christine Hertzog, who has worked as advisor to Smart Grid startups, established vendors, and utilities since she switched her focus as consultant from telecoms to Smart Grid in 2008. In 2009, she published the Smart Grid Dictionary, produced by a consulting and information services firm she runs called the Smart Grid Library. She is also the author of a leading and highly interesting (and independent) smart energy blog.

Hertzog has followed the developments in smart energy closely. She has thought long and hard about how the energy market is changing as a result of them and what the implications are for the various participants in the market. She notes that the changes taking place in the energy market are multidimensional. The introduction of "smartness" (IT) into the existing electrical system (grids and meters) is just one aspect. There are other "game-changing" developments taking place as well: the liberalisation of energy markets, changes in regulation, the drive for renewable energy production and other technological innovations, such as the advent of the electric car. These changes reinforce one another in various ways, leading to a "paradigm shift" in the energy market.

But it is the smart grid that in Hertzog's vision is sitting at the heart of this transformation. In the Smart Grid Dictionary she defines smart grid in a broad sense as: "A bi-directional electric and communications network that improves the reliability, security, and efficiency of the electric system for small- to large-scale generation, transmission, distribution, and storage. It includes software and hardware applications for dynamic, integrated, and interoperable optimization of electric system operations, maintenance, and planning; distributed energy resources interconnection and

integration; and feedback and controls at the consumer level."

The consequences of the development of this smart grid are momentous. As she summarizes them in a recent blog-post: "The smart grid aggregates a number of game-changing innovations to our existing electrical grid. It enables the integration of renewable energy generation, energy storage, and new consumer participation to create markets for kilowatt and negawatt sales. It can radically re-configure the value chain and put renewable generation at points of consumption. It can enhance and improve operational efficiencies and decision-making for electricity generation, transmission, distribution and consumption. The smart grid can become more reliable as well as resilient, improving annual uptime and measuring average downtime (outages) in minutes rather than hours. It can change our energy fuel mix so we can eliminate the massive transfers of capital to regimes that want to kill us and to corporations that poison our environment."

There is a trend forming for large commercial property management companies to use their vast holdings to produce or conserve energy

Prosumers

In a telephone interview with EER, Hertzog discusses some of these transformations in more detail. One of the most important changes taking place, she says, is that "consumers are evolving into what the famous futurologist Alvin Toffler called 'prosumers' (part producers, part consumers)." She adds that when we think of consumers, "we should not primarily think about households, but more importantly at this stage about commercial and industrial consumers."

For example, commercial property managers (e.g. owners of retail properties such as shopping malls or supermarket chains) are "rapidly educating themselves about how they can use their properties to participate in the energy market", Hertzog says. "There is a trend forming for large commercial property management companies to use their vast holdings to produce or conserve energy or to participate in demand response projects." One way to do this is through solar panels on the roofs of their properties, but there are other ways as well, e.g. by using lighting or cooling systems in demand response programs. Another example of this trend are data centers (think of Google, but also banks and financial institutions) who use fuel cells to generate part of their own electricity.

Hertzog also points out that commercial and industrial companies increasingly use vendors like ABB, Siemens and energy service providers to help them with their energy management. As a result of these partnerships, these formerly passive electricity consumers are also becoming active in various parts of the energy value chain.

What about households? Hertzog warns that we should not be too optimistic about the willingness of households to participate in smart energy solutions. "There is a small vanguard that is getting involved, but most people do not. I think that those of us who work in the energy sector on a daily basis, tend to lose sight of the fact that there are a great many people who only think about electricity when they pay their bill or when the power is off." She notes that "people have been spoiled. Grids have functioned well for decades."

Are they waiting for smart energy at all then? "They don't know what they are waiting for! As I have written in a recent blog post, from the typical consumer's perspective, the smart grid is all about smart meters. For most consumers, these meters aren't delivering new value to them NOW. It will be up to the industry to develop solutions that deliver added value."

This raises the question whether the smart energy transition could be accomplished purely as a top-down operation, without pro-active involvement from the consumer. But Hertzog does not believe that this is either wise or possible. "The consumers matter the most for smart grid initiatives", she says, "because they are voters, taxpayers, and ratepayers. And if we don't gain their support for grid modernization projects, we all lose in terms of economic and energy security."

Lifetime consumer value

Clearly the market participants most affected by the development of smart energy are the energy companies themselves. Hertzog advises utilities to think of consumers (large and small) in terms of the "lifetime consumer value" that they can offer to the company. She explains that this is a concept that is used in many other business sectors to provide a numeric value – usually monetary – of individual or consumer segment contributions to the business bottom line.

"For example, a retailer may determine that one category of consumers has a lifetime consumer value of $10,000, but another consumer segment who participate in a "frequent shopper" program have an average lifetime consumer value of $20,000. For utilities, consumers who participate in Energy Efficiency or Demand Response programs will have a lifetime consumer value that factors in the avoided costs of peak power plants or peak purchases. That provides a higher lifetime value to utilities than consumers who simply buy electricity. Consumers who are also prosumers will have a higher lifetime consumer value because of the positive impacts on the utility's resiliency and reliability metrics."

It may take some time, she says, but she is convinced that "smart utilities" will build "consumer-centric operations and programs to build the lifetime consumer value into their customer base by encouraging transitions from consumer to prosumer."

We tend to lose sight of the fact that there are a great many people who only think about electricity when they pay their bill or when the power is off

Those that don't will not only have to bear higher costs as a result of reduced operational efficiency, Hertzog says, "but they will also risk losing their customers to other suppliers or to alternative energy service providers who will become the trusted entity for electricity services."

Bigger perspective |

But the development of the smart grid not only affects market players. There is an important public interest at stake as well, says Hertzog, in two ways. The smart grid stimulates the 'greening' of our energy system, and it makes a crucial contribution to security of supply by enhancing the resiliency of the grid. This resiliency, she notes, "is important for individual people (how well do we survive challenges to the power supply), for cities (how quickly can urban environments rebound from a power outage), and nations (how effectively can a country recover from a widespread catastrophe)."

Today's electricity grid, says Hertzog, by no means offers the degree of resiliency that is desperately needed in our modern society, which is extremely dependent on electricity. "Evolving to a different electricity value chain can greatly enhance the resiliency of the grid", she says.

According to Hertzog, in this type of thinking, Europe is ahead of the US. "Europe is far ahead of America in thinking about the smart grid from a bigger perspective. In Europe there is much more maturity in thinking about how smart grids and smart cities interact."

Europeans will no doubt be glad about that compliment. At the same time they are probably hoping for Silicon Valley to come up with some smart ideas about smart energy. So what can we expect from America's leading technological innovation centre? Are investors in Silicon Valley devoting a lot of resources to smart energy? "They are devoting some resources to it", says Hertzog. "But there is potential for a lot more."

Silicon Valley, Hertzog notes, is "good at some things", like ICT, software and software applications in areas like social media, data analysis and cybersecurity. "But there are a lot of bright minds in Silicon Valley busy thinking about how a retailer can make us buy more stuff. I'd rather see those bright minds devoted to solving some of the bigger problems in the world." ■

Who is Christine Hertzog?

Christine Hertzog is the author and publisher of the Smart Grid Dictionary. She also writes a prominent smart energy blog on her website www.smartgridlibrary.com. She has a strategic advisory form in Silicon Valley called SGL Partners.

Project PowerMatching City

The way to the smart city of the future

The Dutch project PowerMatching City may be the world's first real-life intelligent energy network that can serve as a model for the smart city of the future. According to Frits Bliek, programme manager at technical consultancy DNV Kema, the first phase has been a success. Suppliers, consumers and the network operator interacted smoothly in an automatically functioning virtual market which turned out to be beneficial to all participants. In the second phase, the focus will be on social rather than technological innovation.

| *by Ron van Duuren*

The key to the success of PowerMatching City, says Frits Bliek, is that it is effectively a living lab. Bliek believes that this 'real-life' approach of the study is essential to enable the widespread practical use of smart grids in the future. "After all, the devil is always in the details. The theoretical possibilities of smart grids have long been considered, discussed and tested in closed systems, but not previously tested in people's everyday lives. PowerMatching City enables us to pioneer in actual practice, which makes it a rather unique and exciting study, especially since one of the main principles is to maintain the consumers' level of comfort. Our goal has always been to develop a market model of a smart grid that works under normal conditions and in 99.995% of the time that the Northwest European networks are available. At the end of the day, end users should notice nothing of the smart grid other than lower energy bills."

In the first, now completed phase of the pilot, 25 households in the Dutch town of Hoogkerk formed an intelligent energy network. They were all equipped with a micro-CHP or a hybrid heat pump, a smart meter, a small PC and Internet modem in the meter cabinet, a thermostat and solar panels and remotely connected to a wind turbine and a gas turbine. Moreover, half of the households have a washing machine and a dishwasher with an extra function;

equipped with specific software these appliances buy electricity at the lowest possible price on the local energy market.

The participating households do not live together – they are scattered throughout the town. They don't have to live next to each other, explains Bliek, because what binds the households is consortium partner TNO's so-called Powermatcher, a software program that coordinates the demand and supply of electricity in the community via the Internet. "These local marketplaces are set up on the basis of this technology, which balances the grid and automatically links demand and production as accurately as possible. That means without human intervention, whilst the supply of energy is guaranteed. This is a critical precondition in our research."

Fair system

With a digital marketplace such as Powermatcher, the at times differing interests of three parties can be met, namely those of the end user, the network distributor and the energy supplier. Consumers can use a sustainable, uninterrupted supply of energy and feed back onto the grid at the best possible price, whilst the network companies can distribute the grid load as favourably as possible and the energy suppliers can run the system as a virtual power station. Households can trade the surplus energy they generate on the existing energy markets, such as the APX-ENDEX and the imbalance market. "It is unique that we can combine these interests by means of one market model, so that a fair system can be created in which renewable energy is given precedence over traditional sources. There are plenty of technological means to achieve this, but an important and often overlooked component is social innovation. It is essential for the users that an acceptable solution be realised that is also of direct value to them, and which they are willing and able to deal with effortlessly. This ease of use applies to both the devices and the associated services; sacrificing functionality or comfort is unacceptable. Consequently, the system is highly automated.

'At the end of the day, end users should notice nothing of the smart grid other than lower energy bills'

So far the test has lived up to its promise. "The main result of the first phase of PowerMatching City is proof that the formula works", says Bliek.

The Internet technology offers numerous additional testing possibilities in this smart grid concept. As an example, the information on the energy consumed by the electric cars driven by some employees of partner Essent – none of whom live in Hoogkerk – is linked to the local energy market. The moment of charging and the energy price are determined over the Internet on the same marketplace. This conveniently circumvents the practical problem of participants from Hoogkerk not (yet) having electric cars, whose consumption can therefore not be tested. Just like a few other large customers in Hoogkerk, the charging stations for these employees are equipped with their own software agents, which, based on the availability and price of electricity, determine when to switch on. Of course, the users always indicate by what time the car should be fully charged or the dishes are to have been washed. The users stay in full control of their energy flows and can override the automatic agent any time they wish.

The location-independency afforded by the marketplace via the Internet connection provides numerous opportunities for installing the decentralised energy generator away from where the energy is consumed. This is useful for tenants or people who do not have their own roof. "This system does not necessarily require you to install solar panels on your own roof. You can easily place them in your allotment far outside town and use the energy in your home. This also makes it easier to purchase solar panels or wind energy together with third parties, e.g., with your neighbours or with your family. At the end of the day, the larger the marketplace, the easier it is to coordinate and balance. We will therefore increase the number of participants in PowerMatching City phase 2."

Social component

The anticipated further electrification of the energy grid calls for 'hard' test cases such as PowerMatching City, through which the underlying business case can be validated and the manner in which end users interact with such a system can be tested in practice. The successful first phase showed that the market mechanism works. It also showed that it is very possible to integrate renewable and decentralised sources into the existing energy grid. Moreover, it became clear that the system works for any device: it makes no difference whether an electric car or a washing machine is connected to the system. "This is essential for the large-scale rollout of smart grids, because it is up to end users to decide which applications will ultimately be connected to the intelligent networks. The government can only guide consumers to a limited extent through incentives via subsidies and tax measures. In Hoogkerk, we show

how the intelligent network of the future might work in practice and what barriers need to be removed in order to integrate decentralised energy generation into the energy infrastructure of the future."

PowerMatching City phase 2 focuses on the translation of the concept into concrete smart energy products and services and on further research into how the system can be integrated into the existing energy system. Bliek: "We have completed the big 'technology push'; we now want to focus on the social component. What do the users want to use the smart grid for; do they understand its possibilities, can they band together to buy joint energy, and how will we invoice? In this phase, the web portal where user data can be retrieved will become easier to use and will offer increasingly greater functionality. We will organise the portal based on the end users' wants and needs as collected in phase 1 and will perfect it based on an interactive design process with these people."

Such an easily accessible menu on an electronic screen makes the unique total concept of PowerMatching City and its accompanying local energy markets much more visual and therefore a lot clearer. Furthermore, it will give the visiting busloads of interested people much more to see. Now all there is to see in the basements and attics of the 'perfectly ordinary' houses is a much larger cupboard than the standard central heating boiler, a digital display on the washing machine and a mini computer in the meter cupboard. "It's not visually spectacular, which is perhaps disappointing to some, but the crux lies simply in the market mechanism based on software 'agents' with which existing technologies that are adapted to the intelligent energy network negotiate autonomously on these local energy markets. It is a very elegant solution requiring very limited computing power, but unfortunately, the software is not so easy to visualise," concludes Bliek. ■

We have completed the big 'technology push'; we now want to focus on the social component

Smart Energy Collective

DNV Kema participates in the Smart Energy Collective, which was founded in 2010 and consists of 26 international companies with an establishment in the Netherlands that constitute a wide representation of expertise for the energy supply of the future. Together they aim to acquire extensive experience in smart energy and smart grids in five integral, full-scale pilot projects. The main goal here is to gain more insight into the needs and perceptions of various end users and to gain practical experience with combinations of new technologies and innovative services. The implementation of smart grids, intelligent energy systems, is needed in response to current major changes in the energy landscape. Smart Energy Collective has opted to perform the five pilot projects in very diverse environments: various innovative technologies and energy-related services will be used for different applications, among different user groups in industry, offices, existing neighbourhoods and new housing developments. This will provide a comprehensive picture of the potential of new markets and new value chains that can benefit energy consumers.

This stuff has to be automated; it has to be made really easy. If we can build the control equipment into the appliance, then I think it will get taken up.

