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adjective

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re'sourcefully — adverb
re'sourcefulness — noun

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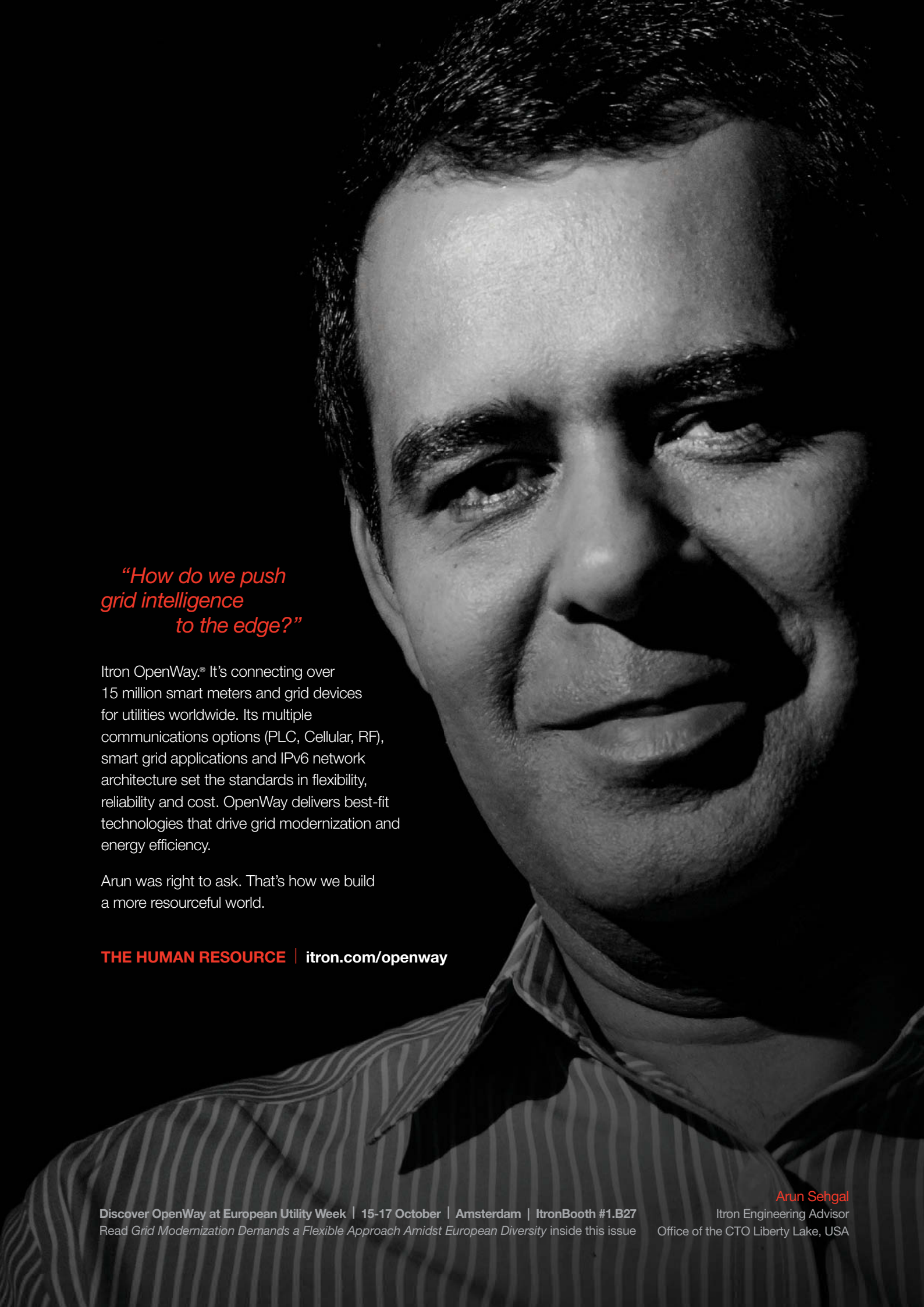

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Read *Grid Modernization Demands a Flexible Approach Amidst European Diversity* inside this issue

Arun Sehgal
Itron Engineering Advisor
Office of the CTO Liberty Lake, USA

EDITORIAL

FOCUS ON EUROPE

With more than 280 smart grid projects and 90 smart metering pilots and counting in 30 countries across Europe, it is clear that there is already considerable activity under way in this region.

These are the projects that have usefully been collected into a single database by the European Joint Research Centre, from which a good overview of what is being done by whom may be gleaned (p. 90). In particular a few interesting points emerge. One is that the size of projects and number of project participants is generally increasing, which is positive in terms of technology scalability and maturity. Another is that an increasing number of projects are being carried out on a multinational basis, which enhances opportunities for sharing not only of the outcomes but also the costs.

But it is also clear that the distribution of projects is uneven – in particular between Western and Eastern Europe – and that while a significant proportion of the funding is centrally from the EC, the number of projects in individual countries is broadly in proportion with the level of government support for these activities. With the EU 2020 targets looming and 2050 targets beckoning, time is fast running out for countries to make their commitments, particularly to smart metering rollouts. Funding, not only for smart metering but also the broader smart grid, will also need attention, with as much as €50 billion required for smart meters by 2020 and a further €480 billion for other system upgrades by 2030.

With this issue I complete 7 years as editor of Metering International, and have decided to step down to refocus my interests. I am pleased to introduce the new editor, Claire Volkwyn, whose background is in Africa's power sector. With technologies such as microgrids set to play a key role in Africa's and other developing countries' energy futures, she is well placed to guide this publication into the future. I will be focussing on our complementary digital offering, metering.com, for which at the time of writing a major facelift is being planned. Our aim is to provide you, the reader, with the knowledge and information you need with all the various tools and media at our disposal.

As always Metering International will have a strong presence at the forthcoming European Utility Week in Amsterdam, The Netherlands in October – the event promising to be the biggest and most comprehensive 'must attend' opportunity of its kind yet. We look forward to seeing you there.

Jonathan Spencer Jones
Editor
jonathan.spencerjones@spintelligent.com

FRANCE'S SMART METER ROLLOUT GETS GO AHEAD – BUT NATIONAL ROLLOUT NOT RECOMMENDED IN GERMANY

France's national smart electricity metering rollout has been given the go ahead and the national gas smart meter rollout has been approved in principle, but a national rollout has been advised against in Germany.

The first phase of France's rollout will see 3 million Linky meters deployed by 2016, with the full nationwide rollout of 35 million smart meters due to be completed by 2020, at a cost of €5 billion. More than 300,000 ERDF (Électricité Réseau Distribution France) developed Linky meters have been under test since 2009.

Final approval for France's gas smart meter rollout will be given following a tender process for the Gazpar meters developed by GrDF (Gas Réseau Distribution France). If approved, the proposal is for the first phase of 150,000 meters to be deployed over a year beginning in late-2015, with the remainder of the 11 million meters to be completed by the end of 2022.

However, in Germany a national smart electricity metering rollout has been found to not be cost beneficial and is not recommended. In particular, the study by Ernst & Young found that for consumers with low annual consumption, the costs of a smart metering system would significantly exceed the average annual energy savings to be achieved. Instead a targeted approach to the expansion of smart metering in Germany in line with energy policy has been recommended, with further details yet to come.

www.erdfdistribution.fr / www.grdf.fr / www.bmwi.de

PROVIDERS FOR GB SMART METER DATA AND COMMUNICATIONS COMPANY

Britain's government has announced the names of the preferred bidders to establish the Data and Communications Company (DCC), which will link the 53 million smart electricity and gas meters nationwide with the business systems of the energy suppliers, network operators and energy service companies.

The licence for the DCC has been awarded to Capita PLC. In this role Capita will manage the smart metering service of its users and will contract with, and manage, the data and communications service providers.

CGI IT UK Limited (which includes the former Logica) is the preferred bidder for the data service provider contract for the DCC, which will develop and operate the system controlling the movement of messages to and from smart meters.

For the communications service provider contracts, the preferred bidders are Arqiva Limited for the North region (north of England and Scotland) and Telefónica UK Limited for the Centre (Midlands, East Anglia and Wales) and South (south of England) regions. These contracts will provide wide area communications to and from the smart meters.

Gemserv is the preferred bidder for the Smart Energy Code Administrator and Secretariat, which will maintain and update the industry code governing the use of smart meters across the energy industry.

The bids are subject to the conclusion of the contracts, which have a combined value of £2.4 billion.

www.gov.uk/government/organisations/department-of-energy-climate-change

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FOUNDATIONS FOR NATIONAL SYNCHROPHASOR NETWORK IN PLACE IN US

The United States' electric system had installed 1,126 phasor measurement units (PMUs) and 154 phasor data concentrators (PDCs) at the end of March 2013, with more than 80% percent of these resulting from Recovery Act funded projects.

As a result large portions of the country are now covered by these technologies and although there isn't necessarily 100% coverage of the 12 project recipients' service areas, for most recipients, major portions of their area will be covered.

Based on preliminary calculation the median total installed costs of synchrophasor deployments in these projects are $43,400 per PMU and $107,000 per PDC, with individual costs ranging widely from less than half the median value to more than double the median value. This is due to the different functional specifications and capabilities of the devices, different construction requirements, and for many of the recipients limited experience in the technology. Thus, future installations would be expected to be less costly.

The US DOE hopes that, by 2015, half of the transmission operators will have, to some degree, planning or operating procedures in place that incorporate synchrophasor measurements.

www.smartgrid.gov

17,000 PREPAYMENT METERS IN DOMINICAN REPUBLIC BY YEAR-END

The Dominican Corporation of State Electrical Companies (Corporacion Dominicana de Empresas Electricas Estatales, CDEEE) expects to install approximately 13,000 prepay meters in the next few months to bring the total to almost 17,000 by year-end.

The three electricity distributors that comprise CDEEE (Electricidad del Norte – EdeNorte, Electricidad del Sur – EdeSur, Electricidad del Este – EdeEste) currently have about 3,700 prepaid customers. The new customers will be added in the National District and in the South region.

The prepay meter deployment began last year in El Manguito in the National District in EdeSur's concession area, before being extended to Sagrario Díaz, Esther Rosario and La Yuca. EdeEste has deployments in Villa Juana and Villas Agrícolas, and EdeNorte in the Pontezuela community.

Along with the prepay deployment the companies are also doing rehabilitation of the networks, including installation of new poles and transformers.

In the next stage EdeEste will install approximately 1,900 prepay meters in the Borojol sector of the National District, and EdeSur will install over 11,000 prepay meters in the South region.

www.cdeee.gov.do

KING ISLAND DEMONSTRATES 100% RENEWABLE PENETRATION

The King Island Renewable Energy Integration Project (KIREIP) has achieved a milestone with sustained periods of 100% renewable energy penetration when the diesel operation could be shut off completely.

With this result it is expected that zero diesel operation will now occur for extended periods overnight when customer demand is lowest, and in daylight hours under high wind conditions.

KIREIP is an initiative of Hydro Tasmania, and brings together a portfolio of new and existing technologies to increase renewable energy use on King Island and reduce dependence on fossil fuels. King Island is an island of about 1,000 km^2 in extent located in the Bass Strait, approximately half way between the Australian mainland and northwest Tasmania.

To achieve 100% renewable penetration Hydro Tasmania used its own advanced automated control systems and dynamic resistor technology, coupled with a standard flywheel uninterruptible power supply system that was installed last year. This enables all diesel generation to be switched off when there is sufficient wind and solar power to meet customer demand.

Hydro Tasmania anticipates that later in the year the performance will be enhanced further through the use of customer load control and energy storage. This will help maintain a stable power system in the absence of diesel generation, even during lulls in wind or solar conditions.

www.kingislandrenewableenergy.com.au

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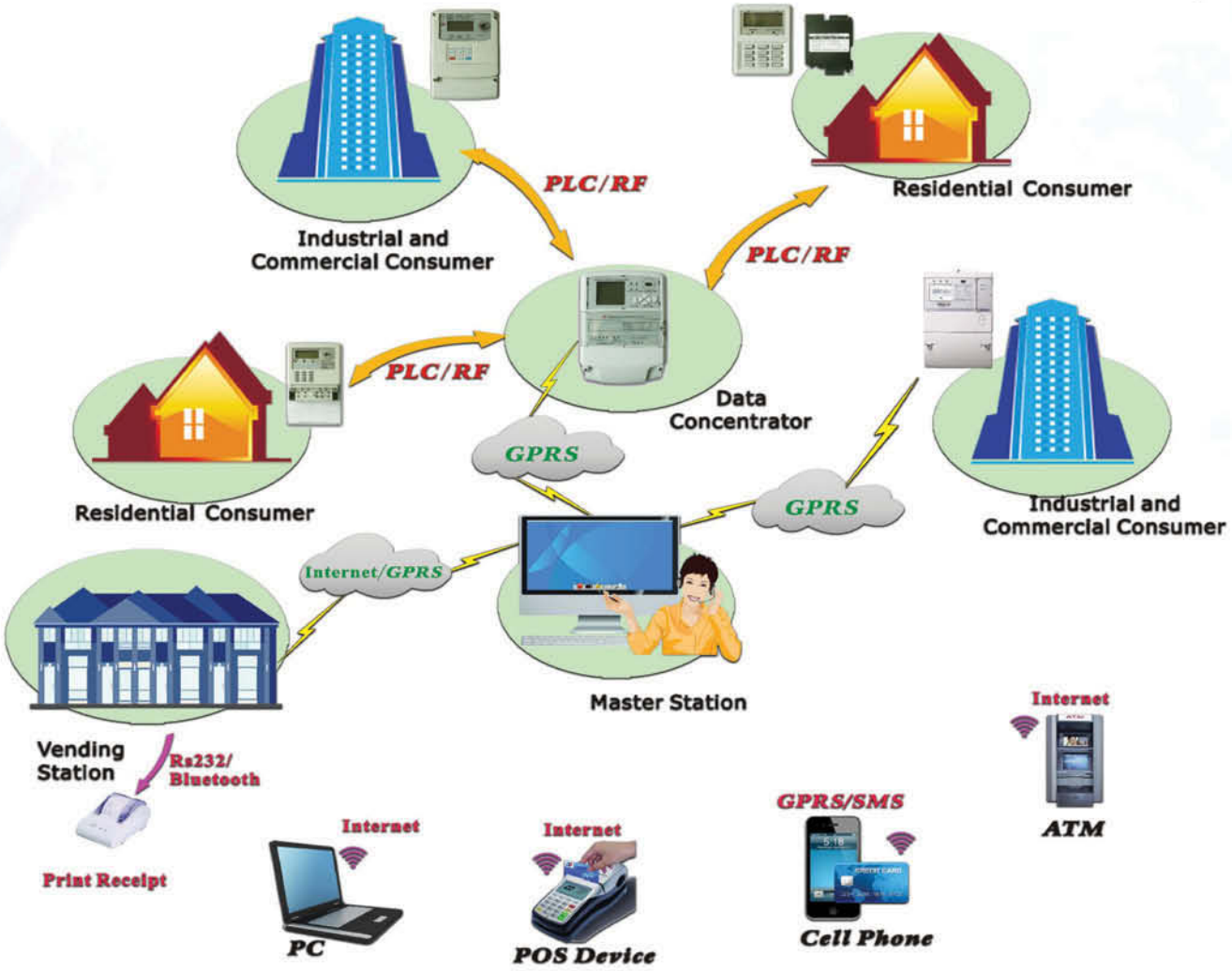

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IRISH WATER TO START WATER METER ROLLOUT

Irish Water has started its more than 1 million AMR water meter rollout across Ireland. Approximately 27,000 meters will be installed each month in the nationwide program, which is due for completion by the end of 2016.

In the first three months, water meters will be installed in Kildare, moving swiftly to Kerry, Meath, Wexford, Dublin City, Limerick, Mayo and Fingal.

Three regional contractors have been appointed to manage the installation of the water meters – GMC/Sierra Ltd., J Murphy & Sons Ltd., and Coffey Northumbrian Ltd.

Irish Water estimates that the program will create 1,600 jobs, and has committed to allocating 25 percent of roles involved in installations to small businesses, graduates and school leavers, and unemployed persons.

Irish Water has been established as a subsidiary of Bord Gáis Éireann, as a national utility centralizing the water services delivered by 34 county and city councils.

Water charges are due to be introduced in Q4 2014 with the first bills issuing from January 2015. Homes with meters will be billed on usage, while homes that have yet to receive a meter will be billed at an assessed rate.

www.water.ie

MORE WORLD BANK FUNDING FOR SMART METERING, SMART GRIDS

Smart meters, smart grids and other new clean technologies are to receive increased support from the World Bank.

A new paper outlining future directions for the World Bank Group's energy sector says that future activities will directly finance projects for specific sustainable energy technologies and facilitate new technology development through policy support, capacity building, the launch of clean energy market mechanisms, early stage equity investments by IFC in clean technology companies, and knowledge generation and sharing.

The paper, "Toward a Sustainable Energy Future for All," is closely aligned with the Sustainable Energy for All initiative, which has the triple goals of achieving universal access, doubling improvements in energy efficiency, and doubling the global share of renewable energy by 2030.

The paper says that supporting universal access to reliable modern energy is a priority. In countries with low energy access, the priority will be affordable and reliable energy.

Grid, minigrid, and off-grid solutions will all be pursued for electricity. In rural, remote or isolated areas, off-grid solutions based on renewable energy combined with energy efficient technologies could be the most rapid means of providing cost effective energy services.

Efforts to improve energy efficiency will be scaled up according to countries' needs and opportunities. Opportunities vary widely but include increasing the efficiency of the existing energy infrastructure through rehabilitation, moderating demand for energy, adopting more efficient technologies, and making cities more energy efficient.

The Group will also continue to support and finance all forms of renewable energy, as well as national and regional planning. Regional integration will be promoted as offering the potential to meet the three sustainable energy goals faster and at lower costs.

www.worldbank.org

JAPAN TO DEMONSTRATE LARGE SCALE GRID STORAGE

A large scale battery storage demonstration is to be undertaken in Japan by Tohoku Electric Power Co., Inc., Hokkaido Electric Power Co., Inc. and Sumitomo Electric Industries, Ltd.

The aim is to examine the installation and utilization of large scale storage batteries in electricity grid substations in managing the integration of renewable energies, as well as to develop the technology to optimally control and manage such batteries.

The demonstration is focused on measures for dealing with frequency variation and for adjusting the supply-demand balance in cases of demand decrease with the integration of variable wind and PV power generation.

Tohoku Electric Power Co., Inc. will install a 20 MWh Li-ion battery in its Nishisendai substation in Sendai, Miyagi Prefecture, in northeastern Japan.

Hokkaido Electric Power Co., Inc and Sumitomo Electric Industries, Ltd. will install a 60 MWh redox flow battery in the Minamihayakita substation on the island of Hokkaido in the northern prefecture. These companies will also develop the battery control and management technology.

www.meti.go.jp

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CONNECTICUT LAUNCHES MICROGRID PROGRAM

The state of Connecticut has awarded $18 million in funding, primarily through the Department of Energy and Environmental Protection (DEEP) Microgrid Pilot Program, for nine projects – and an additional prospective $30 million to come.

The program is designed to develop innovative ways to keep critical buildings powered during electric grid outages. Microgrids will provide electricity to critical facilities and town centres on a 24/7 basis and will include an isolation system so the microgrid can provide power despite any large scale outages.

The projects will provide power for government services and businesses that are critical during extreme weather events: police, fire, and emergency response teams, hospitals and health care facilities, state and town emergency response centres, grocery stores, and gas stations.

The Microgrid Pilot Program was established under Governor Malloy's storm bill (Public Act 12-148), which was passed last June, in the wake of Hurricane Irene of the previous year, to standardize emergency preparedness for natural disasters and intense weather events.

www.ct.gov/deep

SMART METERS FOR DJIBOUTI

A 3,500 smart meter pilot is to be deployed in the city of Djibouti by Sagemcom, with the prospect of later extension to more than 41,000 delivery points.

Sagemcom will implement its turnkey OFDM PLC PRIME solution including meters (single and three-phase), data concentrators and management platform, as well as the central meter data management software.

The project forms part of Djibouti's power access and diversification project, initiated in 2005, which is aimed at increasing access to energy and improving distribution service through new meter installation and electric lines restoration, among other activities.

In partnership with the World Bank, the authorities of Djibouti have opted for a smart electric grid, which will provide Electricité de Djibouti and its customers with streamlined access to distribution, efficient management of commercialization, and new sources of supply integration.

www.edd.dj

SOUTH AMERICAN SMART GRID MARKET WORTH $49.8 BILLION BY 2023

Smart grid expenditure in South America will cumulatively reach $49.8 billion by 2023, allocated across the five segments of advanced metering infrastructure, distribution automation, wide area measurement, home energy management, and information technology, according to a new study from Northeast Group, LLC.

The bulk of the spending will be in distribution automation ($23.2 billion), followed closely by smart metering ($19 billion with 80.7 million meters).

The study covers all ten Latin countries in South America. Eight of these countries already have significant pilot projects in place, while half of the countries have begun to develop some form of smart grid roadmap. Brazil is leading the way with pilot projects dating back to the mid-2000s, over one million smart meters deployed and a number of smart city projects that are testing out a variety of smart grid applications.

Ecuador has set an even more ambitious timeline for smart grid deployments, while Colombia and Peru are in the process of finalizing smart grid roadmaps. Chile is developing its own smart city projects, Argentina is funding smart grid R&D, and even Paraguay is developing smart meter pilot projects.

Beyond AMI, distribution automation is a focus for almost all South American utilities due to high outage rates, and several South American countries are also currently developing phasor measurement unit projects throughout the transmission grid.

northeast-group.com

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ATCO GAS COMPLETES AUTOMATED METERING DEPLOYMENT

ATCO Gas has completed its automated metering deployment including 1.1 million gas communication modules, mobile and handheld collectors and associated software, two years ahead of schedule.

This marks the largest gas automation project in Canada to date. ATCO Gas provides natural gas service to more than one million customers in Alberta.

The automated gas metering solution was provided by Itron, and is designed to help streamline the meter reading process, improve operational efficiency and reduce costs.

The installation at ATCO Gas was scheduled to be completed within four years, but took just over two years to complete, after starting in Spring 2011.

www.atcogas.com

CALIFORNIA AND TEXAS HAVE SMARTEST GRIDS IN U.S., NEW INDEX SHOWS

California and Texas have the smartest grids in the United States, according to a new Grid Modernization Index (GMI) developed by the GridWise Alliance and Smart Grid Policy Center.

The next group following are (in order) Maryland, Delaware, Pennsylvania, Arizona, District of Columbia, Ohio, Nevada, and Illinois. Completing the top fifteen are Florida, Virginia, Oklahoma, Vermont and Maine.

The Index is aimed to evaluate electric grid modernization in the US. It is based on a set of criteria comprised of three components – state policies and regulatory mechanisms that facilitate grid investment (policy), investments in customer enabling technologies and capabilities (customer engagement), and investments in grid enhancement technologies and capabilities (grid operations).

The study covered 41 states and the District of Columbia.
Among the findings:

- Scores for states that have retail choice, belong to RTOs or ISOs, and have renewable portfolio standards all showed high positive correlations, indicating a relationship exists between these federal and state policies and greater investments in grid modernization
- A high positive and statistically significant correlation was found between states that received ARRA Smart Grid Investment Grants and the scoring across the three components (i.e. policy, customer engagement and grid operations)
- No correlation was found between electricity end use prices in any customer segment and the Index scores, indicating that the price of electricity is not a primary driver for grid modernization
- States that scored higher overall in the Index also demonstrated higher scores in addressing cybersecurity and data privacy than other states
- States that scored higher overall also have higher scores in engaging customers
- States that scored higher overall also have deployed more sensors and advanced modeling tools for both transmission and distribution grids
- The 15 highest scoring states all have deployed smart meters to their residential and small commercial customers to some extent, with 10 of these having installed smart meters for at least 60 percent of their consumers
- Most states are lagging in the areas of establishing metrics, measuring the value of grid investments, and in determining appropriate cost recovery mechanisms.

www.gridwise.org

SMART BILLS THE WAY TO ENGAGE CUSTOMERS

Smart bills that are sent to an entire customer base can be a cost efficient and effective way to engage with customers, promote energy efficiency and foster conservation behaviour, a case study prepared by VaasaETT Global Energy Think Tank for the World Energy Council (WEC) and ADEME has found.