Photo: Thinkstock

Feature Policy Overview – part Two

The issues, the snags, the solutions

As we have seen in Part One of this two-part Policy Overview, there is broad agreement in Brussels on many smart energy issues, such as targets and standardisation. But there are also important topics that still need to be worked out. Two stand out: the roles and responsibilities of different stakeholders in the value chain, i.e. the business model, and data protection and privacy. Both have a direct impact on the customer and therefore on the public acceptance of new smart technologies.

by Sonja van Renssen and Hughes Belin

The business model debate is a direct result of the EU's third energy market liberalisation package. Adopted in 2009, this was intended to open up the European market, bringing an end to the old energy monopolies that ran everything from energy generation to delivery. It has at least partially succeeded and the European Commission is clear: there will be no fourth package.

By facilitating the move towards a more decentralised system, the Third Package helps lay the foundations for a smarter system. As Gérard Magnin, Executive Director of Energy Cities, which represents local energy agencies, puts it: a more decentralised market is a "prerequisite for the relevance of smart grids". The Third Package also offers explicit support for smart meters: it decrees that 80% of European consumers should have one by 2020.

But the Third Package has a downside as well, when it comes to implementing a smart energy system. "One of the problems [with rolling out smart meters in Europe] is that this is much more

complicated in a liberalised, unbundled market," says John Harris, Vice President and Head of Governmental Affairs for Europe at smart meter maker Landis+Gyr. If you have an integrated utility from power plant to electricity delivery, that company can shoulder all the investment costs of a smart meter roll-out because it will reap all the benefits, right across the value chain.

"In Europe however", says Harris, "the entity that's going to make the investment is the regulated network operator but other market actors are going to benefit as well." Market fragmentation complicates matters. "The third energy package hasn't made it any easier", says Jessica Stromback, Executive Director of the Smart Energy Demand Coalition (SEDC), a lobby group that promotes demand side programmes in Brussels. "But we're stuck with it," she adds. "It means it's all the more important to create real competition in the market so you at least get the benefits that real competition can bring."

Creating competition |

Ray Pinto, Senior Government Affairs Manager at Microsoft Europe, says: "It's the opening up at the retail level that's going to create an explosion of innovation opportunities and economic growth." This is exactly what is occupying the European Commission today: how to ignite the retail market, and, more specifically, define where it starts and ends, to pull smart meters and grids off the shelf.

In the European Smart Grids Task Force, the main forum for policy debate on smart meters and grids in Brussels, there are several market models under discussion for a new, smart energy system. At the core of these discussions is the role of the Distribution System Operator (DSO), the company that today manages the low-voltage cable network that delivers energy to end-users. It is a regulated business: national regulators set tariffs that let DSOs recuperate their costs through grid use fees from consumers. DSOs want to be at the heart of the smart energy system, and they have been assigned a central role in most countries. But are they the ones who are best suited to drive the system forward?

"They should be responsible for reading the meters," says Gunnar Lorenz, Head of Networks at European electricity trade association Eurelectric. "The meter is not an energy service. It's part of the network. The services are what can be done by the market." Eurelectric puts forward several arguments for why the DSO should retain the meter as a regulated asset. One is that it needs access to energy consumption data to optimise the delivery network. Another is that as a regulated entity it is best placed to collect this data and make it available to potential service providers in a non-discriminatory manner. "I see DSOs as a market facilitator," says Lorenz.

Others are coming to the table with different ideas. In the UK and Germany, the meter is no longer a regulated asset and data is collected and managed by a third party. Lorenz doesn't believe this is the way forward: "We're talking about unbundling that is going beyond what is in the third package. Of course you can segment the market into many pieces, but can you still make a margin?" He believes excessive fragmentation could slow things down. "The German experience proves that the liberalisation of metering has, so far, not delivered the expected benefits to both customers and the system," a Eurelectric position paper says.

EU sources however, suggest the Commission may tire of waiting for DSOs and national regulators to agree on cost recuperation for smart meters/grids and invite other players to step into the space. These could be telecoms companies and they could even be supermarkets. In addition to the DSO-centric model, the Smart Grids Task Force is discussing two other business models: a third party collects and distributes the data, or a third party collects and distributes the data and also provides new services. The main difference with the DSO-centric model is that here the DSO would do the minimum: maintain the wires but not get involved in the data flow.

"All these models are theoretical. The chosen one may be a combination of those," says Mercè Griera-i-Fisa, from the European Commission's Smart Cities and Sustainability Unit, DG Connect.

Big data = big money |

The fight at the heart of the smart meters/grids debate is not over energy but over data. A smart grid is a series of cables with a communication network associated with it and it is the data collected by this network that will enable the explosion of services people like Pinto get so excited about.

Who collects and manages this data is the big question. Just consider what's possible: software leader SAP has launched a new technology that lets it read ten million meters in less than half a second. No wonder it advocates a so-called "shared services" model that brings third parties into the heart of the energy distribution or retail system like in the UK and soon the Nordic market. "We get a lot of data thanks to our 65% market share," says Maher Chebbo, Vice President of Utilities and Communication Industries for Europe, Middle East and Africa at SAP. "If tomorrow we want to act Google-like for European energy data management, we definitely can."

"Managing data is not the main business of DSOs," says Griera-i-Fisa. "DSOs take care of electricity."

But stakeholders such as Magnin from Energy Cities say that today's big technology companies could end up replacing the old energy monopolies in terms of the power they wield. This is especially true in relation to the emerging concept of "Smart Cities", where transport and resource use are all optimally managed through ICT and interconnected with other city data. "It would be dangerous if cities were controlled by large private companies," says Magnin. Companies not cities are requested to lead the applications for EU financial support for smart cities under the EU's Strategic Technology Plan's Smart Cities Initiative.

But Microsoft's Pinto says: "I really struggle to see one company take over everything and become a complete monopoly. There are rules and regulations to control that. It'll be really competitive."

Data protection |

The big danger is misuse of data and invasion of privacy. "When you look at big data, the EU clearly has a role, an incredibly important role and that is talking about data protection, privacy, security, and so on," says Pinto. "If the data doesn't flow across borders or data protection is not figured out quickly enough it will slow down the market from having these services."

Luckily, stakeholders agree the EU is on the right path with its current revision of the 1995 data protection regulation. And there seems to be support among many too for the German data protection template for smart meters that would set security standards akin to those for Internet banking – i.e. very strict. The idea is to make consumers feel comfortable. "The issue of data protection and privacy is too sensitive and the benefits to European households from smart metering are too great, not to give this subject the attention it deserves," says Harris from Landis+Gyr.

The referee here is the European Data Protection Supervisor (EDPS), an independent supervisory authority at European level devoted to protecting personal data and privacy. Its opinion in March on the Commission's proposals to revise the 1995 data protection regulation called them "a huge step forward" but "far from comprehensive" and "disappointing in the law enforcement area". The so-called Article 29 Working Party, which is composed of representatives of national data protection authorities, the EDPS and the European Commission, also advises on data protection issues.

The European-wide roll-out of smart metering systems will enable the massive collection of personal information from European households, unprecedented in the energy sector. The potential intrusiveness of this is heightened by the fact that the data may reveal intimate information about what members of a household do within the privacy of their own homes. By analysing detailed electricity usage it may be possible to infer or predict when members of a household

The European-wide roll-out of smart metering systems will enable the massive collection of personal information from European households, unprecedented in the energy sector

are away on holiday or at work, when they sleep and awaken, whether they watch television, use certain devices, or entertain guests in their free time, etcetera. Such information can be used for nefarious purposes, including marketing and advertisement. "Considering the risks to data protection, one of the key pre-conditions for the roll-out of smart metering systems is to ensure a high level of protection of personal data," says the EDPS.

In a recommendation issued on March 12, 2012, the European Commission says data should be rendered anonymous so that individuals are not identifiable. It plans to develop a data protection impact assessment template and discuss it with consumers at the next meeting of the London Citizen Energy Forum on 13-14 November. This is a regulatory platform established in 2007 to help arrive at competitive, energy-efficient and fair retail markets for consumers.

"Public acceptance is indispensable to a successful roll-out of smart metering," concludes Harris. He supports the German Federal Office for Information Security's (BSI) proposed 'Protection Profile': "This is the most concrete thing we have on the table and it's based on international standards." But "data protection and security measures have a price", Harris concedes and such security measures should be included in any economic assessment of the costs and benefits of smart metering.

Who will pay?

The bottom line is always cost. And that brings us back to the business model: who will pay? In theory, smart meters can pay for themselves through savings. This is certainly true for commercial and industrial demand response programmes. "They are a business," says Stromback of the SEDC. Companies "have the communications and the technology, and the programmes are valuable enough to pay for the metering: if you can earn €100,000, the €2000 industrial meter is no longer a problem".

For residential consumers, it's different. "We are sceptical about demand response and time-of-use tariffs... at residential level, even with electro-mobility at a large scale," says European consumer federation BEUC in a 2010 position paper on smart metering. "Regarding the financial costs incurred by consumers in relation to the development of the technology, we believe that national regulators and Member States should ensure that they are justified, transparent and fair." Regulators must ensure that benefits to the network are passed on to customers through lower tariffs.

Upfront investments have to be made and "a large part of the upfront capital expenditures will be borne by DSOs", says Eurelectric. DSOs have paid for about 70% of the cost of some 300 smart meter/grid pilot projects conducted in Europe to date, worth about €5.5bn. For Harris, the biggest obstacle to the deployment of smart meters in Europe today is at the national level: "The bottom line is who pays for what? How much and over what time period can DSOs recuperate the costs of investment in smart metering through grid use fees? How much will they gain through operation optimisation?" There are 27 of these debates in 27 member states. "I'm not sure how you can solve that at the European level", Harris says.

Patricia de Suzzoni, Advisor to the Chair at French regulator CRE and Chairperson of CEER's Customer and Retail Markets Working Group, plays down the importance of these debates, saying they are part of the traditional negotiations between DSOs and their regulators: network operators have to invest and the regulator has to keep tariffs as low as possible.

Keeping down costs

Member states wishing to do so had until 3 September 2012 to carry out a cost-benefit analysis of the roll-out of smart meters in their country within the context of the third energy market

liberalisation package. More than half have chosen to do so and sent their conclusions to the European Commission. EU sources say at least one, Belgium, has come up negative.

What type of meter consumers should be getting has a direct bearing on cost. Service and meter providers want these devices to be the best of the best – two-way communication is the bare minimum. Yet EU policymakers – and DSOs, which in their preferred scenario would recoup meter costs from customers through grid use fees – argue that meters should be kept as basic as possible, albeit meeting certain minimum standards such as two-way communication, to keep costs down. "If the customer wants a full home automation system, let him buy it on the market," says Griera-i-Fisa.

> *It's the opening up at the retail level that's going to create an explosion of innovation opportunities and economic growth*

After the meter, the way to keep down costs is for DSOs to partner up with telecoms companies to develop smart grids, i.e. overlay the electricity infrastructure with a communications infrastructure, she suggests. "It's logical to use what already exists. We cannot afford to build parallel networks. And it will go faster," says Griera-i-Fisa. Existing infrastructure offers plenty of options in urban areas: cable TV companies, virtual telecom operators, etc. In poor suburbs and rural areas, in contrast, the roll-out of the smart grid could go hand-in-hand with broadband deployment. The Commission calculates that 80% of the cost of broadband deployment is engineering works. By working together on physical construction, utilities and telecoms companies could save on money and permits.

Closer cooperation between the two requires changes to the regulatory framework of both, however. DSOs would need to be allowed to make money – from working with a partner – and telecoms networks would probably face new technical requirements. But the prospects are good. In Germany, the same regulator looks after energy and telecoms, and it has issued guidelines for joint investments. Other countries are considering merging their regulators. "People start to understand it's the way forward," says Griera-i-Fisa.

Doubts, where they exist, relate to the technical capacity of existing telecoms networks to handle the data smart grids would generate. And both parties, naturally, envisage themselves as the dominant partner in charge of managing that all-important data flow.

The consumer has the last word

If both the business model and data protection rules are critical to the roll-out of smart meters and smart grids because they ultimately determine public acceptance of these new technologies, it is worrying to read in a recent report for the European consumers federation BEUC by the Free University of Brussels, that "consumers are not adequately safeguarded in the current discussions". This message was echoed by several other stakeholders in the smart debate in Brussels. The report moreover, provides food for thought for any cost-benefit analysis: for example, the 15% potential energy saving from smart meters actually assumes an in-house energy consumption display, not just a smart meter in the basement (that delivers just 2-4% savings when used properly, the authors say).

Finally, the study warns that "smart meters will only become so when consumers use them smartly". This implies that they should "actively participate in the creation and definition of functionalities, usages and meanings before techno-economical drivers decide and standardise the new objects". An interesting message from the end of the value chain that industry and regulators would do well to listen to. ■

Interview Bastian Fischer, Oracle

It's the economics, not the technology!

"We are at the stage where we are thinking about how we can adopt smart energy technology in an economic and socially optimal way." Bastian Fischer, vice president industry strategy of Oracle Utilities Global Business Unit, and a recognised expert on smart energy, says smart meters and grids "are entering the phase of adoption". Technologically, says Fischer, there is nothing holding the industry back. The challenge is how to make the technology work economically so that it benefits both energy suppliers and consumers.

by Karel Beckman

Where does the smart energy market in Europe stand at this moment?
Smart meters and grids are going through a normal technology cycle. Two, three years ago there was the hype, there were over-expectations. Then there was a more realistic phase. Now we enter the phase of adoption. From a technological perspective, we understand what smart technologies can provide, where they make sense, where they are available for scale deployment. As an industry we have reached the ability to deploy smart energy solutions. Where we still have work to do is to make the technology work economically and to get the regulatory framework in place that will ensure that those who invest in smart energy will be rewarded for doing so.

How does the European market compare to other markets, in particulary the US?
An important difference is that the European market is unbundled. Network ownership has been split off from generation and supply. This can lead to split incentives. For example, a network company may be faced with the choice of making investments into the grid that may primarily benefit generators and suppliers. That's why we need to put in place an investment and reward model that supports business cases for investment in smart technologies.

Are you saying that unbundling hinders the development of smart meters and grids?
No, I don't think so, because unbundling and competition is a good approach to provide more choice for customers. It creates a baseline for innovation. If we were still living in an unbundled world, we probably would not be talking about implementing smart technologies today. There would have been little incentive to innovate. What I am saying is that regulation needs to provide the right investment

incentives and allow for a proper distribution of rewards. Let me give you another example: if you as an energy service provider run a virtual power plant – a cluster of distibuted generation installations –

> *The pure network operator may not need the same level and range of smartness as those who are offering advanced energy services*

you need bidirectional energy flows and data, which requires investment in infrastructure, which may have to be made by the network operator. So in this case the energy service provider has to be able to reward the network operator for its investments. We need guidelines from regulators how this can be done. The pure network operator may not need the same level and range of smartness as those who are offering advanced energy services.
We do not propagate a particular model. Each country must find its own operational model. Whether this means the supplier or the network company or a third party owns the device or the data, everything is possible. And it's not only about meters – it is also about inhome displays, thermostats, microgeneration units, other appliances.