Smart bills were found to be responsible for reducing household electricity consumption by between 1.1% and 2.7% and gas consumption by between 2.2% and 2.8%, while at the same time proving cost effective compared to other feedback and energy efficiency programs.

In the study, smart bills were assessed from eight different geographies – California (U.S.A.), Ireland, Sweden, Victoria (Australia), Abu Dhabi (UAE), Chile, South Africa, and Hong Kong (PRC).

The study found that just a few simple features can greatly improve traditional bills and provide useful actionable insight to household consumers. Further while quality and insight are greatly improved by the data granularity enabled by advanced metering infrastructure systems, enhanced bills can also be implemented with traditional meter data, as shown by the case studies in Chile, Abu Dhabi, South Africa and Hong Kong.

Smart bills are also most effective when they are part of a comprehensive education and feedback package. The most advanced and arguably the best cases of smart bills are to be found in countries with both enhancing technology and supporting regulation, as for example in California and Ireland.

www.vaasaett.com / www.wec-policies.enerdata.eu

METER REPLACEMENT PROGRAM IN PAKISTAN PROGRESSES

The meter replacement project being carried out as part of the United States Agency for International Development (USAID) supported Power Distribution Program is making progress, with almost 40,000 meters replaced to date.

The project is replacing old mechanical meters and damaged meters with new electrostatic meters in three government-owned power distribution companies – Lahore Electric Supply Company (LESCO), Faisalabad Electric Supply Company (FESCO) and Peshawar Electric Supply Company (PESCO).

More than 20,000 meters have been replaced in LESCO and 9,000 in both FESCO and PESCO, in selected subdivisions where improvements in meter reading and subsequent customer billing can be monitored, a recent USAID statement was quoted as saying.

The objective of the project is to improve the commercial viability of the discos by improving the accuracy of the energy billed to the customers and eliminating the need to estimate bills. This will improve the confidence of the consumers in the accuracy of their bills and is expected to reduce the commercial losses of discos and improve their profitability.

The Power Distribution Program is a five-year initiative launched in 2010 to improve the performance of Pakistan's discos by reducing losses and improving revenue and customer services.

As part of the program it is also intended to install samples of both walk-by AMR systems and AMI systems in the discos.

www.usaid.gov/pk

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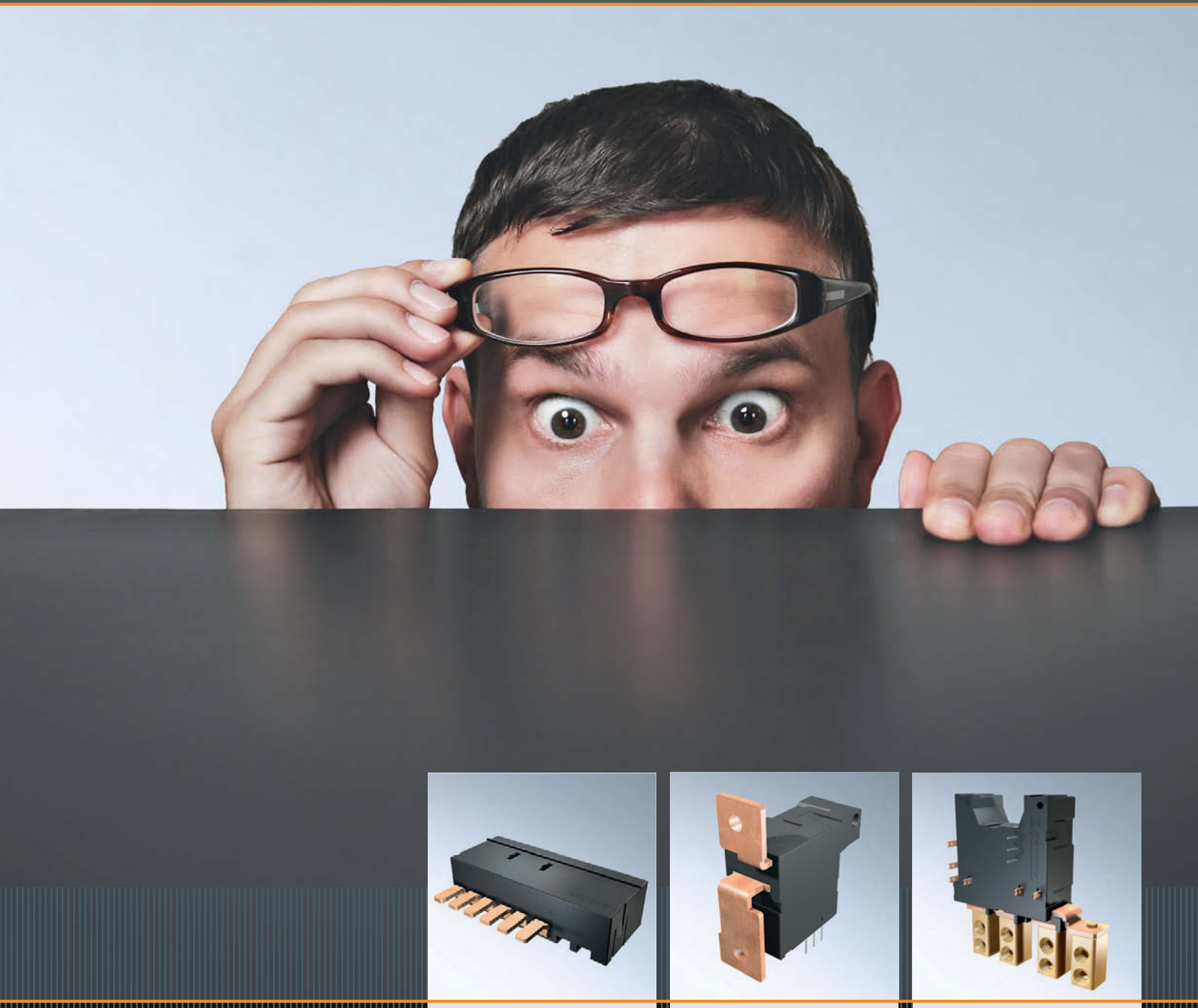

736 3-phase 100 A

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Schalten und Bewegen

DLMS/COSEM UPDATE: FUNCTIONALITY, EFFICIENCY, SECURITY, CONNECTIVITY

The new edition of the IEC 62056 standards series – the DLMS/COSEM suite for meter data exchange – has been published in Q2 2013 (see at www.iec.ch). With this step, the Blue Book (BB) Ed. 10 – specifying the COSEM object model/OBIS object identification system – and Green Book (GB) Ed. 7 – specifying the DLMS/COSEM application layer and the communication profiles – have reached international standardization.

The basic concept of DLMS/COSEM – with the extendibility of its object based data model and the flexibility to integrate new communication media – has been taken over by IEC TC13 in the DLMS/COSEM standardization framework project (draft IEC 62056-1-0).

To meet ever evolving smart metering requirements, the DLMS UA further extends DLMS/COSEM and brings the new results also to standardization. At the time of writing this article, the final touch is being given to the long awaited BB Edition 11. It has grown by some 40%, while keeping full backwards compatibility.

Functional enhancements:

- An extended version of the "Association" interface class (IC) enables the meter to distinguish between different users from the client side and to log their activities accessing the meter;
- The "Parameter monitor" IC enables the meter to build an audit trail of parameter changes;
- The "Push setup" IC supports the modelling of the data push operation: defined sets of data can be pushed by the meter to defined destinations, at a given schedule or event, using defined message formats and media.

New communication capabilities:

- New versions of the "Auto answer" and "Auto connect" ICs offer extended features to manage the connection of the meter to the network in a secure way;
- The "GSM diagnostic" IC provides monitoring of the GSM network operation;
- New setup ICs support the management of the latest OFDM-PLC technologies PRIME and G3;
- The new "IPv6 setup" IC supports data exchange over IPv6 networks;
- ZigBee® setup ICs support the configuration and management of a ZigBee ® local network by a DLMS/COSEM client. The new ICs are to be implemented partly in the ZigBee® coordinator, and partly in ZigBee® end-devices running DLMS/COSEM applications.

A new edition of the Green Book (GB Ed. 8) supporting the new features of BB Ed. 11 is in preparation. Among others, a new unified service to access COSEM objects, called *ACCESS service* and a new *general block transfer* service are specified, further improving efficiency. A new *DataNotification* service supports push operation. In addition, new *general protection services* providing the means for true end-to-end security between any user and the meter are also being specified. Further, the elements to support public key cryptography will be part of GB8.

SUMMARY

A short overview of latest developments of DLMS/COSEM is given. These will be presented at the DLMS pre-conference seminar at the European Utility Week. For more information please contact us at dlms@dlms.com.

Gyozo Kmethy, President, DLMS User Association
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FEATURED OPINION PIECE

What are the ingredients for a successful smart meter rollout? Lessons from across the globe

The recent delay in Britain's smart meter rollout has been regarded as an intelligent move by the government. Pushing the start date back to 2015 will ensure that the functionality will be in place to meet consumer demands. It has been widely acknowledged that consumer engagement and public acceptance is crucial to the success of the rollout, highlighted by what we have seen from the experience of the U.S. and our European counterparts.

http://www.metering.com/node/22933

FEATURED WHITE PAPER

Kinetis M Support for Distinct Separation of Legally Relevant Software

We are surrounded by residential, commercial and light industrial electronic measuring instruments. Water meters, gas meters, heat meters, energy meters, weighing instruments, taximeters, and many more electronic measuring instruments are all around us. Currently, most of this equipment includes a microcontroller dealing with billing information and parameters that are subject to legal control. In other words, our bills depend on the accuracy and reliability of the measuring instrument and its control software. Both the International Organization of Legal Metrology (OIML) and European Cooperation in Legal Metrology (WELMEC) provide advisory guidelines for writing applications for software controlled measuring instruments, namely, rules for software separation. This document describes the basics of software separation and shows the Freescale Kinetis M microcontroller family is well suited for measuring applications where achieving software separation brings technical advantages, reduces development cost, and accelerates time-to-market.

To view this white paper, visit: *http://www.metering.com/node/22879*

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Our Industry Expert Interview Series features exclusive interviews with leading industry experts who are part of European Utility Week 2013, either as speakers, sponsors or exhibitors. The event takes place from 15 – 17 October in Amsterdam.

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Utilities historically have had limited insight into the condition of the distribution grid, despite this being where a majority of outages originate. In the absence of distribution-line monitoring devices, grid operators have relied upon static and outdated models for state estimation.