But is it efficient if everyone adopts their own model? Won't this hinder the development of smart energy?
The challenge we face is the same for everyone: how to better manage our finite energy resources and complement them with renewable energy. I am sure we will find ways to do this. Whether centralised or decentralised, who will own the meters – I don't know. There may not be a one-size-fits-all solution. Look at how the telecommunications industry developed. At first telephones were owned by the telephone operators. Now open systems have developed with different devices and different types of contracts.

Don't we need standardisation then?
We do need standardisation at different levels: in hardware, but also in software, to make interoperability possible. Consumers should be able to plug in smart appliances into their homes and be part of a smart grid or smart city without any obstacles. To make this possible data need to be integrated at the operational level. This process has only just started. Compare it to the financial services industry. Consumers can now use bank services anywhere in Europe without problems.

But it took 15 years to make this happen. Once we have this worked out in the energy sector, industry will be able to produce cost-efficient and innovative products and services and consumers will have the confidence to buy appliances without fear that they will become outdated.

Is this what policymakers should be focusing on?
It is one aspect, yes. They should make access to data a discrimination-free right, as long as it does not interfere with business confidentiality. We need a pan-European agreement on this just as we have on financial transactions. This still has to be built from scratch. Another aspect is that network operators should apply more smartness in their investments, which means they must have incentives to do so. They should be able to include this in their tariffs.

Are the US and other markets ahead of Europe in smart energy?
In most markets they don't have the fragmentation that you have in Europe as a result of unbundling. But they have their own challenges. In the US there has been a big push towards smart and renewable energy technologies, but this is now being retarded because of the increased availability of cheap unconventional gas and oil. This has weakened the business case for putting more intelligence into the energy system. Australia and New Zealand are very competitive. Japan may get the largest demand side management program in the world because of the shift in energy supply after Fukushima.

How do you see the European market develop? Will we see new players coming up?
Definitely. Look at how telephony advanced. The first

> *We need to put in place an investment and reward model that supports business cases for investment in smart technologies*

providers, like Nokia, Siemens and Ericsson, have virtually left the market. The ones that are on top now are computer manufacturers like Apple or search and advertisement giants like Google. The Vodaphones of this world have become almost pure capacity providers.

Who should we be watching?
We are already seeing new energy service providers entering the market. They are not even waiting until

the meter is intelligent. They go around the meter. In the UK in particular the market is very active. They are a couple of years in advance of the rest of Europe.

What products or innovations are you most excited about?

Big advances are being made in power equipment, particularly in storage and the bidirectional flow of energy. These are fields in which we as a company are not active. Where we do play a key role is in making equipment smart all along the value chain. To automatically balance loads you need to have an array of smart options installed. You need to put intelligence even into the far edges of the grid. That's a key enabler to make energy supply secure and to integrate distributed and renewable energy as much as possible. It will reduce the necessity to transport electricity across large distances and avoid bottlenecks. A lot of exciting things are happening in this area. And then there is the customer side of course: giving customers the information and alerts they need to consume energy efficiently and to become their own energy producers.

When can we expect real results?

As I said, we realise now that the technology is not holding us back. We are at the stage where we are thinking about how we can adopt the technology in an economic and socially optimal way. We are at the point of deciding how the processes should look, how engagement with customers and stakeholders should be done. There will still need to be a lot of discussion, and there won't be a one-size-fits-all solution across Europe, but we should not worry about that, it's a normal development. I am convinced that we are on the way to implementation. ■

Who is Bastian Fischer?

Bastian Fischer has extensive experience in the utility industry, in IT technology, customer management and the smart grid & smart home area. A regular speaker on the theme of utility industry innovation, he is an active contributor to a variety of customer thought leadership initiatives. He is currently leading the Oracle Utilities team in Europe, the Middle East and North Africa, setting the focus on strategic projects and smart grid initiatives as well as providing direction to the largest utility customers. He also leads the Oracle Executive Customer Advisory Board for Utilities. Fischer was educated in Germany and holds degrees in Business Administration and Computer Science from Universities in Stuttgart and Saarbrucken.

Interview Nandini Basuthakur, Opower

Ranking the neighbours

Can utilities make money by selling less energy? It's one of the concerns suppliers have when they contemplate the smart energy transformation. Fortunately, an innovative American company, Opower, has created a successful model that helps utility companies do just that. How? By making use of some basic behavioural insights. Nandini Basuthakur, Senior Vice-President of Opower, explains: "human beings are motivated most, not by noble ideals or economic incentives, but by what they see their neighbours doing".

by Karel Beckman

"You would not think that a business that helps utilities sell *less* energy to their customers would be viable, but the big finding here is that efficient customers are more engaged customers. They are less likely to go to a different utility. And more likely to buy more products from their existing supplier."

Nandini Basuthakur, Senior Vice-President at Opower and Managing Director of Opower's European, Middle Eastern and African business, spent 17 years building international businesses, mostly in telecoms and financial services. Since October 2011, she is engaged in helping to build up what is perhaps the strangest venture that she has ever been involved in: a company that is specialised in one thing only – getting people to use less energy.

Stranger still, is that Opower does not work directly for end users at all, but exclusively for utilities, i.e. for the one sector that does not have a direct interest in seeing people become more energy efficient. Nevertheless, Opower is a big success: through the utilities that are its clients it now works for 14 million customers, so far mostly in the US but partnerships are underway or coming on-line rapidly in several European countries.

Experiments

Admittedly, the company got its start in regulated markets in the US where utilities were required by law to deliver energy savings. Yet Opower has also been successful in liberalised markets like Texas and fully intends to conquer the competitive markets of Europe as well. According to Basuthakur , the incentive energy suppliers have in competitive markets to help households save energy, can be summed up in two words: customer engagement. "If you make me use less energy and reduce my bills, I feel good about you. That means I will be interested in other things you have to

offer me – services, boilers, insulation – all the way up to electric cars. And I won't switch to another supplier of course."

More on "customer engagement" in a moment. First we want to know, how they do it – get people to reduce their energy consumption? This is a far from simple matter, as environmental activists know. It's another strange story, which goes back to experiments that were done in the early 2000s at Arizona State University and California State University by psychologist Robert Cialdini. This was at the time of the power crisis in California. Cialdini tried to get people to turn off their air conditioning at night and do other small things that reduce energy consumption. He confronted his subjects with different messages: *Do this please to protect the environment! Do it to save money! Do it to be good citizen!* None of it had any effect. Until he told them: *Do it because your neighbours are doing it!* Consumption promptly went down by 6%. It seemed that human beings are motivated most of all, not by noble ideals or even economic incentives, but by what they see their neighbours doing.

It took two entrepreneurs to convert this knowledge of human behaviour into a business plan in the energy sector. In the mid-2000s, Dan Yates and Alex Laskey, two young environmentally conscious business adventurers, were looking for some plan to make money *and* to make the world a better place. They had this idea that – as Yates put it in a recent interview – "the utility bill was really crap". So they invented what Opower calls Neighbour Ranking. What it comes down to is that customers get a colourful report that shows how they are doing with their energy usage compared to a like grouping of similar homes. They learn, for instance, that they use 14% more energy than their more efficient neighbours, or that over the past winter, they used 37% more energy on heating than their neighbours. It also contains historical data in the form of simple graphs ("Good work, you rank is improving!"), tips to save energy and product offerings, e.g. to install attic insulation.

If you make me use less energy and reduce my bills, I feel good about you

Competition increasing

Simple as this concept may seem, it works, says Basuthakur. Opower says it has managed to reduce energy consumption by 3 to 5% on average among the 14 million end-users that they reach. "We have saved 1.4 TWh (Terrawatthours) already this year and will reach 2 TWh before the end of the year." 1.4 TWh is about $240 million in money terms." Another way of putting it: a savings of 2 TWh is as if over half a million (European) households went off the grid. That the Neighbour Rank method works, says Basuthakur, it is perhaps not as surprising as it seems at first. "You see it in a lot of things. Take recycling. Do people recycle because they believe it is good for the environment – or because their neighbours are doing it? The same goes for wearing seatbelts, smoking in public places, and so on."

But would the Opower scheme also work if there were no regulatory drive behind it, in other words, if utilities were not pushed by legislators to achieve results? The EU has recently adopted an Energy Efficiency Directive which, among other things, puts a 1.5% annual energy savings obligation on suppliers. "The Directive will help", says Basuthakur. "It adds another reason why utilities could work with us. But", she adds, "regulation is probably not the most important thing. Competition is. We see competition in the energy sector increasing everywhere, across the world, even in regulated markets. It would be a mistake for utilities to think that they will be able to survive if they don't succeed in engaging their customers."

In this new competitive environment, the winners, says Basuthakur, will be "those who are best able to use the assets they have. If you are a utility, you cannot control the weather, or the price of oil and gas. But you do have customer data and relationships with your customers. So the question is, can you move from being a commodity provider to a service provider?" Electricity, says Basuthakur, can be provided by anyone – from retailers to financial services companies. "So utilities have to develop programmes to engender loyalty amongst their customers. They have to reduce the number of customers who leave. They have to sell products with added value, be it insulation or the type of information provided for example by Google Analytics. They have to ask themselves what services they want to be in, what kind of company they want to be, how they will get out of being just a commodity player."

Engagement engine

What Opower does is to help suppliers build "an inhouse customer engagement engine". The Neigbhour Rank scheme that the company offers is just the tip of

the iceberg, says Basuthakur. "We have a huge database with energy consumption data of 14 million households. We employ the smartest people – that we took over from top companies like Google and Amazon – who are busy gaining insights through combining behavioural science and data analytics. I compare ourselves to a pharmaceutical lab for the utility industry. We do experiments every day. Learning never stops."

Sometimes Opower releases some interesting overall insights from its data analysis. For example, they found that users of Yahoo Mail use 11% more electricity on average than users of Gmail. The reason of course was not in the email program itself, but in the fact that Yahoo Mail users tend live in larger and less energy efficiency homes than Gmail users.
For most energy suppliers this kind of approach is very different from what they are historically used to,

Do people recycle because they believe it is good for the environment – or because their neighbours are doing it?

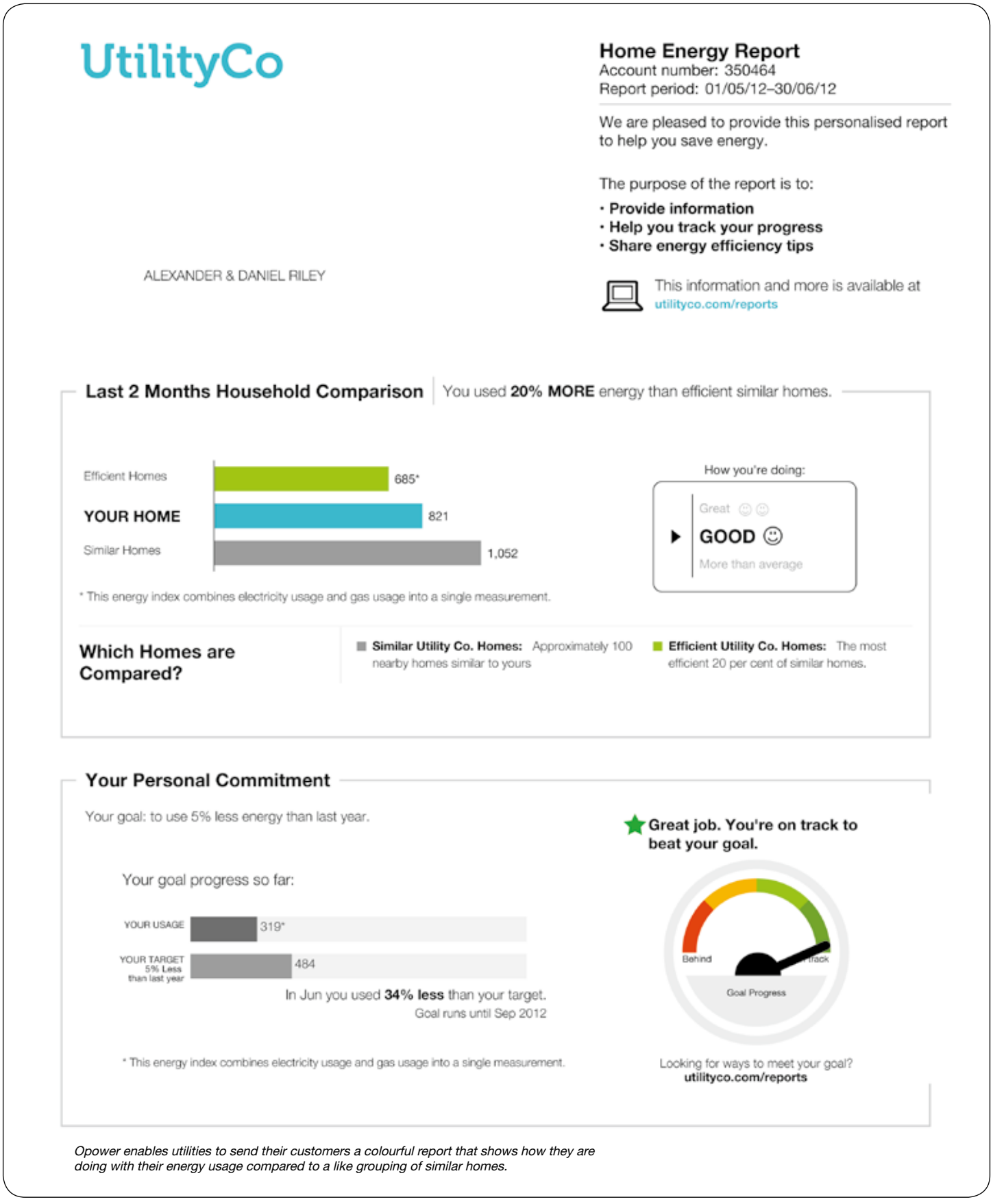
Basuthakur knows. "They come from a very different world, a commodity world." She also acknowledges that energy is not an easy product to sell. "It's a low-engagement product. Research shows that customers spend six minutes a year thinking about their energy use. They deal with their supplier only when the power goes off and when they get their bill. And when they get their bill, they feel it's too high."

Suppliers on their part also deal with their customers almost only through their bills, says Basuthakur. "But they don't do anything with that. When I go to Amazon, they offer me tips and suggestions. What does my utility bill do for me?"