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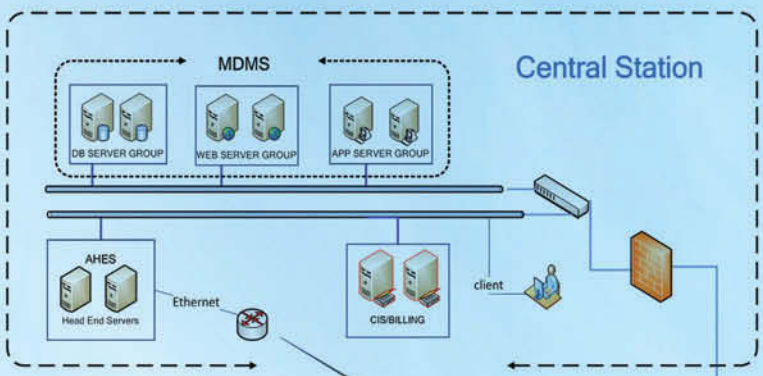
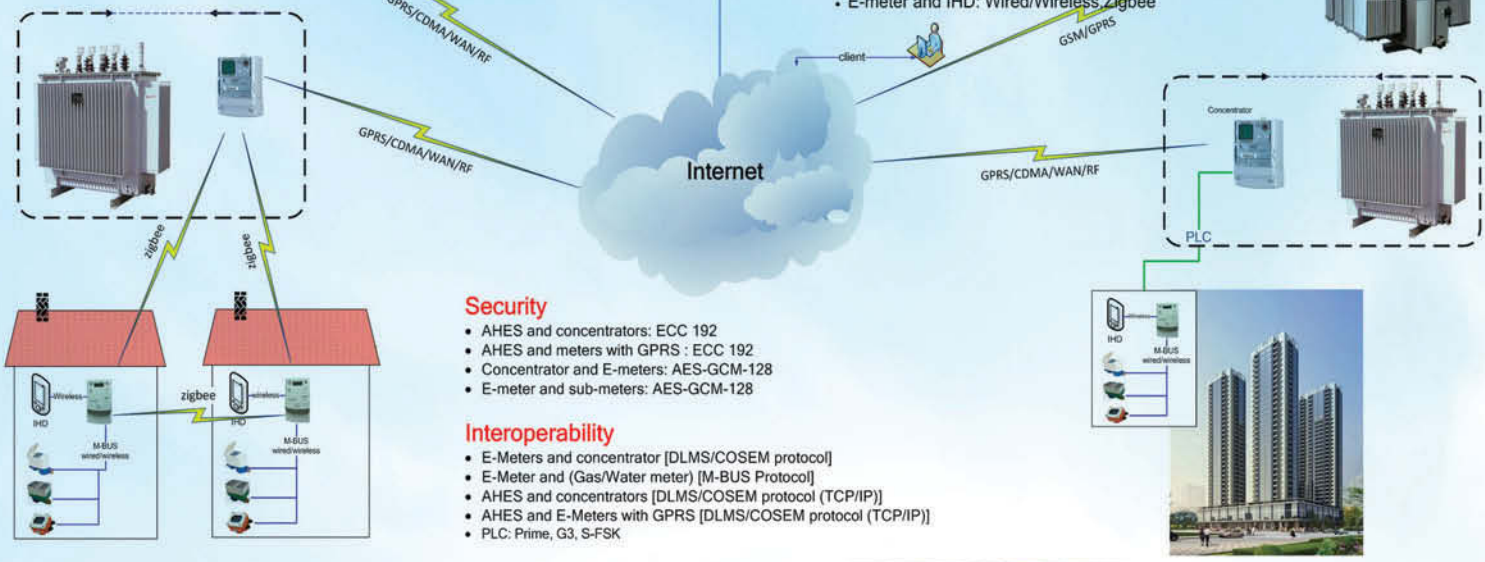


System construction

- Central Station
  - MDMS : DB servers, Web servers, application servers, client PCs
  - AHES: Head end servers
- On-site data collecting devices
  - Concentrators
  - E-meters (DLMS/COSM, M-bus,...)
    - single-phase meter
    - three-phase meter (DC, CT,CT/VT)
  - Sub meters: gas meter, water meter, ...
  - IHD
- Communication channels
  - AHES and concentrators: GPRS/CDMA/LAN/WAN/RF
  - AHES and E-meters: GPRS/CDMA
  - Concentrator and E-meters: PLC/Zigbee/RF/RS485
  - E-meter and sub meters: M-bus
  - E-meter and IHD: Wired/Wireless Zigbee



Security

- AHES and concentrators: ECC 192
- AHES and meters with GPRS : ECC 192
- Concentrator and E-meters: AES-GCM-128
- E-meter and sub-meters: AES-GCM-128

Interoperability

- E-Meters and concentrator [DLMS/COSEM protocol]
- E-Meter and (Gas/Water meter) [M-BUS Protocol]
- AHES and concentrators [DLMS/COSEM protocol (TCP/IP)]
- AHES and E-Meters with GPRS [DLMS/COSEM protocol (TCP/IP)]
- PLC: Prime, G3, S-FSK

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This column is to create a forum for ideas, passions and perspectives on our industry that are controversial, provocative and energising. The views expressed here may be unpopular, politically incorrect, heretical or simply humorous. They may be ideas that all of us have had but didn't care (or dare) to articulate. The opinions expressed are those of the author alone, but are probably shared by many who have yet to say so.

THE AMI BUSINESS CASE

FACT OR FANTASY IN THE REAR-VIEW MIRROR?

By Compos Mentis

A wild guess? A shot in the dark? A ballpark estimate? Wishful thinking? A business case isn't supposed to be any of these! It isn't supposed to be some wildly speculative guess about costs and benefits. I don't get it! We are talking about an AMI system business case. It isn't supposed to be hazy, wishful thinking. So what happened that has now prompted certain countries, provinces and states to doubt that the previously projected benefits of AMI can ever be realized? Why does Germany or the state of Maine now question whether projected benefits are realistic and realizable?

Oh, there is little doubt that some dubious business cases were developed that captured all favourable assumptions and ignored the negative, off-setting assumptions. I know of business cases where the alleged benefit to cost ratio was 1.05 to 1.00! I know of business cases where the absence of "hard" cost data in a particular utility meant that "broad industry averages" were used instead. I know of business cases in which the potential economic impact of unquantifiable benefits or speculative benefits exceeded assured benefits by factors of five or more. I've seen business cases that came up short of justifying what management wanted to do anyway, so the business case was padded with favourable assumptions to push it into a positive zone.

You have seen it. We have all seen business cases that claimed substantial future demand response benefits from peak sensitive pricing. We have all seen claims of even greater demand response benefits when customer-side technology is added such as smart thermostats, etc. Have those demand response benefits been obtained by anyone? Are they even remotely in sight? Why or why not? We need answers! Was it lack of TOU rates? Poor prior research? Lack of marketing? Customers not interested? Regulatory reluctance? We need answers! We need to know.

Business cases for AMI systems are hard work and require in-depth, enterprise-wide expertise and "penetration." An authoritative business case may easily take 3-6 months to produce. They demand the cooperation and participation of all facets of utility operations. Fortunately this process also produces the necessary "buy-in" by the various groups who must be involved in establishing costs, benefits and risks for their facets of the business. Generally, an experienced consultant team that is well armed with refined models and templates must be involved. It is an expensive but critically necessary process. The assumptions, estimates, and unknowns must be clearly articulated to establish the bands of uncertainly in the predicted costs and benefits. Only then can utility management and regulators know exactly what to expect. Yes, there is always some risk associated with the unknowns. Management can make a good decision only when given a comprehensive discussion of risks. A good business case is not abstract art. It is not a fashion statement. It is not a wild guess. It is a scientific, realistic portrayal of what is known and what is not known, with quantitative bounds on the potential consequences of the risks. A good business case is a valuable tool; not only when it is crafted but for years thereafter.

Every utility that has deployed an AMI system based on a detained business case should pull out that business case one year later, two years later, five years later to see if the projected benefits are truly as predicted. If not, why not? If not, fix it. If not, was the system or its implementation at fault … or was the business case an utterly inaccurate collection of whimsical nonsense?

We are seeing utilities and regulators questioning whether promised economic benefits are real. Do they exceed costs? If not, who should pay? Who is to blame? Do other utilities have good reason to go slow, or to call off their plans?

My friends, there is a lot at stake here. If regulators and utility managements are to make good decisions they must have good information. It is high time that current reality be compared with the projections articulated in the AMI business cases produced in the past 10 to 15 years. Our industry cannot go forward in the dark, or if big decisions become abstract guessing games. Let's pull out those business cases and see how we did. Let's share our lessons learned. Let's get it right! Your career depends on fact, not fantasy. MI

Compos Mentis is Latin for "a sound mind." This is the chosen pseudonym of a prominent North American expert with more than 35 years of direct experience in metering, AMI and smart grid applications worldwide. The cloak of anonymity allows him to insightfully "pop the balloons" of conventional utility industry thinking.

If you would like to comment on this Viewpoint, please write to the author at cm@metering.com

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TECHNOLOGY:
KEY TO ENABLE ENERGY SAVING AND REACHING THE 2020 TARGET

By Nicolle Raven

Consumer engagement is imperative to optimize energy savings and reach the stipulated 20% energy savings by 2020 at EU level. ESMIG believes energy consumption feedback and control technologies are essential to achieve energy consumption savings far above those typically experienced in pilots to date, on the premise that the consumer is educated, encouraged and assisted in the process.

The EU mandated rollout of smart meters accounts for 250 million smart electricity meters to be put in place by 2020. Up to now, only 12 member states have decided to go ahead with their rollout. Investments in smart meters are still limited on a European scale. This noticeable delay in the rollout of smart meters has several dimensions, but a fragment of the opposition against smart meters is based on misconception of what a smart meter actually is and can do for us.

Smart meters ensure accurate measurement and transmission of electricity, gas, water or heat consumption data or load profiles. They facilitate dynamic pricing based on its advanced time-based pricing mechanism. The smart meter will be connected to digital technology, communications and control devices. This creates an advanced metering infrastructure[1]. In other words, the smart meter is not a solution in itself, but a central part of an infrastructure that offers various smart grid-related functionalities to various stakeholders to gain insight in energy data and usage.

With this insight, consumers will be able to better manage their consumption and, as a result, to potentially lower their bill. Accurate and more detailed billing information will improve their knowledge about how much electricity they consume. Smart meters will also help make consumer processes more efficient and reliable, leading to faster supplier switching and higher consumer satisfaction.[2] In other words, to give the consumer as well as the utility the most accurate data on energy consumption, having a smart meter seems an obvious choice.

In most cases, the consumer will not read consumption data straight from the smart meter. Real data that are appropriate for consumers need to be presented in consumer friendly ways. There are several devices that can translate the data coming from the smart meter into understandable feedback on current consumption level, current bill and historical consumption. The functionalities of these technologies such as in-home displays (IHDs) should not be confused with those of a smart meter.

Research performed by VaasaETT, Empower Demand 1, is based on extensive analysis of more than 100 pilots. The study suggests an average energy efficiency saving from in-home display based feedback of around 9%.[3] The follow-up research, Empower Demand 2, confirms that to realize such energy savings, the use of communication and feedback devices are key.[4] Many consumers have been confronted with smart meter infrastructure technologies and related costs without sufficient understanding of how that technology might assist to manage their energy consumption.

ESMIG members produce all the technologies to realize consumer empowerment: smart meters with the correct functionality, IHDs, smart phone apps, web applications and more. All these are available on the market today. Below are some examples:

An example of direct feedback[5] is an energy monitor: a technology for meters that show actual consumption from the meter and possibly individual appliances. With this type of feedback, consumers can have more information about their energy consumption, so effectively this technology can lead to itemized billing and customers can modify their behaviour to cut their bills. The advantage is that it is easy to use: the display and interaction is simple and intuitive.

These monitors are already put into service as part of the UK foundation phase rollout and have showed their effectiveness in significant customer behaviour trials in, e.g. Ireland, the Netherlands and various other member states.

Examples of indirect feedback[6] are customer energy management (CEM) applications: a web application run by utilities and offered as a service to their customers. The advantage of this solution over monitors is that utilities can also engage with their customers: offering real time analysis of detailed consumption data, providing energy savings tips, comparing energy savings with their neighbourhood and sending feedback to the utility.

CEM applications are in use in Europe, Asia, US, Australia and New Zealand. In Europe, they have been implemented for example in Belgium, The Netherlands, France, Germany, UK and Switzerland.

Technology is an important and enabling factor in realizing the energy saving potential of smart meter enabled programs, particularly when developed in accordance with the needs of end-consumers, enabled through constructive regulation and introduced with outstanding consumer education. In ESMIG's Technology Review[7] you may find a full account of available technologies from ESMIG members. MI

1 SM-CG report TR 50572
2 Communicating smart meters to customers– which role for DSOs? A EURELECTRIC paper, June 2013, pg 6
3 http://www.esmig.eu/press/filestor/empower-demand-report.pdf
4 http://www.esmig.eu/press/publications-new/Final_Empower%202_Demand_Report_FINAL_Distr2.pdf/view
5 Feedback in real time, either through an individual associated in-home display or as part of a prepayment program
6 Feedback that has been processed before reaching the end-customer and communicated through another channel
7 http://goo.gl/nGZJX2

ABOUT THE AUTHOR
Nicolle Raven graduated in European Law and Politics, with a Master's degree in European Public Affairs. She worked as a public affairs consultant for 3 years in the energy and healthcare sector. After working for the European Commission on youth policy, she returned to the EU energy sector last year, as policy officer for ESMIG and as an Adviser with the Orgalime Partnership.

ABOUT THE ORGANIZATION
The European Smart Metering Industry Group (ESMIG) is the European industry association that provides knowledge and expertise on smart metering and related communications at a European level. ESMIG's members are the leading companies in the European smart metering market: meter manufacturers, IT companies, communications product and service providers, home energy management product and service providers and system integrators.
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SMART METERING PROJECT FOR BEDAS, ISTANBUL

IN POLE POSITION FOR THE TURKISH MARKET

Diehl Metering has tested the operational capability of its smart metering solution via powerline communication (PLC) under extreme conditions in a pilot project in Istanbul with resounding success. The results show that a large scale rollout is possible in Turkey in the near future – for economic meter reading, future oriented meter management and innovative energy services.

In close cooperation with the electricity utility Boğaziçi Elektrik Dağitim A.Ş. (BEDAS), Diehl Metering searched for ways of implementing full coverage meter reading based on PLC.

Difficult conditions: Although parts of the existing infrastructure were somewhat adventurous, the modern smart metering solution was implemented without problems

The test area was in the centre of the old city quarter of Istanbul. This area is a real challenge due to the complex urban development structures originating from various centuries. The widely differing mixture of old and modern infrastructure also had to be considered. The installation and operation of the smart metering solution had to be achieved despite these difficult conditions.

TURKEY IS READY FOR SMART METERING

The introduction of smart metering in Turkey is currently still progressing slowly. The reason is the simple fact that the meters belong to the end consumers.

The current pilot project is an initial step towards the introduction of smart metering for BEDAS. Besides the basic feasibility on the basis of the difficult conditions in the area, specific functionalities were tested, such as:

- Activating and blocking individual meters from the PLC
- Testing the performance limits of the infrastructure
- Working with different tariffs
- Automatic error alarm and event reports.

ONE STOP KNOW-HOW AND SOLUTION

For the test project in the old city quarter of Istanbul, Diehl Metering offered a turnkey smart metering solution based on PLC. The consumption data of the meters are transmitted over the existing electricity cable to data loggers and sent to the central METERUS system platform via GPRS.

To ensure that BEDAS can make optimum use of the possibilities offered by the smart metering solution, Diehl Metering supported the customer with know-how transfer and staff training, plus support and operation of the solution.

First the staff had to be convinced of the prospects and cost effectiveness of this new solution, which is a technological revolution for the Turkish market at the moment. Technical workshops and training courses were held to explain the system at the technical levels, show how to replace the meters and introduce the staff to the new tasks.

Diehl Metering is responsible for particularly sensitive system components, such as operation of the system software and taking the data loggers into operation. The advantages of transferring the risk are obvious: BEDAS can be sure of having a fully operational smart metering platform at all times – and Diehl Metering ensures that this is available.

MINOR OBSTACLES EASILY OVERCOME

The extremely varied infrastructure in the old city quarter of Istanbul was not a real problem in implementing the solution. The installation of the smart metering solution was completed quickly and without great effort. The transfer of data from the meters to the data loggers was provided by high quality system components from the Diehl Metering range, and the necessary mobile radio transmission from the data loggers proved to be very good and stable. The conditions for smooth long term communication were created by agreement with the mobile radio network operator.

So this first smart metering project in Istanbul was completed in only three months – including the test phase. The main hurdle to the introduction of smart metering will be overcome in 2014 on completion of the BEDAS privatization process already in progress and the change of ownership of the meters. At the same time the regulatory authority, TEDAS, is working on general conditions that will favour the introduction of full coverage smart metering and create sensible standards.

SATISFACTION WITH GOOD PROJECT RESULTS

BEDAS is highly satisfied with the course of the project. Finally, the good preparation and the professional project management by BEDAS favoured the success of the project. The positive feedback confirmed the demand for smart metering and its great relevance to the Turkish market. Diehl Metering and BEDAS proved to be real smart metering pioneers with their intensive and constructive cooperation.

Diehl Metering supplies everything for the economic and sustainable use of water, thermal energy, gas and electricity from its extensive portfolio of products and services – from meters, reading technology and smart metering to energy services.

Qualified services for the energy market are available from Diehl Metering's own Centre of Excellence for Smart Metering. These powerful services range from independent advice from experienced consultants accompanying the process and qualified support for operational business by expert personnel to cross-process training services. MI

ABOUT THE AUTHOR

Björn de Wever joined Diehl Metering in February 2010 and started as a project leader for several smart metering projects. As a member of business and project development at Diehl Metering, he takes the responsibility for supporting all business units from Diehl Metering regarding the business development in the field of electricity smart metering, meter data management and related services. A special focus is on smart metering turnkey solutions with a wide range of supporting services and multi-utility applications.

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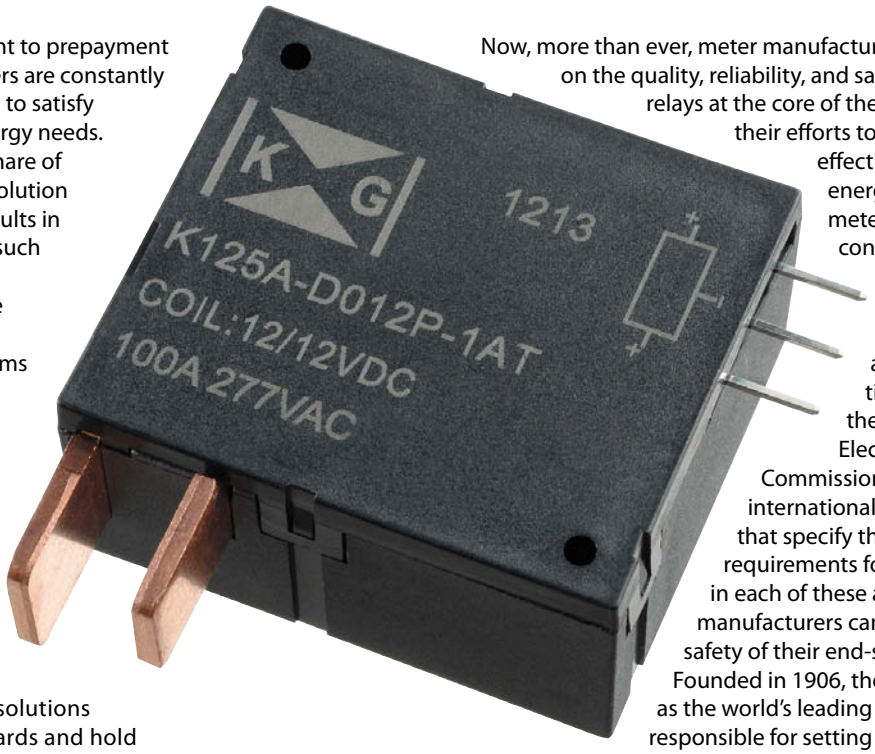
smart in solutions

DESIGNING TO STANDARDS SIMPLY PRODUCES STANDARD RESULTS

By Tim Wells

The smart grid is changing the way we power our lives. Latching relay companies who understand how to design products that meet international standards yet exceed expectations will provide a long term, high quality solution for meter manufacturers, as well as long term financial savings for energy producers.

From demand side management to prepayment meters, today's energy producers are constantly developing more efficient ways to satisfy the world's ever expanding energy needs. Yet evolution isn't without its share of trials and tribulations. Rapid evolution across an industry generally results in early headaches and setbacks, such as in aviation, architecture, and manufacturing. Whether it's the recently produced Boeing 787 Dreamliner with battery problems or a structurally inept garment factory in Bangladesh, the need for standards to ensure product and public safety is unquestionable.



Now as smart meter technology moves through its evolutionary cycle, both latching relay and meter manufacturers are faced with developing high quality solutions that meet international standards and hold up to the demands of the market. The jury may still be out on whether demand side management (DSM) is a positive service feature for energy consumers. Yet, it is apparent that as emerging economies become more energy dependent, energy producers will need to leverage smart meter technology to provide energy safely and economically. And while international standards ensure safety, they alone do not ensure high quality or effective pricing. Companies that understand how to design products that meet international standards yet exceed expectations will provide a long term, high quality solution for the meter manufacturers, as well as long term financial savings for energy producers. This type of front-end, proactive thinking is paving the way for a new generation of latching relay and meter base assembly solutions.

INTERNATIONAL STANDARDS SHAPE LATCHING RELAY TECHNOLOGY

Leveraging the advantages of DSM and prepayment meters is at the heart of next generation energy management. DSM gives energy producers greater flexibility in managing supply through the reduction of demand during peak hours, energy savings through individual load switching, accurate billing of consumers and the ability to disconnect users refusing to pay or abusing the use of electricity. This ability to disconnect power is possible because of the use of latching relays inside the meter. As a result, the latching relay has now become a key product feature for many meter manufacturers.

Now, more than ever, meter manufacturers are focusing on the quality, reliability, and safety of the latching relays at the core of their meters. In their efforts to provide a cost effective solution for energy producers, meter manufacturers consider the relay's ability to handle over-current, short circuits, and loads over time. Fortunately, the International Electrotechnical Commission (IEC) sets international standards that specify the minimum requirements for latching relays in each of these areas so that meter manufacturers can guarantee the safety of their end-state products. Founded in 1906, the IEC has served as the world's leading organization responsible for setting standards for electrical and electronic technologies. In coordination with its sister organization, the International Organization for Standardization (ISO), IEC works with international, governmental, and nongovernmental organizations to develop international standards, technical specifications, and technical reports that guide the design and manufacturing of a wide range of products. The two most relevant standards that apply to latching relay technology are IEC 61810-1 and IEC 62055-31.

IEC 61810-1 applies to electromechanical elementary relays (i.e. non-specified time, all-or-nothing relays) that are used in equipment. This standard defines the basic functional requirements and safety related aspects for applications in all areas of electrical engineering or electronics, including medical equipment, information technology and business equipment, telecommunications, and transportation. While IEC 61810-1 serves as the guiding standard for most latching relay applications, IEC 62055-31 raises the bar for latching relays used specifically for static watt-hour payment meters mounted indoors. This standard directly addresses the requirements for over-current, short circuit, and reliability.

"Latching relays designed for the way energy has been produced and distributed will not serve all purposes for the way energy will be produced and distributed in the future."

One of the features of IEC 62055-31 is the load switching performance requirement. This specific requirement is linked to a utilization category chosen by the smart meter manufacturer or designated by the energy producer. As an example, most smart meter manufacturers now require Utilization Category 3 (UC3) compliance to IEC 62055-31 for the latching relay used inside their meter. Previously, manufacturers only required UC1 or UC2. This higher requirement means that the relay (and consequently, the meter) must withstand higher short circuit or over-current events. Some latching relay manufacturers choose to partially comply (and assume the attendant risk) in order to save relay costs, by completing only the short circuit portion of the requirements and not the entire test suite.

While partial compliance might save a little bit of money, it does compromise the relay's ability to withstand repeated short circuit or current overload events. Additionally, the possibility of greater liability exists due to increased potential for a field failure, which would require field service and, consequently, added costs. This problem increases the variable costs for energy producers who often recoup these costs by monetarily penalizing their meter manufacturer. Thus, it pays to be proactive.