More insights |

So where do smart meters fit into this picture? Are they needed at all to make a success of customer engagement? After all, Opower's business model works as long as utilities are recording at least monthly usage. But according to Basuthakur, the introduction of smart meters is nevertheless important. "With smart meters come more data. And with more data come more insights. There are huge opportunities to transform those insights into personalised and customised value propositions to save people money and at the same time improve the environments we live in. The bottom line is that the success of any smart meter roll-out depends on behavioural change on the part of the consumer. For this, consumer engagement is critical."

She has no preference for a particular regulatory model or for who should "own" the meter. "Different models are possible", she says. But, she warns that the introduction of smart meters is a complex and sensitive process that should be undertaken with great care. "We have seen a backlash in places like California and The Netherlands. People were afraid the government could look inside their refrigerator or that smart meters can cause cancer. You have to have a very pro-active and detailed education on what it is for, what it will enable customers to do, what the utility will be able to do, how the information will be accessed and used, and how this will impact the customers. The consumers have to be engaged from the start." ■



Opower enables utilities to send their customers a colourful report that shows how they are doing with their energy usage compared to a like grouping of similar homes.

Project 'EcoGrid EU' project on Danish island

The Bornholm Legacy

Two thousand households on the Danish island of Bornholm are expected to show how Europe can manage over 50% of wind power and other fluctuating renewable sources. The idea is to get them to adjust their consumption patterns through market-based mechanisms – but without asking their active participation.

| *by Gert van Wijland*

Bornholm. A windy and remote Danish island in the Baltic Sea, to the east of Sweden and off the north coast of Poland. Is this where Europe's sustainable energy future is taking shape? It could well be.

At this moment, more than 25% of the island's demand is already met by green energy. Danish grid operator Energinet.dk expects that the share of low-carbon energy sources on Bornholm will reach (well) over 50 percent by 2050. "We'll easily reach that goal with wind alone," says Kim Behnke, head of Energinet's R&D department. Combine this with a well-educated population familiar with and keen to adopt sustainability and you have a potential of 28,000 households to connect to green electricity.

Bornholm, then – which is connected with a cable to the main Danish grid – seems an ideal location for a live experiment to examine what impact this would have on the grid. The key question is how to balance supply and demand so as to properly coordinate peaks and troughs?

This issue is exactly what an international cluster of companies, knowledge institutes, grid operators and other organisations are exploring. Operating under the name EcoGrid EU, this consortium has chosen Bornholm as the pilot location for the installation of a smart grid. "From here we hope to roll out the grid throughout Europe," explains Behnke, initiator of the project on behalf of Energinet.dk.

Future-proof |

The Consortium, Behnke says, aims to develop a future-proof European grid. Approximately half of EcoGrid EU (€13 million) is subsidised by Brussels. The most important goal of the project is to reduce the imbalance between supply and demand in the energy system. Since the supply generated by solar panels and wind turbines is difficult to manage, the balancing will need to be done on the consumer side. "That means shifting from a demand-driven market to a supply-driven market. We will try to get consumers to adjust their electricity consumption to the generation."

If this balance is not achieved, it will not be possible to achieve the objective of 50 percent sustainable generation by 2050, says Behnke. "No grid will be able to handle those peaks and troughs", predicts Behnke. Storing electricity as a buffer is not an option. "Storage simply involves too much loss."

But how do you motivate consu-

If you look at Denmark's current energy facilities, you can see how Europe will generate energy in the near future

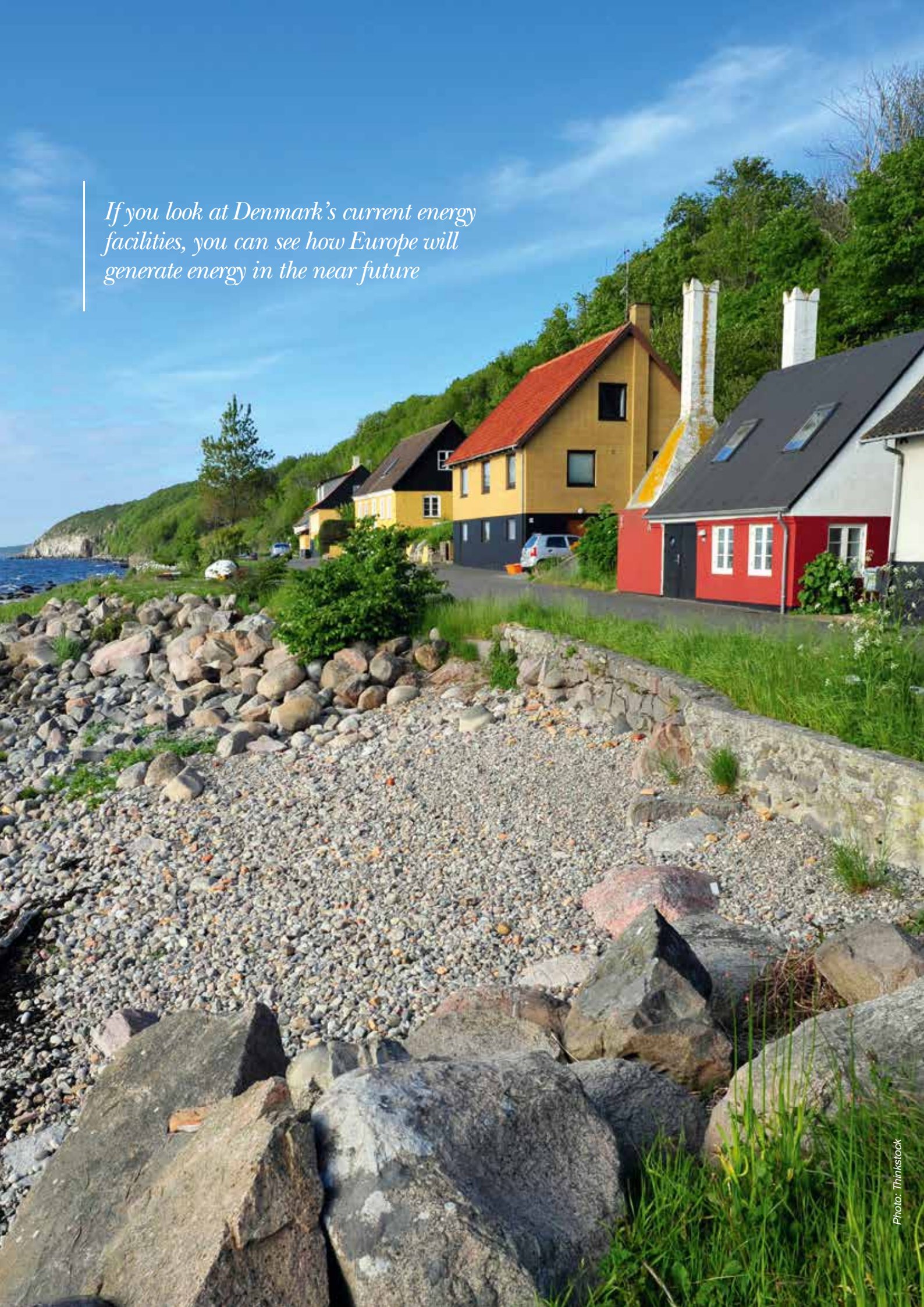


Photo: Thinkstock

mers to do their laundry when the sun shines and to turn off the light when there is no wind? "Through their pocketbook," says Koen Kok of Dutch research organisation TNO. This knowledge institute is involved in developing the smart software EcoGrid needs to make it a success. "The main thing is that electricity consumption should respond to what is happening higher up in the electricity system. That can best be achieved by varying the price of electricity. Electricity will be cheaper when more energy is available."

Previous tests have shown that consumers quickly get tired of checking a screen

Checking a screen

It is fairly easy to inform consumers of the cost of electricity, for example, through a smart meter linked to a display. "People can check the rate on the display and adjust their behaviour accordingly." But Kok says more is required to actually balance supply and demand. Smart computer programmes should virtually automatically balance supply and demand without consumers having to worry about it.

Previous tests have shown that consumers quickly get tired of checking a screen. To manage demand on an on-going basis, it is more efficient to have the smart grid communicate directly with the equipment in the home. Washing machines that display when the washing is to be done are already available on the market. But the user should still have the final say, says Kok. "If the appliance does not have an override button, no one will buy it."

One of EcoGrid's ultimate goals is to give consumers direct access to the part of the market where the price is formed. Kok explains: "The market price changes in time – every 30 or 15 minutes – which is of value for flexible consumption. Currently, only large industrial customers are alert to and respond to this. EcoGrid opens up this segment to consumers who are, for instance, organised in small consumer groups."

This requires more than enabling these parties to read out the price every 15 minutes or so. Kok: "The washing machine responds automatically to the fluctuating price on behalf of the customer; without intervention it uses more or less electricity, which is then billed in units of 15 minutes."

Settlement occurs via the smart meter that registers both consumption and production. In the coming years, households are expected not only to consume electricity, but also to supply electricity through decentralised sources. All this must be settled at constantly fluctuating prices. The technology required for this is either available or is at least under development. According to Kok and Behnke, the technology has advanced from the lab to actual applications. "TNO has demonstrated in its home market [the Netherlands] that they are able to develop smart software, which is exactly what we needed for our project," says the Dane. Not entirely surprisingly, he considers Ecogrid Eu among the most advanced of all current initiatives. "The strength of the consortium is greater than the sum of its parts. We have brought together all necessary knowledge and skills to create a sustainable network."

Technical standard

Another advantage of a consortium is that the parties can combine to make a powerful lobby for a proper European legal framework. Much still needs to be laid down in laws and regulations. "We don't want every country making its own rules with respect to privacy and security, and to erect market barriers. For a pan-European network, we need a strong Europe," says Behnke. "That's easier to enforce with all international parties on board."

Kok sees a second issue where fragmentation looms. He believes it is crucial that a technical communication standard be developed for the entire network, comparable to Blue Tooth and USB technology. "Virtually all of the world's computers use this to communicate with their peripherals. Imagine the chaos if those standards had not been developed."

He considers it unlikely that companies will enter into an all-out war to force their own technological standard through. "That would cause years of delay in the development of a functioning grid. Nobody needs another skirmish and Europe will hopefully not allow it".

Behnke sees many practical advantages of the test on the island. "We have a controlled space here, in which we can test the effects of smart-grid on demand management, for example." Of the 28,000 households, 1800 will get a full EcoGrid connection. "We will also have a control group of 200 households, enabling us to compare how the energy use in the participating households changes because of it."

If all goes well, these people will hardly realise they are participating; after all, the entire scheme is virtually fully automated. They get renewable energy at lower rates, "but they don't have to get up in the middle of the night to turn on their dishwasher," says Kok. "As far as we're concerned, that's exactly what we want to avoid". ■

Feature Post-Fukushima Japan

Japan catches up to smart energy

Fukushima is a turning point. Before the nuclear disaster in March 2011, Japanese electricity companies were downright disdainful of smart meters and grids. They were proud of the production capacity and reliability provided by their large power stations. With the Japanese government's decision to phase out nuclear power, the situation has now completely changed. The government has designated renewable energy, smart grids and smart cities as economic growth priorities. Rudolf ten Hoedt reports from Tokyo.

| *by Rudolf ten Hoedt*

After a tour of Japan in May 2011, American author Mark Pendergrast noted that the country had arrived at a crossroads. "Japanese trains run to the minute, and the country's businesses pride themselves on energy efficiency. (..) Yet they rely primarily on imported fossil fuels and nuclear power, live in energy-wasteful homes, and import 60% of their food. That may be changing in the wake of the Fukushima nuclear disaster."

Pendergrast has been proven right. Before the tsunami, power giant Tepco and most other electricity companies in Japan weren't overly concerned about demand side management. "They weren't interested at all", says Toru Hattori, senior research economist at the Central Research Institute of Electric Power Industry (CRIEPE) in Tokyo. "Utilities had more than enough capacity and were sceptical about the benefits of smart grids and meters. They gave some incentives to use cheap electricity at night but overall hardly looked at interaction with demand. They were convinced that their grid was already smart and efficient enough."

The explosions caused by overheated reactor chambers at Fukushima in March last year brought the complacent electricity producers tumbling off cloud nine back to earth with a tremendous thud. The nation, so accustomed to high-quality services, was dumbfounded when trains came to a halt and lifts stopped dead as the power failed. The reputation of the state-protected power producers was severely damaged.

Restoring the status quo of before the disaster is not possible anymore. Fukushima was a turning point. The prevailing sentiment in Japan is in favour of a thoroughly revised energy policy. Of the 47 nuclear power plants, only two are currently in operation. Nuclear energy enjoyed a 30% market share with a projected 50% by 2030 according to a plan drawn up in 2010. For months now the country has been deliberating the new energy mix. In September the government announced that it intends to gradually phase out all nuclear power stations, reducing the share of nuclear energy to zero by 2040. The production of electricity from renewable sources is to increase tenfold and now, for the first time, an agreement is on the table to accelerate the large-scale introduction of smart meters. The goal is to provide 80% of the electricity consumption via smart meters in five years' time.

No more of the usual intransparency: Tepco will adopt international standards for telecommunication connections and other technical specifications enabling foreign competition

Back against the wall

The country is now under considerable pressure to revamp its energy system. Japan is in the unprecedented position of having to depend entirely on foreign gas, oil and coal to generate electricity. The country is finding it increasingly difficult to foot the rapidly increasing bill as its stagnating economy is not only ageing, but also suffering the impact of the financial crisis. The promised reduction of CO_2 emissions is in danger of becoming unfeasible. It's all hands on deck now. With its back against the wall, the government is clutching at means the country disdainfully shunned in the past.

First and foremost, the government aims to increase the share of renewables (excluding hydropower) to 10% or even 20%. That equates to a revolution of which it still remains to be seen whether it will actually happen. The country has a long way to go. Japan has the lowest share of renewables in the industrial world. Solar, wind, biomass and geothermal currently account for only 1%. An estimated 500 billion euros in new investments are needed to drastically revolutionise the energy situation in favour of renewables. A 'green revolution' will require a complete overhaul of the existing transmission and distribution network, which used to be one of the most reliable in the world. In a future with little or no nuclear energy, it seems inevitable that Japan will need to drastically raise its already high energy prices.

In order to transform the Japanese energy market, the Japanese government is pushing the power companies to open their networks to renewable energy. The long-term feed-in tariffs for electricity from renewable energy sources were finally established in July. These are needed to win over investors in solar parks and wind farms. The number of large new projects announced in recent months is encouraging. These projects mainly concern solar and, to a lesser extent, wind and biomass. The initiators are Japanese and foreign groups who, until now, had been excluded from the closed Japanese energy market.

Meanwhile, the Japanese electricity companies are reaching or even exceeding the limits of their capacity. Last summer Japan narrowly escaped massive power failures. Experts say they only did not happen because of the sluggish economy. But companies are reluctant to make investments

in new capacity in the current uncertain investment climate. Perhaps now that the government has made its decision on nuclear power, new investments in capacity can be made.