SMARTER DESIGNS YIELD LONG TERM GAINS

American business schools are known for using a popular quote from hockey legend Wayne Gretzky in teaching strategy to their students. Gretzky is famous for stating that he always skated to where the puck was going to be rather than where the puck had been. His natural intuition made him one of the greatest players in his sport, just as smart meter manufacturers today are attempting to set themselves apart in a market that has yet to fully emerge. Yet, smart meter manufacturers aren't doing it alone. In partnership with latching relay manufacturers, they are collaborating to build reliable, cost effective products that address the needs of diverse markets.

Latching relays designed for the way energy has been produced and distributed will not serve all purposes for the way energy will be produced and distributed in the future. As we are learning from emerging markets in Asia, India, and Latin America, the demands on a smart meter change as the use of prepayment meters increases. Now relays that have been designed to switch (or disconnect) less than a handful of times in their lifetime, may now be required to switch on a daily, weekly, or monthly basis. Issues brought on by magnetic tampering, shock damage, and over-current events have greatly altered the way latching relay manufacturers must think through their designs for use in a smart meter. This shift in thinking is also forcing meter manufacturers to partner more closely with latching relay manufacturers to build solutions that fit the future state use rather than solutions designed to fit the current state of energy distribution.

Current international standards require the same tests for all latching relays used for the same purposes – albeit, there are differing levels of testing for each usage purpose. So why then do some latching relays perform better than others? Foresight and collaboration. The latching relay can be the most expensive component inside the smart meter. Its quality, reliability, and safety are integral to the smart meter's functionality. Hence, it is becoming important for latching relay manufacturers to have the ability to produce a more value-added, integrated solution (i.e. the complete production of a meter base assembly). In doing so, they produce a more cost effective and efficient solution that has been fully tested within the end-state meter base assembly.

On the other hand, failing to proactively address the requirements of the entire meter may contribute to performance issues. Considerations regarding creepage, clearance, shock absorption, magnetic immunity, and mechanical/electrical endurance, if not adequately addressed, will ultimately decrease overall performance of the meter. The resulting added expenses and burdens of time are simply unnecessary and can be reduced when the relay and meter manufacturers collaborate earlier in the process. Earlier planning and collaboration allows both parties to meet the ultimate usage requirements for the relay, rather than simply relying on the relays to pass international standards as a confirmation of end-state product reliability.

KG TECHNOLOGIES: SOLUTIONS FOR THE FUTURE OF ENERGY MANAGEMENT

KG Technologies, Inc., a leader in switching solutions for the world's energy management market, prides itself on developing reliable latching relays and ensuring dependable manufacturing and distribution of its innovative products. Beyond relays, KG Technologies offers highly integrated value-added assemblies effectively streamlining its customers' supply chain and reducing overall the cost of procurement. The Cotati, California-based company looks beyond the current needs of the market to develop solutions that help the world switch to a greener tomorrow. To do so, KG Technologies focuses on building key relationships at both ends of its value chain and designing innovative products like the new K125 latching relay that raises the bar for quality and value.

KG Technologies believes in the importance of building open and honest relationships with its customers. As the company continues to look ahead to the future needs of the smart energy market, it recognizes that its customers need more than a latching relay supplier, but rather a thought partner who builds solutions that reduce failure rates, logistics costs, and lead times.

The company is building relationships in the market around these key objectives, which enables it to remain agile and provide flexible design solutions for the evolving smart meter market. It is through cultivation of these customer relationships that KG Technologies achieves its core customer service motto of working with you so that their products work for you. MI

ABOUT THE AUTHOR

For over a decade, Tim Wells has been working at companies at the forefront of innovative technologies, from where he has brought his expertise in leveraging customer relationships to enhance product design to KG Technologies. Now as Vice President of Engineering, he is cultivating global customer relationships to design innovative solutions for the smart meter market.

ABOUT THE COMPANY

KG Technologies, Inc. is a leader in switching solutions for the world's energy management market. We have developed patented latching relay technology for the smart grid that changes how the world handles high current, high voltage switching. Utilizing one of the largest, state of the art factories in the industry, we ensure high volume production, timely delivery and competitive pricing.

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AMI SYSTEM OPERATIONS POSE UNEXPECTED CHALLENGES

By David Gordon Kreiss and Masoud Abaei

Utilities have found that the operation of their smart meter/ AMI system is more complex than expected. AMI is not a mature technology nor is AMI operations a mature activity. Utilities have learned to expect the unexpected. This article will describe the challenges that utilities are facing as they operate their AMI systems.

AMI vendors for the most part have supplied quite reliable systems. They are to be applauded for providing both hardware and software that reliably collects and stores billing data. But when it comes to the myriad of tasks associated with the operation of an AMI system, utilities have experienced many unexpected challenges. Below is a summary:

- The identification and analysis of AMI meter and communications issues are more complex than expected
- AMI operating tasks are more complicated and require more steps than expected
- Operating and analysis tools beyond those supplied by the vendor are needed. These tools include geospatial, work management, reporting and analytical applications
- Many additional processes are required as well as unexpected changes to existing established processes
- The organization and staffing to effectively operate an AMI system was not clearly understood

BACKGROUND: AMI OVERVIEW OF OTA ACTIVITIES

AMI operations are focused on the performance and reliability of over the air (OTA) activities. AMI systems provide a number of daily OTA services. Billing interval data is generally collected daily. Many utilities also execute daily reads of network statistics, meter events, and voltage profiles. Other OTA services would include remote service switch activations or de-activations, meter re-programming (configuration), and diagnostic tasks to include meter pings and load side voltage checks. Also, a collection of OTA activities strictly associated with communications backhaul devices occurs continuously checking the health of these devices and collecting communications metrics.

In addition, large OTA activities such as meter and backhaul firmware downloads as well as mass configuration changes are conducted throughout the year. It is important that these activities do not affect overall billing read performance.

While these OTA services are carefully scheduled, it is not completely understood how the system will be loaded during the course of the day. Packet message size can be determined, but what cannot be identified is loading at any point of the system and the identification of bottlenecks.

The primary goal of an AMI system is to insure the reliable and timely completion of these OTA activities.

AMI SYSTEM OPERATIONAL OBJECTIVES

AMI operational objectives are to optimize network performance and manage risk and reliability. A metric for measuring network performance is meter read rate. A 99.5% daily meter read rate would be a target but a 98-99% actual rate is most generally the case for fully deployed networks.

Reliability can be measured in a few ways. Field device failures are used as a primary metric but other incidents that affect the ability of the AMI system to perform its OTA activities must also be tracked. These issues could be head-end system interruptions or data upload failures (to include ETL) or delays that are required for operations.

Risk will be discussed later, but as an operational objective, risk management is to avoid an incident that could have a significant financial impact or seriously affect the utility's reputation with the public or commission.

Below is a description of challenges being faced by utilities in meeting their operational objectives.

IDENTIFICATION AND ANALYSIS OF AMI DEVICE OR COMMUNICATIONS ISSUES IS MORE COMPLEX THAN EXPECTED

The necessity and effort to integrate many additional sources of data beyond those provided by the AMI system to effectively monitor and manage an AMI system

It was expected that an AMI system would provide data, such as meter events and head end communications "result codes" which would allow a client to directly identify hardware and communications problems. Utilities have found that this data alone is not sufficient and must be correlated and processed with a broad array of disparate data sources to provide actionable information.

AMI field devices, to include meters and backhaul, along with the head-end system provide quite a bit of information regarding the health of a device or system component. In fact, for a one million meter deployment, a utility can receive millions of records daily. This data by itself is not generally useful until it is correlated with other utility data. For example, a meter reporting a time synchronization event may not need to be addressed if it switched backhaul devices, or the system reporting a non-responding meter may not be relevant if the meter had been scheduled for replacement. The challenge utilities face is to first set up the rules for converting data to addressable incidents and then to integrate the necessary data sources to allow for a correlated analysis.

AMI system analytics require an end-to-end view

For many AMI incidents it is difficult to immediately determine the cause of the issue. Impacts of meter read rate performance could be due to backhaul device issues, backhaul system issues (cell tower issues), head end or network management issues or event security appliance issues. An end-to-end view is necessary to isolate the part of the system that has failed, become unavailable, or has become a bottleneck.

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Energy Measurement ICs (IEC-Compliant)

Device	Accuracy/ Measurement Error	Resolution/ Dynamic Range	Interface	Channels	V_{REF} Drift	Supply Voltage	Type
MCP3911	94.5 dB SINAD	16/24-bit	SPI	2	7 ppm/°C	2.7-3.6V	AFE
MCP3903	91 dB SINAD	16/24-bit	SPI	6	15 ppm/°C	4.5-5.5V	AFE
MCP3905A/6A	0.10%	500:1/1000:1	Pulse Output	2	15 ppm/°C	4.5-5.5V	Active Power Block
MCP3909	0.10%	1000:1	Pulse Output	2	15 ppm/°C	4.5-5.5V	Active Power Block

Recommended 8-bit PIC® Microcontrollers with Energy Measurement AFE

Product	MIPS	ADC Bits	Flash	RAM	LCD	UART	RTCC	Temperature Sensing	DMA	Power Down/RTC Current (µA)
PIC18F87J72	12	16 & 12	64–128	4	4 X 33	2	RTCC	CTMU	-	3.6/1.6
PIC24FJ128GA310	16	12	64–128	8	8 X 60	4	RTCC	CTMU	Yes	0.04/0.4

Recommended Wireless Solutions

	Device	Freq. Range	Sensitivity	Power Output	RSSI	Tx Pwr	Rx Pwr	Sleep	MAC	MAC Feature	Encryption	Interface
IEEE 802.15.4 Transceivers/ Modules	MRF24J40	2.405-2.48	-95	0	Yes	23	19	Yes	Yes	CSMA-CA	AES128	4-wire SPI
	MRF24J40MA	2.405-2.48	-95	0	Yes	23	19	Yes	Yes	CSMA-CA	AES128	4-wire SPI
	MRF24J40MB/MC	2.405-2.475	-102	20	Yes	130	25	Yes	Yes	CSMA-CA	AES128	4-wire SPI
IEEE 802.11 Modules	ZG2100MC/2101MC	2.412-2.484	-91	10	Yes	156	85	0.1	Yes	802.11	WPA, WPA-2, WEP	4-wire SPI
Sub-GHz Transceivers/ Modules	MRF49XA	433/868/915	-110	7	Yes	15 mA @ 0 dBm	11	Yes	n/a	n/a	n/a	4-wire SPI
	MRF89XA	868/915/950	-113	12.5	Yes	25 mA @ 10 dBm	3	Yes	n/a	n/a	n/a	4-wire SPI

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AMI TASKS ARE MORE COMPLEX AND REQUIRE MORE STEPS THAN EXPECTED

Firmware and configuration downloads and management

Field device firmware and configuration upgrade projects can be treated as an art rather than a science. The activity cannot be executed using a simple playbook where a fixed collection of steps can be taken to complete the task. The actual process is generally a broadcast(s) download followed by a collection of point to point jobs to help fill in the gaps, and then a series of cleanup and activation steps. Near time analytics and mitigation are required to mitigate communications issues during the process so as to get to optimize the number of devices with a complete download. This is extremely important since in some cases devices that have not received the new firmware or configuration would need to be replaced. This occurs when the new firmware is not backward compatible such as with a communication speedup or when a necessary security patch is pushed.

Security alert identification and false positive analysis

Maintaining cyber security of the field devices and communications system is a critical activity. While AMI devices do provide useful data for identifying a cyber-attack, the raw data must be correlated with other data to glean out possible threats. The data sources used for correlation are quite varied and include real time field activity information. In addition, AMI users are experiencing large quantities of false positive cyber security alerts. Manual analysis is often not possible to meet SLAs. Therefore, some utilities are implementing automated, rues engine, analytics to solve the volume problem.

Finally, the criteria for identifying a cyber-attack are constantly changing. Utilities often have periodic workshops with the vendor, meter organization, IT and their own security department to re-visit the rules and processes for cyber-attack management. Any changes must be implemented promptly.