It is for this reason that the roll-out of smart meters has now been accelerated. "Capacity shortage is the drive" says Toru Hattori. "Government and industry are now seriously deliberating how to use the technology of smart meters to effectively steer demand for electricity. Among the utilities, there is an urge to manage peak demand."

The total energy consumption of Japan should be supplied via smart meters by around 2020. It is not yet a statutory requirement, but the government is pressing more than ever. The state has a lot of leverage because Tepco, by far the largest company, has in effect been nationalised. The Japanese government has had to step into breach after Fukushima, paying billions in compensation to the victims to avoid Tepco going bankrupt. In return, the state has acquired a majority stake in the largest listed power company in the world. The Japanese state's Nuclear Damage Liability Facilitation Fund is now keeping a close eye on Tepco's operational management.

The New Tepco

Japan has 70 million analogue meters. The replacement market is estimated at roughly 7 billion euros. As an indication, only 25 million smart meters have been sold worldwide to date. Tepco plans to fit 27 million households with a smart meter between 2014 and 2023. In line with the government's accelerated introduction of smart meters, 17 million will have to be installed by 2018. This is a major investment for Tepco, which is already scrambling to make ends meet. Since the state has reduced the planned increase in electricity rates, the company will miss out on 800 million euros in revenues next year. "We had planned to install our own fibre optic cable network (for smart meters) in 2011, but now (with the nuclear accident) we cannot finance it on our own", replies new Tepco president Naomi Hirose to questions posed by European Energy Review during a recent press conference in Tokyo. "We are now seeking alliances and other funds to achieve the necessary investments", says Hirose.

This summer, sales of Sony's new type of rechargeable battery doubled, particularly in and around Osaka, which is highly dependent on nuclear power

Everything is now in motion. Tepco announced in July that business as usual will not apply to the tender for smart meters. That is to say: no more of the usual intransparency. The company will adopt international standards for telecommunication connections and other technical specifications enabling foreign competition. That decision has eliminated the fear that Tepco would try to impose its own standards to protect its monopoly and to favour present suppliers. In a joint document dated 12 July 2012, the Nuclear Damage Liability Facilitation Fund and Tepco state: "Procurement of the large amount of smart meters (...) has to present the 'New TEPCO' business attitude. A drastic reform of procurement procedure such as international procurement or having advice outside the company will be performed, not by the closed custom of procurement from the affiliated companies, so called 'family companies', nor companies having continuous contract, to reduce cost even more and improve transparency in business."

The new tendering standard means more competition for Osaki Electric, which, together with a few other Japanese manufacturers, dominated the national meter market. Osaki is now forced to rationalise production. The expected price for a smart meter has been slashed from 30,000 JPY (approximately €300) to 10,000 JPY (€100), which is good for Tepco, as it is under immense pressure to reduce its operational costs. Various foreign companies, among which Italy's Enel, are showing interest in competing for orders from Japanese power companies. Tepco is expected to call for ten-

ders in the spring of 2013. American company General Electric, which has formed a joint venture with Japanese manufacturer Fuji, called GE Fuji Meter, stands a good chance.

Scepticism |

However, to define an international standard for smart meters and grids, the Japanese will need to overcome their seclusion quickly. Japanese companies own many world-class technologies of the brand 'Galapagos', which can only be used in Japan. Due to the relative isolation of their domestic market, Japanese companies are slow to hook up with international standards. According to a recent survey conducted by the Japanese Ministry of Economic Affairs, even major Japanese companies do not have enough in-house standardisation experts. The government recognises that. A programme will now be launched to train young talent in the industry and civil service in international standards and global negotiations. The programme centres on 15 sophisticated high-tech areas, including smart grids, and is headed by a former Sony chief executive.

At first glance, the wide introduction of smart meters and smart grids in Japan seems unstoppable. The introduction of smart meters will perhaps also give the Japanese utilities time to postpone major investment decisions by lowering the demand for electricity. Examples elsewhere in the world suggest that. However, Toru Hattori has his doubts. "I am not very optimistic about the positive impact of smart metering on energy consumption, especially not in the long term. I can see it working for large power consumers, but not for households. Who knows, the hype of smart meters for all consumers might turn out to be just a new bubble." According to Hattori, there is still widespread scepticism among the electricity companies as to the usefulness of smart meters, although they won't always show it. "I am even more optimistic than they are. Their scepticism is still on the table."

New dynamism

Opening up a large protected market like that of Japan to the next generation of smart meters unleashes a new dynamism. Once Japan gets the spirit, things can change fast. Japanese companies see opportunities in this new branch of 'green' technology. The invasion of the smart meter will boost the current eco cities, four in number, which lead a fairly isolated existence in Japan. This spring, Toshiba took over Swiss company Landis+Gyr, leader in the field of smart meters, for $1.6 billion. At the Japan Motor Show earlier this year, auto manufacturer Toshiba exhibited an eco-house that can be powered by an electric car – as did its rival Nissan.

Another interesting newcomer is telecommunications group Softbank. The group says it will have seven mega solar plants with a total capacity of 256 MW up and running by 2013, making Softbank Japan's largest solar operator. Softbank's entry into the energy sector is a strategic move. Along with other telecommunications companies like Nippon Telegraph and Telephone (NTT) Softbank is establishing a foothold in the power industry with an eye toward future sales of smart-grid data communications infrastructure.

The precarious energy situation in Japan is not only gearing the country up for the rapid introduction of smart meters and smart grids, it has also stirred the Japanese retail market. The energy crisis is driving consumers towards energy saving and flexible energy consumption. A fear of higher expenses and rationing or loss of electricity is driving up demand for energy-smart appliances and batteries for storing energy. This summer, sales of Sony's new type of rechargeable battery doubled, particularly in and around Osaka, which is highly dependent on nuclear power. Yodobashi, a Japanese megastore selling electric (household) appliances, rapidly sold ventilators with batteries that charge overnight.

Japanese present first 'digital grid router'

Towards the internet of energy?

Professor Rikya Abe of the University of Tokyo and several supporting companies, including NEC and Hitachi, recently presented the very first Digital Grid Router. At the size of a small suitcase, this router is an essential tool of the "Digital Grid" that according to Abe has the potential to revolutionize the grid as we have known it for over 100 years.

| *by Rudolf ten Hoedt in Tokyo*

In a press conference on September 9th in the Japanese capital, he called the successful development of the Digital Grid Router "the first step towards the realization of the internet of energy" where large synchronous grids will be divided into smaller segmented grids or cells. These cells are connected asynchronously, via multileg IP addressed ac/dc/ac converters called digital grid routers. These routers, explained Abe, communicate with each other and send power among the segmented grids through existing transmission lines, which have been repurposed as digital grid transmission lines.

The digital grid (see www.digitalgrid.org) can accept high penetrations of renewable power, prevent cascading outages as we have recently seen in India, accommodate identifiable tagged electricity flows, record those transactions, and trade electricity as a commodity. So yes, technically spoken, the Digital Grid Router can even act as a smart meter. And according to Abe, it will open the gate to a truly free electricity market with many suppliers of renewable energy without compromising the stability of the grid and in which the consumer can choose which electricity 'package' to pick.

The Digital Grid Router on show has been tested and proved to work. Further tests will follow at a facility of the Electric Power Research Institute in Knoxville, USA. The founding fathers of the Digital Grid are certainly interested in Europe as well. Senior vice-president of NEC Takemitsu Kunio told European Energy Review that he is in contact with an Italian company.

Abe suggests that the Digital Grid may be of particular interest of developing countries. "Just as developing countries have skipped the use of fixed line phones and have jumped directly to cell phones, the developing world can skip the stage of centralized, one way power generation with large investments in infrastructure and jump directly to smaller scale energy sources and distributed control." ■

Interview Stephen Woodhouse, Pöyry Consulting

'Smart energy needs a strong regulatory push'

Can smart energy live up to its promise? Stephen Woodhouse, Director at Pöyry Management Consulting, and a specialist on smart energy, cautions that "the theoretical potential of smart energy is much greater than what we will actually realise". The consumers can't and won't do it by themselves, he says and the business case for most of the facilitators is not very clear. That means that we will need "ambitious targets and an ambitious regulatory regime" to make smart energy happening and worthwhile.

by Alex Forbes

The proponents of smart energy systems make impressive claims about the benefits they could bring: from facilitating the decarbonisation of electricity to reducing customers' bills to improving security of supply. How realistic are these claims, given all the challenges that need to be faced?

Technically it's quite realistic that those things could be delivered. The serious barriers are in customer acceptance and in getting the utilities and other key stakeholders to want to drive this forward. Smart energy from my perspective is about intelligence in consumption patterns. It's partly about making sure that people are consuming energy deliberately, not inadvertently, and it's partly about making sure that people are consuming at the right times.

So the business case for smart energy is largely in terms of savings to consumers, whether through reduced network investments, or whether through reduced costs of generation. But the consumers can't do it themselves and it's not very clear that there's a strong business case for the people who need to facilitate it. So it needs strong regulatory push to make it happen.

Why do you say there's not a strong business case for the people who need to push it forward?
Look at the economics. Smart energy either means more intelligent use of demand – broadly moving demand away from the peak times, which, of course, is where the generation earns value – or reducing aggregate consumption. So as a vertically integrated utility with generation and retail, it isn't obvious that pushing smart energy is in your overall business interest.

Similarly, using smart energy as a tool to balance systems, as opposed to calling on thermal generation, is a leap of faith to some degree. System operators haven't really taken that leap yet, at least not for mass roll-out of small-scale smart systems. Calling on large users to reduce load at key times is a bit better understood.

Using smart energy as a tool to balance systems is a leap of faith to some degree. System operators haven't really taken that leap yet

And again for the distribution companies, the network companies, to the extent that smart energy reduces the need for investment, it doesn't fit well within the basic regulatory model in most countries, which is about supporting investment by giving a return on capital while penalising operating expenditure.

So the basic economic case for smart energy comes down to reducing the costs for customers, not necessarily improving the profitability of utilities or network companies.

Are you saying is this is being driven more by policy-makers and regulators than by the industry itself? That the industry is, in a sense, being pulled into it?
I'm not sure that anyone is really driving at this stage. The people who are most excited about this are the technology providers and the people who would service all of the data.

If we want to continue to invest in renewable energy, we need something to help balance the system and smart energy is actually one of the tools. So there comes a point where it is strongly in the interest at least of some of the market players. But it doesn't fit very well with the traditional utility model.

Here in the UK we're talking about getting a whole lot of players to work together to make all this happen. And on a Europe-wide basis we have all the various countries involved, with the various differences that there are between them. How realistic is it to aim for a pan-European smart grid?
I don't think we need a single set of smart energy solutions for the whole of Europe. Essentially it's about delivering flexibility over different timeframes and the needs for flexibility are different in different systems. Ireland, for example, has a wind-driven system while the Nordic countries have a lot of hydro – so their needs are rather different.

What will happen is that balancing services are likely to get harmonised to some degree across borders to allow cross-border trading. That's an integral part of the European 'Target Model' that's being rolled out.

However smart energy covers a lot of things. For me it's about demand management and integrating demand to the decision-making. It can be more general than that. If we're rolling out things at the household level, clearly there are some economies of scale in standardised protocols and technology. There's potentially value in mandating some of this at a European level, at least for mass market devices. The really untapped potential is in commercial buildings and I don't think there's necessarily a need to harmonise there.

What evidence have we seen to date that smart energy systems can work in practice?
We're at the pilot stage. The UK is as advanced as anywhere in rolling out its pilots and the Low Carbon Networks Fund (LCNF) has been demonstrating some very good progress; there's a substantial sum of money there to demonstrate these kinds of 'smart' carbon-reducing technologies. But we're at an early stage in the whole demand-side revolution.

There are programmes which do call on demand-side participation. We designed one for Ireland, for example: the winter peak demand reduction scheme. That was quite successful in delivering in its first year about 100 MW of load reduction at the system peak.

And if you look at the Triad [i.e. peak] charging for [industrial and commercial] customers in Great Britain, it substantially reduces the peak load from the larger customers. The larger customers definitely have demonstrated their responsiveness to predictable prices.

The real challenge of smart systems is whether we can move that to a dynamic basis, so that people respond when we know what the wind patterns are – and, separately, whether we can take it down to smaller and smaller customers.

What are the main challenges in getting a fully fledged smart energy system to work – beyond smart metering?
Clearly there is some standardisation of the technology and protocols to be put in place. I think any of the technologies can be made to work now; it's a question of harmonising and getting some common systems. The incentives on the utilities, the network companies and the system operators are the key part of this. Without an appropriate regulatory framework we're not going to realise the value. There are real challenges as well in consumer acceptance.

The people who are most excited about this are the technology providers and the people who would service all of the data

But it does depend what we mean by smart energy. At the household level we haven't really got any load worth re-scheduling at the moment – not until we electrify heating and hot water, and later transport. At the domestic level it's not worth messing about with the timing of people's dishwashers.

The untapped potential is in buildings like the one we're in now where there are ventilation systems; there is quite significant potential to move load about without it affecting customers' experience. But until more dynamic pricing is fed into those businesses there's no real incentive to do that.

What about the political challenges?
Some of them relate simply to perception. One part of it is the attitude of consumers to the industry, which has got a very bad press at the moment.

Ten years ago people were virtually rioting in the streets over the level of diesel prices but now we have diesel prices higher than they were then and is that what consumers are encouraged to complain about, 60% of which is directly under government control? No, funnily enough the government has diverted attention over price gouging to the electricity companies and gas companies.

Governments have used the electricity industry almost as a scapegoat and that won't help the roll-out of smart energy systems. A low level of trust in the utilities isn't a good starting point for asking customers to allow other people to take control over some of the appliances in their house.

Similarly, there are lots of spurious concerns about data protection. We've already seen articles which say "the government will know when my fridge comes on and off". Frankly, I would imagine that even in totalitarian regimes the government might have more interesting things to worry about. There is a perception issue to overcome before we're going to get the real take-up, and data protection concerns could become a real barrier.

Demand-side response – whether by consumers themselves or in more advanced systems by network operators – will have a crucial role in smoothing out peaks and troughs in demand and helping to flatten price duration curves. How is demand-side response likely to work in practice in the three main sectors: household, commercial and industrial?

At the large industrial scale I would expect customers to be facing real-time prices and organising some of their production around that, with some kind of direct relationship with the local network business to avoid consumption at critical periods. Those customers may also be offering ancillary services to the system operator, directly or through an aggregator. So I guess those customers will be integrated in the market, whether it's getting value on an energy basis in the wholesale markets or through the balancing services or other flexibility contracts.