Utilizing power outage and restoration events

A well promoted function of AMI meters was to issue real time notifications when connected power is lost and when power is returned. On the surface, the use of power outage events (POE) or last gasp transmissions seems rather simplistic. When a POE is received the expectation is that the premise has lost power, and when a power restoration event (PRE) is received the expectation is that power to the premise has been restored. However, that has not been the case. While AMI users did not expect 100% reliable reception of POEs and PREs, the actual percentages have been well below expectations. In addition, during complex outages (multiple outage and restorations due to the nature of the fault and response of the protection systems), it may not be possible to match a restoration message to a particular outage alert for a given premise.

Let us be clear that POEs and PREs are extremely useful data, of great value to storm outage management and no lights response, and to identify nested outages. But analytics and processes must be developed to support the raw POE and PRE data.

One last note, the expectation that POEs can be mapped to an individual transformer or phase of a circuit may be optimistic. Utilities have found that the accuracy of the electrical connectivity mapping of these assets can be too low to provide crisp analytics to accurately identify a faulted phase or a faulted distribution transformer. To remedy this issue there are a number of active projects to not only improve the accuracy of the existing connectivity model but to also create an automated system to maintain an acceptable level of accuracy over time.

Managing overall system risk

Risk, as distinct from reliability, defines an event that can result in a large financial loss or a serious impact on the reputation of the utility with its customers and commission. Utilities have experienced quite surprising events that thankfully did not result in a catastrophic incident. But there is the possibility of such incidents as a large scale unauthorized remote disconnect or a cascading equipment failure. Strategies and processes to address these risk factors were not generally implemented in the initial plan and deployment of the AMI system.

Faced with this unexpected challenge utilities are realizing the need for real or near time monitoring and analytics. In other words, the need for real time situational awareness. The specific need is to identify a critical event as quickly as possible. To supply management with real time information and to create processes with very specific SLAs to mitigate the impact if not prevent a potentially catastrophic event.

NEED FOR TOOLS BEYOND THOSE SUPPLIED BY VENDORS TO INCLUDE GEOSPATIAL, WORK MANAGEMENT, REPORTING AND ANALYTICAL APPLICATIONS

AMI supplied tools are insufficient

AMI system vendors have provided monitoring and analytical tools to support the operation of their system. These tools generally include the ability to perform OTA ad hoc data collection, a database for storing AMI data to include communications and meter events, and a reporting application that sits on top of the database. These basic tools have been insufficient for a variety of reasons.

As previously presented, AMI monitoring and analysis requires data from many different sources to include customer service, meter services, security appliance and backhaul data to name a few. The databases provided by the AMI vendors were not appropriate to store this data and therefore the AMI reporting system was deficient.

Need for an integrated geospatial application is critical

Many utilities are now integrating a geospatial analysis application in their AMI operations processes. These applications provide essential information to analyze meter issues especially when diagnosing possible RF issues. A geospatial field tool is also needed when engineering solutions to address communications issues.

Work management

The need for issue tracking tools to include work management applications quickly became apparent as the AMI user was faced with an unexpectedly large number of daily non responding meters and other system issues. Utilities needed an effective way of organizing and tracking the large number of AMI devices being worked on by the operations team.

EXTENT OF ADDITIONAL PROCESSES THAT WOULD NEED TO BE CREATED AS WELL AS CHANGES TO EXISTING ESTABLISHED PROCESSES

Most utilities deploying AMI systems found themselves creating many additional processes that were not originally expected. The handling of the many variations of security alerts, the management of backhaul activation/de-activation, security key and appliance requirements, and the management of mitigation driven field communications devices required in many cases unexpected processes. Change management also became a bigger task to not only manage process, release and version changes but also to manage diagnostics rules and work activities.

ORGANIZATION AND STAFFING TO EFFECTIVELY OPERATE AN AMI SYSTEM

It seems that every utility has its own unique organization structure to provide overall end to end management of the AMI system. Some utilities have a collection of loosely connected groups to

address each component of the AMI system. This results in separate groups to monitor, analyze and manage OTA communications, field device mitigation and management, head-end system, security appliances, MDM, and product management. In some cases still other groups are in charge of AMI related projects and processes.

What utilities have learned is that operating an AMI system requires a collection of skills that need to be tightly integrated rather than spread over disparate groups. This need becomes quite obvious when viewing typical AMI operational processes such as "mitigation of non-responding meters" and "security alert false positive analysis". For a 1 million meter deployment, hundreds of new meters may not have communicated over multiple days. To effectively and efficiently process these non-responding meters requires effort from those with expertise in mesh networks as well as backhaul communications, head-end IT systems, field devices, and even customer service systems where the meter may have been removed or cut out flat. As noted earlier, utilities receive quite a few potential cyber alerts a day. Again, this requires expertise of the operations staff over a range of AMI components to effectively and quickly perform false positive analytics.

CONCLUSION

AMI systems have delivered great value. The OTA collection of billing data has been successful and utilities are piloting projects to utilize AMI functionality in smart grid oriented distribution operations to improve system efficiency and reliability and reduce O&M. But the operation of an AMI system clearly requires staffing, tools, and processes beyond what was generally planned. AMI systems are just more complex than expected.

Many utilities are finding it difficult to address the challenges discussed in this article. Not because of technology but because the cost to address these challenges was not included in the original project funding package. The result is that utilities are addressing each challenge with a piecemeal approach rather than architecting a holistic solution. While the piecemeal approach may seem more feasible to obtain funding, over the long haul it will cost more. Incident identification application should be integrated with work management as well as geospatial tools. The result is that instead of utilities having an efficient operating centre with integrated operating system software, they have sets of standalone tools and are in a constant state of catch up.

It has been only recently that large scale deployments have been completed and their utilities are assuming operation control from their vendors. Much is being learned and hopefully will be shared. One utility has just deployed an enterprise AMI operations system that provides real time monitoring and automated analytics. Others have integrated AMI data into their volt/var and distribution automation system. We can expect that the systems, tools, staffing and processes associated with AMI operations will evolve over many years to come. MI

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AMI REGULATION IN A CONTESTABLE METERING MARKET

By Ron Beatty

Competitive electricity trading is a complex industry, with high market turnover but low profit margins. Consequently, the risk profile, including regulatory risk, can be considered high.

Most of the volume of sales in any electricity market is measured for invoicing by electricity meters that were once considered non-strategic assets, but have now become strategic information sources for consumers' decision making processes.

The electricity industry has evolved from 100+ years of monthly, quarterly or even annual meter readings and averaged tariffs used to calculate consumers' invoices, to time-of-use metering capable of delivering accurate price signals directly to consumers. We are seeing the metering industry evolve from producing 'dumb' data to an in industry providing information that can benefit both the industry and consumers, provided that regulatory requirements allow this to occur.

The extent that a market deregulates the provision of metering services determines who carries the investment risk, and how much of the cost of these risks is passed on to consumers.

A DEREGULATED ELECTRICITY MARKET, INCLUDING MARKET FOR METERING SERVICES

The New Zealand electricity market is a workably competitive and deregulated market governed by the Electricity Authority. Full retail competition in the New Zealand electricity market commenced on 1 April 1999. Market activities that are deregulated include generation and retail; line service remains a natural monopoly. Consumers are free to choose which retailer they want to purchase electricity from, and retailers are free to choose the offer that they make to the consumer, and how that offer is delivered. This includes the type and attributes of any metering, as well as the metering service supplier.

The following characteristics of the New Zealand electricity market set it apart from other electricity markets:

- Contestable metering and metering service provision (traders may displace a meter owner at a consumer's point of connection). The usual reason for such displacement may be cost, available functionality, level of service, or compliance with the metering rules
- Full global reconciliation – all buyers and sellers buy from and sell to the electricity market on the same terms
- The average time period for consumers to switch between retailers is less than three business days
- Tradability of distributed generation to ensure that any consumer that elects to generate electricity can have the generation settled in the electricity market, and can freely switch between retailers
- Retailers typically read meters monthly or, at most, two monthly.

A RETAILER-LED, NON-REGULATED ROLLOUT OF AMI

Until recently, New Zealand had an aging legacy metering population, but is currently undergoing a retailer-led, non-regulated rollout of advanced metering infrastructure (AMI). Approximately half of New Zealand's metering stock has already been replaced with AMI.

There are several drivers for this:

- The current metering requirements regulated by the Authority require all metering installations to be certified in accordance with the metering rules by 1 April 2015
- Full retail competition has caused retailers to actively offer beneficial services that will attract and retain customers
- The structure of the electricity market means that the savings from AMI in relation to reduced manual and estimated meter readings, invoicing , connections, disconnections, and vacant premises consumption, accrue to retailers.

There are few jurisdictions that permit contestable metering to the degree that New Zealand has. While there are pluses and minuses to a deregulated metering industry, the Authority considers that:

- There are definite advantages in leaving the decision making for investment in AMI and the development of metering services to those that have the ability to innovate and develop offerings for the benefit of consumers
- In a competitive metering market, the decision on who supplies the metering at a consumer's premises does not necessarily need to be regulated to protect consumers
- Competition can deliver significant benefits while driving down the costs of providing and maintaining both conventional and AMI meters, especially in the current period of rapid technological innovation.

CONTESTABLE METERING HAS LONG TERM BENEFITS TO CONSUMERS

The contestable principle puts suppliers in charge of key investment decisions in metering. It provides the best means of providing benefits to consumers over the long term by:

- Ensuring that the cost of metering is appropriate for the functionality required, and aligned to the benefits
- Making investment risks more transparent to meter owners so that an efficient level of investment is likely to occur
- Providing an incentive for meter owners and the users of AMI information to be continuously innovating to improve the services they provide.

"Metering arrangements are complex and the provision of accurate metering information is absolutely critical to the accurate operation of all downstream market settlement"

METERING REGULATION – KEEPING PACE WITH RAPID MARKET AND TECHNOLOGY EVOLUTION

New Zealand's current metering rules originated in 1994 as part of the Metering and Reconciliation Information Agreement (MARIA) that enabled retailers to compete for large consumers. The metering rules were updated in 1999 to allow for full retail competition. Since that time, the shape, composition and technology of metering has substantially changed as the electricity market has evolved. Some examples of this evolution are the entry to the market of third party meter suppliers and the development and implementation of AMI, smart grids and lower cost distributed generation.

Metering arrangements are complex and the provision of accurate metering information is absolutely critical to the accurate operation of all downstream market settlement and consumer invoicing activities. In order to ensure that the metering arrangements have kept pace with the evolution of the market, the Authority and its predecessor, the Electricity Commission has:

- Reviewed the potential consequences of the installation of new metering technology and published an AMI policy and associated guidelines in early 2008
- Reported on its review to the Minister of Energy in December 2009 and recommended against a mandated rollout of AMI
- Reviewed and completely revised the current metering rules.

This review process commenced in August 2008 and was taken over by the Authority in November 2010. The new metering rules will become effective on 29 August 2013.

NEW ZEALAND'S METERING RULES REQUIRED SIGNIFICANT REVISION

The development of new metering rules that set a regulatory structure that allows innovation, while ensuring that the Authority's statutory objective is met, has been a long and difficult process.

What became rapidly obvious, even to those relatively unfamiliar with existing rules, was that there were numerous problems with the existing requirements:

1. The existing metering rules were out-of-date:
   a. They did not reflect the impact of changes in the ownership arrangements for metering installations since 1999. Participants had obligations placed on them by the metering rules, when they were not in the best position to manage those obligations. Information flows had also changed significantly, making it very difficult if not impossible for participants to comply
   b. They were internally inconsistent, referred to obsolete international standards, were ambiguous in some parts, and were obscure in other parts
   c. There was a lack of transparency with respect to the specific (and timely) information necessary to allow efficient customer switching
   d. In some instances they raised barriers to the innovation opportunities presented by AMI and other new technologies.
2. Responsibility for providing a metering installation, and ensuring it is compliant with the metering rules required clarification (this was further complicated by New Zealand's specific circumstances where any one metering installation may have between one and four owners of the components within it, one of which could be the customer themselves):
   a. At times more than one participant was responsible for a requirement, making the requirement unenforceable, particularly when neither participant was fulfilling the requirement
   b. Recovery of accurate records could be an exceedingly difficult task
   c. There was an unclear demarcation between the responsibility of a metering installation owner and a trader's meter reading responsibility.