For the domestic consumers I would envisage automation. Unless it's smart it's not going to happen. Talking to people in Ireland, a friend gave me this example: someone makes the effort of changing the timing of his hot water tank to make sure he's not consuming electricity unnecessarily over the peak on a particular day, and his wife says later: "And how much did you save? Did you save the price of a pint of Guinness?" And he didn't because electricity only costs him half the price of a pint of Guinness a day.

Electricity costs the average household less than £2 a day so the potential to save money isn't that great in the first place. The people who would have the understanding to be able to do this wouldn't see the value.

So the answer is: you don't save the price of a pint of Guinness every time you spend time messing about with this, you save the price of a slurp of Guinness. So it isn't worth people's while unless it's simply automated and taken out of their hands.

If it is, then on the one hand we could have smart appliances - making their own decisions according to whatever criteria they're fed. But what about the concept of people's appliances being controlled remotely by a network operator or distribution system operator? Could we see that?

The concern will always be that people have local control to over-ride. Provided there are over-ride provisions, people will accept those kind of controls. There will obviously be a price benefit.

The next question is: who does the controlling? If we have flexibility from the demand-side, we can deploy that for lots of different reasons: it might be to benefit the local network operator; it might be to benefit the transmission operator in system balancing; or it might be simply a wholesale energy issue. If we lock down a control to only one of the counterparties, they will only have one of those values in mind. So it's important to make sure that the flexibility is offered for whichever of those services gives most value at the time.

Knowing who's doing the controlling, and whether the control is based on price or some other means, is an important part of getting the regulatory framework right. If it's just the distribution company, they don't perhaps care about energy prices. If it's just the retail business, they don't care about peak load on the distribution network.

You don't save the price of a pint of Guinness every time you spend time messing about with this, you save the price of a slurp of Guinness

Smart energy systems will generate vast volumes of data. How do you go about effectively managing that?
Is it any different to the telecoms business? If we look at the volume of data generated by people's mobile phone transactions, I imagine it's comparable. Clearly we need appropriate ways of managing the dataflow and dealing with security, especially once we start allowing remote control. I don't see that as a radically new issue. It may be new to this industry, but it's about designing effective centralised mechanisms. Having a national central data collector is a good starting point.

Decarbonisation, renewables and distributed generation

The European Commission says "smart grids will be the backbone of the future decarbonised power system". How can smart energy systems facilitate decarbonisation?
Look at wind generation and the need for backup. If we want a system built substantially on wind generation, we need to build back-up generation to meet demand during the peak hours when the wind isn't blowing. If we have a very well-established smart energy system we can move load away from those peak hours so we don't need to build the same quantity of back-up generation.

We've done a substantial amount of work on various intermittency studies and produced a number of public reports on what happens when we build a system substantially with wind and solar generation. How do the economics change?
We looked at various mitigating factors. We can solve intermittency technically in a number of ways. We can build a lot of back-up generation. We can build a lot of interconnection – but that's not a silver bullet because we can get low wind across wide areas of Europe at the same time. Yes, there is the concept of storage but we're building hundreds of gigawatts of wind and we are not going to be building hundreds of gigawatts of storage. The final mitigant is smart energy and being able to move load around to match generation – as opposed to the current regime where we bow down to the great god of demand and move the generation to match the load.

The growing share of renewables in the power generation mix will lead to growth in distributed electricity generation, such as small-scale solar and wind installations. What issues does that raise for the operators of electricity systems and how can smart energy technology help?
The distribution networks were designed for one-way flows of power from the generation to the transmission to distributors and then to customers. With the proliferation of distributed generation we start putting peak loads at points in the network that weren't designed to accommodate them, and smart

energy might trigger new local peaks at times when energy is cheap. With those less controllable and less predictable patterns of flow on the networks the distribution companies will need better monitoring tools and tools to control voltage.

Customer participation

Smart energy systems will require the active participation of consumers for the full range of potential benefits to be realised. How do you encourage consumers to participate?

Money should be the primary motivator. There will be a small group of people that like the new technology, some eco-friendly consumers who do this deliberately, but unless there's a money driver it's not going to take off. So we either mandate it or we give people clear incentives.

> *Trust in the utilities at the moment is at a low ebb. I think there will be a problem with customer acceptance*

There is a challenge there because electricity consumers at the moment have the right to consume how they want when they want. They don't face any penalty for consuming at the peak instead of at the off-peak. So, essentially, they have the right to consume peak power at subsidised prices. And electricity is relatively cheap compared to the value it confers.

Although I'm very conscious of the fuel poverty debate, nevertheless this is a very valuable product that we don't pay very much for, generally. How much time are people prepared to invest to save 20p or 30p a day?

So this stuff has to be automated; it has to be made really easy. If we can build the control equipment into every domestic hot water appliance and if it comes as part of our electric car chargers, then I think it will get taken up.

There is a problem though. We've seen consumer backlash against time-of-use pricing. As soon as we start to say to customers, "at the peak it costs you a lot but off-peak, when you don't really want it, it's cheap", we start introducing new constraints on people's decisions and they don't like it.

We've seen that backlash in Australia already, where the time-of-use pricing was really unpopular. We're working in Ireland now, helping the regulator with the smart metering strategy. They're proposing to mandate time-of-use tariffs – without this, the danger is that if customers don't like time-of-use tariffs, there isn't a strong driver for a retail company in a competitive environment to offer very segmented time-of-use tariffs. There needs to be some kind of push to overcome people's initial fears and perceptions.

Will it be easier to persuade industrial and commercial energy users than households?

It should be. It will be helped by the various CO_2 reduction requirements, and also the level of electricity prices now. Energy is more of a prominent budget item for most businesses these days and there's real potential to be able to get customers to move some of their load around without a great deal of effort and save some share of the cost.

For commercial businesses there is real scope. Most such buildings will have some kind of ventilation system with an energy management system at the heart of it – probably made by one of a small number of manufacturers, the Honeywell's and Dimplex's of this world, who are very keen on getting into the smart energy space.

The industrial customers, I would expect, are already doing this to some degree.

What changes though is that, at the moment, we know when the peaks are. It's rather predictable: it's 5 to 7 pm on a winter weekday, week after week. In the days of the Electricity Pool we could read the Financial Times and find out electricity prices for each half hour for the following day. Businesses could plan tomorrow's production schedule around those prices.

Those days are long gone. It turns out that with a windy system we don't really know which are the peak hours in advance. Generally the winter evening teatime period is the peak – but if the wind is ramping up during the course of the day, we might find that the effective peak isn't the teatime demand peak at all, the effective peak is actually sometime much earlier in the day. So if we've got a simple set of static tariffs that say "don't consume between five and seven, do it in the daytime instead", we may actually make the system worse on that day, not better.

Smart homes will require a range of new equipment. For example, in the UK, as well as a smart meter, homes will need a home-area network (HAN), a wide-area network (WAN) module to communicate data to the central data company; and an in-home display (IHD). If you have solar or wind power you'll need microgeneration control equipment. If you're going to have your appliances controlled remotely you'll need load control equipment. Will customers accept all this new stuff? Or will they perhaps feel that it's just a lot more complicated than it needs to be?

It comes up immediately against the issues of customer awareness on the one side, and whether they perceiving the benefits; and, separately, the issue of trust. As we've discussed, trust in the utilities at the moment is at a low ebb. I think there will be a problem with customer acceptance. The government needs to be doing something proactive to overcome that. It's not simply the utilities' job to sell this.

What can the government do to sell the concept of smart energy?

It's largely about education – making people aware of what the concept is. I see lots of negative articles in the press. I've seen comments in the letters pages of some newspapers saying "I don't want a smart meter because it helps wind farms". That's the level of debate that we see at the moment – but nobody is countering this nonsense.

The government is concerned about the cost of developing renewable and low-carbon energy systems. One of the ways of mitigating those costs is to develop a smart energy system alongside the new generation fleet, but if that falls foul of consumer acceptance issues we'll either end up with very high electricity bills or we won't meet the renewables targets.

Progress in Great Britain |

The UK has a programme to have a smart meter in every home and most small businesses by 2019. But smart meters are just a prerequisite for a smart grid. How long before we see a truly smart grid here in Great Britain?

I would say, before we've captured the full benefits, we're talking at least 2025. But there are some fairly early steps that we could take. We don't need everything to be smart. We don't need everything to be flexible. We only need to capture the most important loads and we've got enough flexibility. So we should be making real inroads by 2020. ■

Who is Stephen Woodhouse?

Stephen Woodhouse is a Director with Pöyry Management Consulting in Oxford. He heads Pöyry's Market Design group which deals with all aspects of energy market policy regulation and design, for private and public-sector clients. He has directed Pöyry's multi-client projects investigating the market implications of intermittent generation, and is working on other aspects of renewable integration and smart energy initiatives, including the Irish Demand Side Vision for 2020, and various projects to define an appropriate set of regulatory arrangements for smart metering and smart energy systems. He works with organisations across Europe on the implementation of the Target Model, and is leading Pöyry's work on the definition of future energy market design.

Project Enel's Progetto Isernia

The smart energy puzzle is coming together

In a rural area in the central Italian region of Molise, Enel Distribuzione is implementing the first smart grid in Italy. Progetto Isernia is one of an increasing number of projects in Europe that are taking a 360-degree approach to smart grid solutions. "In the Isernia smart grid we have concentrated all of the technologies that we plan to deploy at the national level in the future", says Paola Petroni, head of Network Technologies at the Enel Group.

| *by Heather O'Brian*

Progetto Isernia officially aims at "the implementation of innovative solutions under real operating conditions to optimally regulate the bi-directional energy flow on the medium voltage (MV) distribution network while integrating distributed energy resources (DER) and ensuring high system reliability and security."

The project includes:

- energy storage, integrated with PV panels and an electric vehicle (EV) recharging infrastructure managed to optimize the energy flow
- an information technology platform that will also be deployed to improve communication with generators and promote grid efficiency
- a forecasting system for distributed generation
- and lastly, new innovative household devices that will be delivered to end users to allow them to monitor their electricity consumption.

Enel Distribuzione plans to invest a total €10 million in the pilot project, which is set to be completed by 2014.

"Italy and Enel paved the way in smart meters so there is clearly interest in seeing the evolution of that", says Eric Woods, who follows the European smart grid sector for consultancy Pike Research. Woods notes that Progetto Isernia fits into a wider pattern shown in a number of other European smart grid pilot projects to look at a wide range of technologies and issues. Among companies now taking that broader approach, he says, are Spain's Iberdrola, Portugal's EDP, France's EDF and the UK Power Network, which is behind the Low Carbon London smart grid pilot.

The aspects of the project related to telecommunications are very important; they are key enablers for the smart grid

"With the exception of storage, most of the individual technologies are well developed by now", says Woods. "So it is a matter of studying how these specific technologies play into the smart grid equation and trying to understand which of these will be the most attractive from a cost-benefit perspective."

Damage |

As is the case for many other smart grid demonstration efforts, one of the main motivations for the Isernia project is the need to better integrate renewable energy generation into the distribution network. Due to the intermittent and sometimes unpredictable nature of renewable energy production and the fact that the power flows are now bidirectional, renewable integration presents a particular challenge for distribution system operators (DSOs). In Italy, Enel Distribuzione is by far the country's largest DSO, with about 85% of Italy's total electricity distribution volumes.

Geographical conditions at the Isernia site make network automation extremely important. The test site in the province of Isernia was chosen for the high concentration of renewable energy, in particular solar photovoltaic (PV), and to a lesser extent, hydroelectric power and biogas.

"When you connect distributed generation to the medium voltage (MV) network, it can make it more difficult for distributors to respect voltage requirements", explains Petroni, "and if these requirements aren't respected damage can also be done to network equipment." One way to avoid this is through the use of advanced information and communications technology (ICT) to help the system run more efficiently and match up production and generation in real time.

"The aspects of the project related to telecommunications are very important; they are key enablers for the smart grid", says Petroni. In Isernia, Enel Distribuzione is trying out a variety of communications technologies, including optical fiber infrastructure and the 4G (fourth generation) wireless communication protocols WiMax and LTE. "LTE's a very innovative protocol that has the advantage of an extremely low latency period", says Petroni. "Communication delays are very low."

Battery storage |

Another possible way to ensure network stability and integrate a growing amount of renewable energy—battery storage systems– is also being evaluated in Isernia. While the current high cost of these systems is one possible obstacle to their large scale deployment, most industry analysts concur that costs should decrease significantly in coming years. For the moment, traditional methods such as curtailing the production of renewable energy or simply building new power lines have proven to be more cost effective.

Progetto Isernia is testing Siemens' Siestorage system, and is using 0.7MW lithium-ion batteries built by the German firm according to Enel Distribuzione specifications. Petroni says the storage system is the first in Italy to be connected to the medium voltage network and one of the first in Europe. Enel Disribuzione began testing the system in late February and is now ready to go live with the storage system, as soon as the control system and the new communications platform with generators is fully operational.

Smart Info |

Enel Distribuzione is also trying to increasingly engage consumers, improving their understanding and awareness and domestic energy consumption and pushing them to take a more active role in the energy market. Indeed, more than the implementation of state-of-the-art technology, one of the trickiest challenges facing smart grid sponsors may be that of transforming a broad base of energy-wasting consumers into informed and active participants in the electricity market.

This summer Enel Distribuzione began distributing "Smart Info" devices to customers. These devices communicate with Enel's smart meter system through Power Line Communications (PLC), to provide customers near real-time and historic data concerning power and energy consumption split into time-of-use rates, among other data. Smart Info data can be displayed and managed on personal computers, in home

displays, smartphones or other household appliances. "We want to verify, if awareness really does help to reduce useless electricity consumption, as stated in several studies", says Petroni.

The potential universe of Smart Info users is the roughly 8000 families served by the Carpinone substation in Isernia. However, since participation in the Smart Info project is voluntary, Enel Distribuzione has been working hard to get the word out. Initially, the company met with the mayors of the 14 municipalities included in the project to explain the importance of the trial and how the Smart Info device works. An initial Smart Info roll-out this summer involved distribution to about 50 clients, who helped Enel Distribuzione to fine-tune its communication efforts. Since then the company has been present at local fairs and other events to promote the trial of the Smart Info.

Electric Renault

About 150 of the 8000 customers served by the Carpinone substation are also producers. Petroni expects that "prosumers"—producers who are also consumers– will be particularly keen to try out SmartInfo. The device allows them to access a more complete set of data about their own electricity production, she says.

Progetto Isernia also looks at the issue of integrating electrical vehicles into the electricity network, which is expected to be increasingly important as the market for electric vehicles develops. Five electric Renault Kangoo Z.E. vehicles were delivered this July to Isernia for use by Enel Distribuzione. The electric vehicle recharging infrastructure is integrated with both the project's storage system and a PV plant. Electric vehicles themselves may also be used like a storage system.

Another component of the project, says Petroni, involves the use of a new forecasting system for distributed generation. For smaller installations, forecasting is carried out on an aggregate basis while forecasts for larger plants are carried out on a plant-by-plant basis. "Some people say that distributed generation cannot be controlled but you are at least partially able to forecast it", notes Petroni. While the forecasting system does not yet enjoy an extremely high degree of precision, she says it is sufficient to help network operation.

Systemic benefits

Enel Distribuzione's Isernia project is one of a group of eight initial smart grid pilot projects for which the Italian energy regulator Autorità per l'Energia Elettrica e Gas (AEEG) has awarded incentives, as it seeks to stimulate investments. Enel Distribuzione's project was the most extensive of the eight and was also viewed as the most innovative by the AEEG advisers vetting proposals. The smart grid incentive, funded via the tariff DSOs receive for grid investments, sees selected projects receiving an extra remuneration of capital costs for a period of 12 years. Specifically, the weighted average cost of capital (WACC) for incentivised projects has been set at 9% rather than the normal 7%.

The Italian regulator would like to move towards an incentive scheme tied to the relative costs and benefits of specific investments and a consultation process is currently underway. However, some industry observers note that the lack of a consolidated method for analyzing the systemic benefits of smart grid investments makes the process of settling on methodology more complicated.

Frontrunner position

In Isernia and through other smart grid initiatives being pursued by Enel Distribuzione, the company is leveraging on its frontrunner position in smart meters, a fundamental building block for the creation of a smart grid. Enel began deploying its own automated metering infrastructure, Telegestore, in 2001, making it the first DSO in Europe to adopt smart metering on a large scale. Currently it operates more than 32 mllion smart meters in Italy and is completing installation of more than 13 million new-generation meters in Spain, where it is present through Endesa, the Spanish utility that is part of the Enel group.

Petroni says Enel Distribuzione should begin to have the first concrete results from Progetto Isernia next year. While Progetto Isernia is very much a work-in-progress, the company is enthusiastic about the contribution it can make to the smart grid of the future. "To get to this point, however, we have already done lots of R&D and planning and we aren't expecting any major surprises on the technological front. A lot of things that were just theory not long ago are now close to becoming operational technologies." ■

> *The aspects of the project related to telecommunications are very important; they are key enablers for the smart grid*

Some people say that distributed generation cannot be controlled but you are at least partially able to forecast it

Photo: Thinkstock

A summary of (some of) the most important findings in this report

That he who runs may read!

Are you in a hurry? Do you have no time to read this whole report? Then here is a selection of key quotes from the interviews and articles in the report, representing the most important themes and insights.

Why are we doing smart energy?

"The smart grid stimulates the 'greening' of our energy system, and it makes a crucial contribution to security of supply by enhancing the resiliency of the grid."

Christine Hertzog, Silicon Valley consultant, author Smart Grid Dictionary

At what stage are we in the smart energy transformation?

"A lot of things that were just theory not long ago are now close to becoming operational technologies."

Paolo Petroni, head of Network Technologies, Enel Group

"Compared with two or three years ago, smart grids have moved from an academic phase to an early industrialisation phase."

Laurent Schmitt, vice president of smart grid solution, Alstom Grid

There is a consensus among stakeholders that no new legislation on smart meters and grids is needed at European level. It's more about implementation now.

Patricia de Suzzoni, Advisor to the Chair of French energy regulator CRE

Where are we with the technology?

"With the exception of storage, most of the individual technologies are well developed by now. So it is a matter of studying how these specific technologies play into the smart grid equation."

Eric Woods, Pike Research

"We have completed the big technology push; we now want to focus on the social component."

Frits Bliek, programme manager technical consultancy DNV Kema, partner in PowerMatching City

"As an industry we have reached the ability to deploy smart energy solutions. Where we still have work to do is to make the technology work economically and to get the regulatory framework in place."

Bastian Fischer, vice president industry strategy of Oracle Utilities Global Business Unit

What is the best regulatory model?

"The Energy Efficiency Directive will help. But regulation is probably not the most important thing. Competition is."

Nandini Basuthakur, Senior Vice-President Opower

"There are many market actors ready to implement demand response programmes, but the EU has to set a framework for retail market data management, including the formats and interfaces for energy service companies to interact in a safe and secure manner."

Patricia de Suzzoni, Advisor to the Chair of French energy regulator CRE

"It would be very beneficial to the market – and demand response programmes – if capacity and flexibility were priced and paid for."

Jessica Stromback, Executive Director, Energy Demand Coalition

"The consumers can't do it themselves and it's not very clear that there's a strong business case for the people who need to facilitate it. So it needs strong regulatory push to make it happen."

Stephen Woodhouse, Director Pöyry Consulting

"Neither the government alone, nor the private sector alone, can accomplish the goal of modernising the electricity system."

International Energy Agency

What should be the role of the Distribution System Operator (DSO)?

"Managing data is not the main business of DSOs. DSOs take care of electricity."

Mercè Griera-i-Fisa of the European Commission's Smart Cities and Sustainability Unit, DG Connect

"The pure network operator may not need the same level and range of smartness as those who are offering advanced energy services."

Bastian Fischer, vice president industry strategy of Oracle Utilities Global Business Unit

EU sources suggest the Commission may tire of waiting for DSOs and national regulators to agree on cost recuperation for smart meters/grids and invite other players to step into the space.

What do consumers think of it all?

"Smart energy systems do influence people's energy consumption patterns, but they do not fundamentally transform everyday practices such as washing, cooking, heating and bathing."

Yolande Strengers, Research Fellow RMIT University, Melbourne, Australia

"We are sceptical about demand response and time-of-use tariffs… at residential level, even with electro-mobility at a large scale."

European consumer federation BEUC, position paper (2010)

How do we get consumers engaged?

"If you make me use less energy and reduce my bills, I feel good about you."

Nandini Basuthakur, Senior Vice-President Opower

"If you charge consumers for technology and you don't enable them to benefit from it you just rip them off."

Jessica Stromback, Executive Director, Energy Demand Coalition

How important are privacy and security?

"While the Europe-wide roll-out of smart metering systems may bring significant benefits, it will also enable massive collection of personal data which can track what members of a household do within the privacy of their own homes."

European Data Protection Supervisor (EDPS)

"It would be dangerous if cities were controlled by large private companies."

Gérard Magnin, Executive Director of Energy Cities

"When you look at big data, the EU clearly has a role, an incredibly important role and that is talking about data protection, privacy, security, and so on."

Ray Pinto, Senior Government Affairs Manager at Microsoft Europe

What is the best business model for utilities and energy suppliers?

"Utilities have to ask themselves how they will get out of being just a commodity player."

Nandini Basuthakur, Senior Vice-President Opower

Suppliers, consumers and the network operator interact smoothly in an automatically functioning virtual market which has turned out to be beneficial to all participants.

Description of successful integrated smart energy pilot project PowerMatching City

"A low level of trust in the utilities isn't a good starting point for asking customers to allow other people to take control over some of the appliances in their house."

Stephen Woodhouse, Director Pöyry Consulting

What are the most promising trends in the smart energy market?

Of course it's very important to benefit households directly but you can't ignore your biggest consumers – industry and commercial buildings.

Jessica Stromback, Executive Director, Energy Demand Coalition

"There is a trend forming for large commercial property management companies to use their vast holdings to produce or conserve energy or to participate in demand response projects."

Christine Hertzog, Silicon Valley consultant, author Smart Grid Dictionary

For commercial businesses there is real scope. Most such buildings will have some kind of ventilation system with an energy management system at the heart of it.

Stephen Woodhouse, Director Pöyry Consulting

"It's the opening up at the retail level that's going to create an explosion of innovation opportunities and economic growth."

Ray Pinto, Senior Government Affairs Manager at Microsoft Europe

And don't forget the role of telecommunications ....!

"The aspects of the project related to telecommunications are very important; they are key enablers for the smart grid."

Paolo Petroni, head of Network Technologies, Enel Group

After the meter, the way to keep down costs is for DSOs to partner up with telecoms companies to develop smart grids, i.e. overlay the electricity infrastructure with a communications infrastructure.

Mercè Griera-i-Fisa of the European Commission's Smart Cities and Sustainability Unit, DG Connect

Telecommunications group Softbank is building seven mega solar plants, making it Japan's largest solar operator by 2013. Along with other telecommunications companies like Nippon Telegraph and Telephone (NTT), Softbank is establishing a foothold in the power industry with an eye toward future sales of smart-grid data communications infrastructure.

EER correspondent Rudolf ten Hoedt reporting from Japan

Feature The case of The Netherlands

Smart meter rollout: how to do it – how not to do it

The Great European Smart Meter Roll-out envisioned by the European Union is meeting with an unexpectedly strong groundswell of opposition from consumer groups and privacy watchdogs. Critics say privacy and security risks have not been adequately dealt with and many even put question marks behind the supposed social benefits of smart meters. Experience in the Netherlands provides a classic example of how NOT to introduce smart meters. But the Dutch have learned from their faults and are determined to get it right this time.

| *by Jorinde Schrijver*

In 2006 the Netherlands was one of the first European countries to initiate a mandatory roll-out of smart meters to all households. In their wisdom, the government and the energy industry had decided that their initiative would be good for consumers – whether they liked it or not. That proved to be a big mistake. Led by the major Dutch consumers' organisation 'De Consumentenbond' (Consumers Union), fierce public opposition arose. Lots of critical questions were raised, especially on privacy issues. Why surrender control of our electricity

meters to distribution companies and let them have information about our electricity usage every 15 minutes? With some 'smart' analysing, this gives them information about whether an individual has breakfast or not, is on holiday, has an alarm system, etcetera. How is this information processed, how is it secured, by whom is it shared? Do the pros for the consumer outweigh the cons? Doesn't all that data traffic significantly increase power consumption? Do energy companies (in the Netherlands the task has been accorded to the distribution system operators) really have the ability to roll out such large ICT projects? What 'problem' do consumers have to solve anyway and for whom? Michael Karskens, the Consumentenbond's public affairs adviser, experienced the mood between 2005 and 2008 as 'very intense'. Industry and government, which had assumed a smooth transition, reacted strongly to the unexpected opposition. They did not want difficult questions. And they made basic mistakes.

The Consumentenbond found out that the energy companies were willing to install smart meters (that keep them informed of consumers' energy consumption), but not smart displays (that keep consumers informed). Karskens: "If the government's intention was to raise consumers' awareness of their energy consumption, thereby encouraging savings, why did they not offer smart displays?" Karskens notes that, for purposes of energy saving, displays are more important than meters. "The displays can just as easily be installed on the old meters and the information can be kept private." Concurring with the objection that the government bill conflicted with Article 8 of the European Convention on Human Rights, the Dutch Upper Chamber intervened and the government was forced to withdraw its bill. A new bill was introduced in 2010, which has now been adopted. In this plan, smart meters are rolled out in all Dutch households on a *voluntary* basis and consumers may decide what information they wish to share and when. Starting in January 2012, Dutch Distribution System Operators (DSOs) have started replacing traditional meters by smart ones on a limited scale. About one hundred thousand Dutch households have a smart meter by now. The DSOs meanwhile are closely examining the business case, which takes stringent privacy and security measures into account. The Dutch government will decide in 2013 how it will continue with the roll-out. If all goes according to plan, the DSOs should be offering all Dutch households a smart meter starting in 2014.

New ball game |

According to Bram Reinders, manager at the largest Dutch distribution system operator (DSO) Alliander (2.8 million electricity connections), the advantage of the false start is that everybody has learned from their mistakes. "Because there was an open public debate about issues such as privacy and security, the Netherlands has taken on the role of thought leader in smart energy," he says. He acknowledges that DSOs found it difficult in the beginning to deal with the perspectives of consumers and consumer organisations. "The task we have been given to roll out the smart meter is changing our business model. Thinking from a consumer's perspective is a whole new ball game for grid operators and

Smart meter, don't confuse it with the energy consumption display!

A **smart meter** is a new kind of energy (electricity and/or gas) meter that communicates directly with its data user (energy supplier, network operator or other authorised third party). An **energy consumption display** (readable on a monitor in home or on a mobile device) shows how much energy a household is using at different times. Smart meters can be installed without displays (in which case they will primarily benefit the data user), but displays don't necessarily need a smart meter either: they can also be connected to a 'dumb' meter.

of course we have to get used to it." Reinders speaks from experience. "When the Article 8 discussion [about privacy] arose, we went to Brussels and let technicians talk to human rights experts and lawyers. That was a fascinating confrontation. Our people were used to looking upon the transformation primarily from a technical perspective. Now they started to see things in a different perspective. Conversely, the legal experts became more aware of the technical complexity of the whole operation." But one discussion of course does not lead to a transformation in company culture. "Becoming more sensitive to social issues and incorporating this awareness into projects, has prompted us to take on staff with strong communication skills. Also the huge increase of ICT in our daily electricity distribution operations is an example of the voyage and discoveries that we are currently making."

There is no privacy without security. Therefore, another part of this voyage is Alliander's participation in the so-called European Network for Cyber Security (ENCS). This brand new initiative aims to bring together as many public and private parties in Europe as possible to work together on the security of vital infrastructures. At this moment the partners in this project are all Dutch: Alliander, KPN, KEMA, TNO, University of Nijmegen and the municipality of The Hague. Reinders: "Together with other organisations and the European Commission we are organising a Grand Conference on the awareness of cyber security with captains of industry and EU Commissioner Neelie Kroes. We hope this awareness campaign will bring more parties on board."

Many European countries reacted sceptically at first to the 'broad approach' that is now being taken in the Netherlands. But according to Reinders the mood is shifting. "There are more and more countries, like Germany and the UK, that are inclined to follow the Dutch example, and even take it a step further."

UK consumer campaign |

Anna Fielder, consumer rights advocate and campaigner at Privacy International, which campaigns against commercial and state intrusion, agrees that the Dutch 'privacy pioneering' has been of great help for the shaping of privacy protection policies in relation to smart meters in the UK. In May 2010 the UK government announced an accelerated £10 billion (now estimated to cost £11.7 billion) roll out programme to have smart meters in all British homes by the end of 2019. "There are huge differences between the Dutch and UK schemes," Fielder explains. "For example, in the UK the electricity suppliers are in charge of the roll-out, rather than the network operators. These retailers have a much more direct interest in selling electricity in a competitive market. So the rules have to be different."

Hacking smart meters

In April 2012, computer security expert Brian Kebs published a document from the FBI that voiced the FBI's fears of growing numbers of hack attacks on smart meters. The FBI report, dating back to 2010, detailed a series of hacks against a Puerto Rican utility that cost that company hundreds of millions of dollars. The FBI found that using cheap tools and software available online former employees of the power firm and meter maker managed to under-report energy use by up to 75%.

Another trick involved placing a strong magnet on the smart meter to stop it collecting usage data while still providing power. The fraudsters cashed in by charging consumers and businesses for cutting their bills.

To protect consumers against this commercial drive from suppliers on the one hand, and achieve the overarching political goal of saving energy on the other, the UK government plans to set up a central communications body, the so-called Data Communications Company (DCC). This independent entity is supposed to secure the two-way communication between the individual smart meters and the data users (suppliers, network companies and other authorised third parties). These data users only get data at a certain frequency and for specified purposes. "The policy on this is very complicated," says Fielder. "The proposal is for energy consumption data to be automatically collected by suppliers once a month, but they can also decide to do it daily by default, and consumers can actively opt out of this. But we know that in practice people often accept the default option, so few people are likely to opt out. What the government should be doing is make the retailers responsible for proving that they have the explicit consent of their customers to tap their data at frequent (a day or less) intervals, and for particular purposes."

Thinking from a consumer's perspective is a whole new ball game for grid operators and of course we have to get used to it

Fielder feels supported by recent conclusions from the European Data Protection Supervisor (EDPS). "Hi-tech monitors that track households' energy consumption threaten to become a major privacy issue," the European watchdog in charge of protecting personal data concluded. And: "While the Europe-wide roll-out of smart metering systems may bring significant benefits, it will also enable massive collection of personal data which can track what members of a household do within the privacy of their own homes." EDPS underscores the importance of the introduction of proper safeguards. These safeguards are not only necessary to protect consumers for possible 'abuse' by electricity companies (read marketing purposes), the data should also be completely safe from attacks from the outside.

Learning curve |

Both Fielder and Reinders notice that the degree of naivety about the roll-out is beginning to decline. Fielder: "We're halfway the learning curve, and fortunately people are getting more and more aware that this massive rollout has its dark sides too. What we see now, is that when people find out what the side effects of the smart meter are, they are opposed to it." On the question whether this will have consequences for the EU objective to have 80% of the European households provided with smart meters by 2020, Fielder answers in the affirmative. "This 2020 goal is unrealistic in my view, and in any case it was conditional on favourable cost impact assessments. It was a target set before the euro crisis burst out, and there's still so much work on regulation and implementation, that I don't think we will make it across Europe on that vast scale."Bram Reinders is more optimistic. "As a result of all the discussions and changes we are going through it may seem as if we are losing sight of the target. And maybe we are at this moment. But I am convinced that by dealing with the issues in a multidisciplinary way we are working towards an introduction that will be sustainable in the long term. I believe that is much more important than reaching that 80% target exactly. If we reach 70% and we can explain the story in the nine o'clock news – then that's fine, isn't it?" ■

Interview Yolande Strengers, Australian researcher

‘Smart metering can be a catalyst, but we need more than that’

Electricity is regarded by consumers as an essentially limitless commodity. This situation has to change if we are to put our electricity supply system on a sustainable footing, says Yolande Strengers, an Australian researcher who has studied smart metering demand management programs in the energy and water sectors. Smart meters can help in this transformation process, notes Strengers, but they are not a silver bullet.

I *by Annemiek Planting*

Yolande Strengers is quite clear about one thing: smart meters alone are not going to revolutionize the way people use energy. As a research fellow at the Centre for Design at the RMIT (Royal Melbourne Institute of Technology) University, she currently leads the Beyond Behaviour Change research group. The group investigates how and why everyday practices take shape, how technologies and infrastructures such as smart grids, smart meters and energy systems help shape, change or entrench everyday practices and how these can develop towards more sustainable ways of living.

Strengers’ extensive research shows that smart energy systems do influence people’s energy consumption patterns, but they do not fundamentally transform everyday practices such as washing, cooking, heating and bathing. Strengers: “Energy consumption is a by-product of our daily practices. If we want energy demand programs to be successful, it makes sense to focus on the question *why* and *how* householders use energy. In this respect we also need to think about the way we are designing energy systems and providing energy to householders – and the role that plays in shaping demand for energy. Electric power systems, the supplier-consumer relationship, available technologies and housing appliances are all part of people’s day-to-day practices.”

Air conditioning |

Throughout the western world energy is regarded by consumers as an invisible, limitless commodity. "This notion could be turned around by materializing electricity as something that we do have to consider in our everyday lives. Electricity cannot be provided without repercussions on energy costs or the environment", Strengers argues. "What has happened since industrialization is that energy use has kept increasing. At the same time the energy sector has been trying to keep up with this ever growing demand. Although many techniques and appliances have become increasingly energy efficient, the demand for energy is still rising as new products are launched on the market. People need to be made aware of this."

A clear example is air conditioning in Australia. "Fifty years ago hardly anyone used a household air conditioner. Today its market penetration is about seventy percent. On hot days this is causing major peak demand problems, leading to regular blackouts. Large investments in peak plants, grids, smart meters and demand management programs are being made to address these problems. The public is not aware of this, let alone of the question how they can be part of the solution. If we do not raise people's awareness of problems the industry is facing, energy demand and costs will continue to grow."

Strengers believes smart meters can help to bridge the divide between energy production and consumption. "They bring part of the responsibility for energy management into people's homes. In my research I found that dynamic peak pricing did get householders to shift their energy consumption to off-peak hours. In addition, it turned householders into co-managers of domestic energy demand. Feedback on energy data leads to a domestic consumption reduction of five to fifteen percent. But this feedback is still based on the supplier-consumer relationship: utilities provide energy and data to householders, who are expected to gain a better understanding of their energy costs and consumption. This may limit opportunities for reconfiguring the divide between resource management and everyday life. A new way of thinking is needed that prioritizes resource and environmental concerns instead of energy provision at all costs. This new way of thinking should also be reflected in smart metering and the feedback that is provided."

Super Cool Biz |

In order to achieve this shift in priorities, the industry needs to look outside the meter, Strengers says. "Policies and programmes that materialize energy as something with limited availability may well get householders really involved in domestic energy management, without them experiencing this as a burden."

In Strengers' experience people are very flexible and adaptive to resource scarcity. "In Australia we just ended a decade of drought. At a certain point people were asked to use a limited amount of water per day. And without anyone telling them how to cope with this relative scarcity, people became incredibly creative in living their lives with less water. In Japan, the government launched Super Cool Biz in the summer of 2011, a daring campaign where office temperatures were increased to 28 degrees Celsius as energy shortages were imminent. People were asked to get rid of their office suits and dress more climate appropriate. Several ministry workers were ambassadors of the campaign, and carbon emissions were reduced quite substantially. The campaign was repeated in 2012."

Other projects where irregular power generating resources such as solar energy were used, have shown a similar flexibility in people. Strengers: "Their awareness of energy naturally increases if energy access is limited. And then they find their own ways of living their lives, planning their everyday practices around energy availability. My RMIT colleague Dr. Cecily Maller is doing research on how migrants adapt to energy systems and resource availability in various countries. It turned out that different circumstances influenced the way they used energy but this always became part of their daily routine. Especially migrants who had experienced some sort of resource scarcity, held a common understanding not to waste resources. They were much more willing to change their behaviour when this was required by circumstances."

Meanwhile privatization of the energy sector is taking place in Australia. "I may not be aware of all the benefits privatization can bring", Strengers says. "However, I am concerned that privatization will reduce the sense of social responsibility for energy consumption. It positions electricity as a commodity that is not even owned by the government but by commercial parties and private interests. It is causing some confusion and leading to distrust of market players' motives. When the drivers of different market players are not necessarily in alignment, people are not sure who to believe. They are wondering if peak demand programs are really necessary. This may undermine the development of a collaborative relationship between householders and the energy sector." ■

Feature Smart grids

Smart grids move from research to early industrialisation phase

Smart grids – everyone agrees they are needed to transform our energy system. And indeed, projects are multiplying across Europe. Still, long-term success is by no means guaranteed. New regulatory frameworks are needed to provide investment incentives. And new players need to be brought into the market: Google-type companies that can get consumers to start having fun with their energy consumption. Milan-based journalist James Osborne took a smart ride across Europe.

| *by James Osborne*

Here is the good news: European industry has moved from the first, R&D phase of smart grids into a second stage that involves not just testing individual technologies but complete smart grid 'solutions'. Most of the experts we talked to are agreed on that.

"Compared with two or three years ago, smart grids have moved from an academic phase to an early industrialisation phase", says Laurent Schmitt, vice president of smart grid solutions at Paris-based Alstom Grid. The demonstration projects under way now are seeking to test a 'first phase of industrialisation', he says, involving larger numbers of end-users as a way to find a 'consumer context.'

All over Europe an explosion of smart grid projects is taking place. The European Commission's Joint Research Council (JRC) and industry association Eurelectric have published an inventory of all of the projects going on. They came to 300, which are all displayed on an interactive map on the website www.smartgridsprojects.eu. Some €5 billion is being invested in these projects, of which €3 billion is going into smart meters.

But there is bad news as well. All of this activity does not mean that the smart grid is here to stay. It still has a number of structural challenges to overcome. The four biggest ones are:

- the need for a proper regulatory framework that provides the right incentives for investments
- Standardisation
- Getting consumers to participate in the system
- Developing business models that will make it attractive for suppliers and consumers to become part of the smart grid transformation

We will take a look at each of those.

Challenge #1: Regulation and investments

At this moment, utilities operating in the highly regulated market for electricity distribution have little incentive to invest in innovation, especially in researching and developing technologies with uncertain outcomes. The reason is simply that they don't get paid for it. Regulators set tariffs on the basis of costs, not with an eye to making large investments in technological innovation.

"Over the last 20 years, distribution system operators (DSOs) have faced little technological innovation in the way they plan, invest in and operate their networks", explains Eurelectric, the industry body, in a report ("Regulation for Smart Grids") on how current regulation hampers investment in smart grids. "Instead, innovation has been mainly about reducing operating expenditures or creating new, more efficient financial structures." Eurelectric notes that, as new technologies will need to be developed, "DSOs will need appropriate incentives to innovate."

Over the last 20 years, distribution system operators (DSOs) have faced little technological innovation in the way they plan, invest in and operate their networks

"Europe is the region most exposed to renewable generation in the world and this puts us three to five years ahead of other countries, including China and the U.S.", says Alstom's Schmitt. "But we are behind in regulation and finding ways to move forward."

The European Union does provide various support schemes. The 300 smart grid projects counted by the JRC received a combined €184 million from the EU's so-called 6th and 7th Framework Programmes plus some €200 million from the European Recovery Fund, European Regional Development Fund and the European Energy Research Alliance.

And the European Commission is pushing for regulatory changes to encourage smart grid implementation. But it admits that progress is slow. "There is a considerable gap between current and optimal investment in Europe, which can only partly be explained by the current economic downturn", the Commission warns in a communication paper on smart grids of April 2011. "Unless a fair cost-sharing model is developed and the right balance is struck between short-term investment costs and long-term profits, the willingness of grid operators to undertake any substantial investment might be limited."

Challenge #2: Standardisation

Another major hurdle lies in the development of common standards for smart grid technologies, including smart meters. The Commission called on European standardisation organisations to provide standards for communication by March 2010 and complete harmonised solutions

for additional services by December 2011. But the process is well behind schedule. The reference architecture and first set of standards are now due to see the light of day at the end of 2012, even though some say that the broad outlines of smart grid technologies are already becoming clear enough for industry players.

"Some utilities are taking a gamble and making wide deployment before standards are developed", says Scott Petersen of Honeywell Building Solutions. "But many are holding back." To get around this barrier, Honeywell has abandoned its usual approach of using proprietary technology and embraced open standards. This reduces risk for clients such as utilities, which are wary of getting stuck with a system that becomes obsolete or else find themselves unable to change smart grid solution provider, explains Petersen.

Challenge #3: Consumer behaviour |

A key question is: how will people respond if they get the possibility to become smarter in their energy use? And will utilities be able to develop the more complex relationship with their customers which smart grids require?

While demonstration projects logically focus on 'enthusiasts' and early adopters, many users may not want to spend their days worrying about managing their 'smart' home. According to Christine Hertzog, a consultant based in Silicon Valley, author of the Smart Grid Dictionary and co-author of The Smart Grid Consumer Focus Strategy, a commercial space is likely to be created not just by utilities themselves but also by other players that are more finely tuned into consumer technology trends, such as cable TV providers, consumer electronics retailers, telephone companies and software developers.

These companies may be interested in proposing smart home offers alongside home security, home health and health-style applications, says Hertzog. "Many consumers don't want to understand smart grids better", she says, just as people don't need to understand how the Internet works in order to use it. We should not expect everyone else to think as much about it as anyone in the industry. If we are smart, it will be just the same service they enjoy now with the possibility of more active engagement." A lot of the energy-efficiency work will be done instead by machine-to-machine applications.

Challenge #4: The right business model |

But the biggest challenge may be how to get all the players to do their part and put everything together so that the smart grid system can subsequently develop "spontaneously".

The Joint Research Centre concluded in its report that most technologies are known, "but the new challenge that these projects are now confronting is their integration."

The Paris-based International Energy Agency (IEA) concluded more or less the same in a recent in-depth "Technology Roadmap on smart grids". "The broadness and complexity of the electricity system – technologically and from a regulatory and market perspective – and its importance to society in general, increase the necessity to understand who should perform the actions outlined in this roadmap. Neither the government alone, nor the private sector alone, can accomplish the goal of modernising the electricity system", says the IEA. "Collaboration is vital."

Frits Bliek, of the Dutch energy consulting and certification company KEMA, compares the situation to that of the early phase of the internet. "It's like getting the Internet into place", he says. "Once the basic components are in place, it's a question of moving into an area where all kinds of interactions come into place." ■

The development of smart meters and smart grids is still at an early and very uncertain stage. There are many pilot projects being carried out, there is a lot of legislation to be sorted out, there are many uncertainties about what roles will be played by various actors (energy suppliers, utilities, network companies, service companies, new entrants) and how (large and small) consumers can get involved.

EER's specialised reporters have fanned out across Europe and indeed the world to conduct interviews with a wide range of experts and stakeholders, with the aim of finding out:

- how smart energy policies are currently working out
- how smart energy policies may be expected to influence the energy field as they create opportunities and throw up obstacles for market players
- how businesses and other stakeholders are positioning themselves in this complex new field, exploring new methods of producing and distributing energy, measuring energy use, finding ways to save energy
- how consumers can participate in the smart energy transition

The result is a very timely report that reveals where the smart energy transition may be headed and which approaches may be the most promising. It contains 15 in-depth interviews and feature articles with some of the brightest thinkers in the field.

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