THE NEW RULES NEEDED TO ENABLE THE IMPLEMENTATION OF AMI

Changes in technology, such as the development of AMI, have specific regulatory challenges regardless of the electricity market structure. The challenge posed to all regulators is how to set regulation for evolving technology, where full capabilities are not known, at a level where requirements are not so prescriptive that future innovation and benefits are stifled, and not so loose that the industry and consumers are exposed to unnecessary risk.

New Zealand's review of its rules identified a number of issues specific to AMI that have since been proven to require consideration, such as:

- The combination of back office systems, communications and on-site meter form a single integrated system, i.e. with AMI, meter provision and meter reading go hand-in-hand. The party that supplies the metering installation in most cases will be the party that manages the data from the metering installation, as all communications are encrypted. Significant back office processes are required to read and manage AMI systems
- Recognition that the AMI meter firmware has metrology components as well as non-metrology components.
- Regulated metrology processing and unregulated processing can occur within an AMI device, and this has a significant impact on how the devices are certified and the firmware is updated
- Security of information and systems is an important consideration, including:
  a. Preventing inappropriate access to systems (hacking)
  b. Communication between components in the system
  c. Security of hardware on a consumers site.

A number of parties might benefit from access to the information, so the new technology has the capability at a highly granular level for use in:

  a. Smart grids
  b. Retailer billing, meter reading, back office queries, etc.
  c. More granular settlement
  d. Power quality management
  e. Load control for market and capital deferral purposes, using direct or indirect (financial signals) methods to reduce dependency on reserve generation.

- A consumer's privacy needs to be protected. The more granular information available from AMI may identify a consumer's living habits. This could have commercial or criminal value, and suitable protection needed to be put in place
- Indirect load control could become possible. The availability of AMI meters recording electricity at the market clearing period (30 minutes in New Zealand) could change the way market settlement and retailers' back office systems operate. The granularity of information would allow financial signals to be passed to consumers so that they could make a value decision on how they consume electricity, and purchase appliances to receive the benefit of those decisions
- The switching of consumers that have AMI meters on their installation between retailers could become more problematic if consumers were captured under contract by the incumbent AMI provider and switching became prohibitively expensive.

ESTABLISHING AND IMPLEMENTING NEW METERING RULES A CHALLENGING PROCESS

The Authority's new set of metering rules addresses all of the major issues noted above, along with many other issues of a

"We would be very happy to share our experiences with other markets looking to ensure that their metering rules are able to deliver all of the benefits"

lesser nature. The changes are not just related to metering itself. Changes flow into other areas of regulated requirements such as the switching of consumers between retailers, establishment of a single 'database of record' for the industry's metering installations, and settlement in the electricity market.

The Authority recognized that the model of an integrated AMI provider was a desirable model for providing and maintaining metering installations, communication systems and data collection. With AMI undergoing a non-regulated rollout in New Zealand, the Authority decided to regulate the party responsible for providing a metering installation, including the infrastructure. This new participant is called the metering equipment provider (MEP).

Creation of the new metering rules has been complex and has impacted on all network owners, distributed generators, retailers, meter owners and the new MEPs. Consultation on the metering rules involved five major industry consultations and many industry forums. The final metering rules were approved in December 2011.

Implementation of the new metering rules has involved a number of minor consultations, more forums, regular telephone conferences, the development of guidelines, training and complex testing of systems.

The rules are complex, comprehensive and interrelated. To the average person they may appear difficult to read in isolation. However, the metering rules is a set of regulated obligations that set a framework that enables the electricity market to function with both legacy technology and new and evolving technology, while allowing innovation to occur and commercial pressures to apply to minimize cost.

CHANGES TO THE RULES REFLECT GROWING IMPORTANCE OF AMI

While some features of the existing metering rules and the new metering rules are similar, for example meter testing provisions and identification of responsibilities of participants, there has been a number of significant changes, including:

- The establishment of a central repository for metering configuration information that is accessible to any authorized participant and containing information critical for the invoicing, compliance and settlement process and providing key information on how the metering installation is configured
- Creating the MEP as a new class of participant with responsibility for each metering installation's compliance with the Code and, in the case of AMI, collection and security of the metering information
- A switching process to allow a retailer to change the MEP at any metering installation for any reason
- Greater emphasis on the security and integrity of metering installations and metering data
- Changes to the customer switching process to allow consumers with AMI meters to be transferred as easily as those with legacy meters.

NEW RULES EXPECTED TO PROVIDE LONG TERM BENEFITS TO CONSUMERS

The new rules are expected to deliver on the Authority's statutory objective, by promoting both competition and the efficient operation of the industry. The Authority expects the new metering arrangements to deliver the following benefits:

- Clear obligations for connection of installations and provision of metering installations
- Transparent information about metering installations, enabling:
  a. Competition in supply of electricity and metering services
  b. Accurate record keeping
  c. Fewer errors in market settlements
  d. Improvements to the switching process
  e. Assurance to consumers and the market that metering is compliant and accurate.

- Rules that enable the full capability of the new technology to be captured. The new rules recognize that new technology meters combine both metrology and non-metrology functions. Only metrology related functions are regulated. Non-metrology services may be added to a meter without disturbing the meter certification, provided certain conditions are met
- Appropriate allocation of the risks associated with the new technology between industry participants and consumers
- Reduced impediments to implementing demand side participation at the metering installation level through either direct (load switched by the retailer or the lines company) or indirect (load switched by the customer in response to a price signal) load switching
- Responsibilities assigned to those best able to manage them; this includes the demarcation of responsibilities for metering installations between MEPs and retailers
- Auditing requirements that will improve transparency and increase confidence in the market governance arrangements
- Optimized meter management
- Rules that are fit for purpose both today and into the future (i.e. future-proofed) with provision of metering systems to integrate with smart home and smart grid systems.

New Zealand is already unusual for having achieved high (and increasing) levels of AMI rollout without direct regulatory intervention. The new rules are expected to continue to enable and facilitate this rollout, providing New Zealand with all the benefits of this new technology at the lowest cost.

In this article we have discussed the philosophy behind the development of our new metering rules. The new rules themselves are relatively detailed and complex, so it can sometimes be difficult to see how these philosophies have been captured in them. We would be very happy to share our experiences with other markets looking to ensure that their metering rules are able to deliver all of the benefits that rapidly evolving technology is expected to provide. The Authority has also produced a number of guidelines and information documents that are available on its website, together with the new metering rules. MI

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ABOUT THE ORGANIZATION
The Electricity Authority is an independent Crown entity responsible for the efficient operation of the New Zealand electricity market. Its objective is to promote competition in, reliable supply by, and the efficient operation of, the electricity industry for the long term benefit of consumers.

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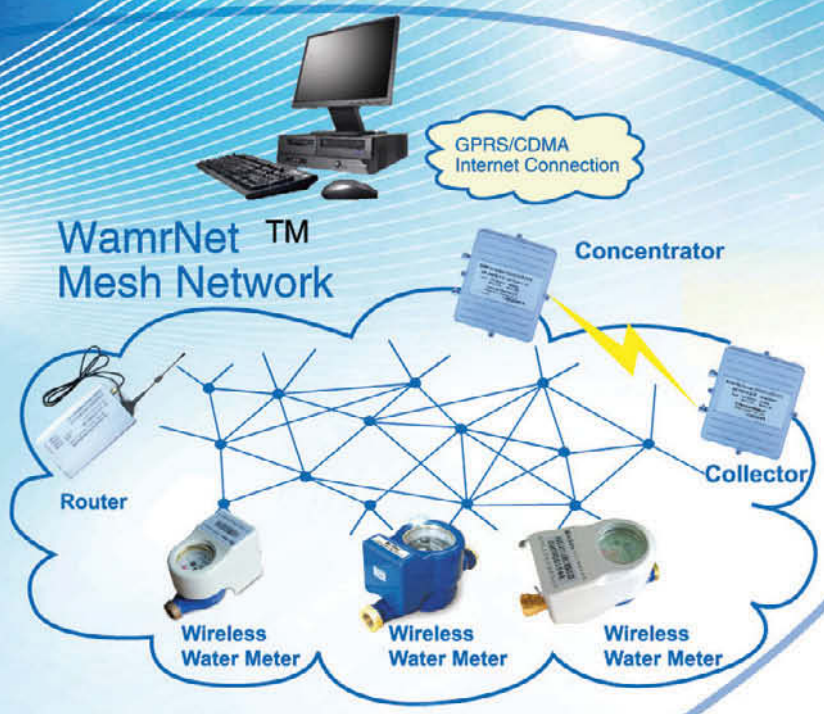
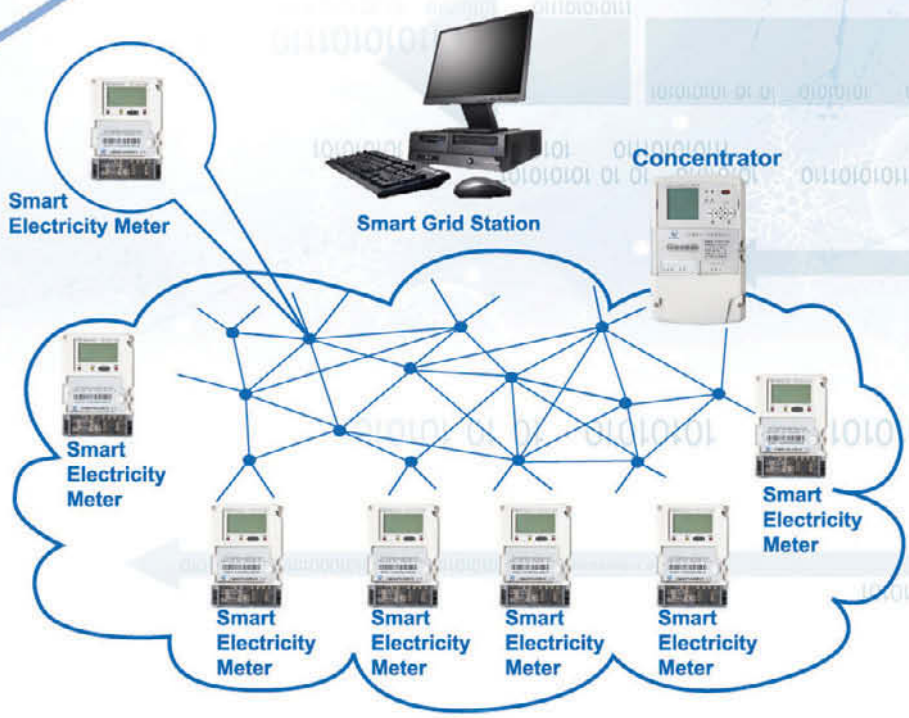


- ***Wireless Gas Meter***
- ***Wireless Water Meter***
- ***Wireless Electricity Meter***
- ***Utility Management System***



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STANDARDIZATION ACHIEVEMENTS IN THE FIELD OF SMART METERING IN EUROPE

By Daniel Hec, David Johnson, Willem Strabbing and Catherine Vigneron

In 2009, the European standardization organizations (CEN, CENELEC and ETSI) were asked by the European Commission to carry out work on the standardization of smart metering functionalities and communications for electricity, gas, heat and water applications.

The standardization mandate (M/441) issued by the European Commission requires the development of an open architecture for communication protocols involving utility meters and harmonized solutions for additional functionalities within an interoperable framework.

In response to this mandate, CEN, CENELEC and ETSI together with other relevant stakeholders established the Smart Meters Coordination Group (SM-CG). This group brings together experts from a number of Technical Committees of CEN, CENELEC and ETSI as well as representatives of various stakeholders (including consumer organizations). The SM-CG is a joint advisory body that provides a platform for the discussion of all issues related to the standardization of smart metering systems in Europe.

SCOPE OF STANDARDIZATION WORK

Smart metering systems comprise all functions, entities and interfaces from the utility supplier to the consumer, including smart meters and home automation devices used in a smart metering context.

At the beginning of the mandated work, in 2009, there were big differences between European countries. While some EU member states had already implemented the deployment of smart meters, others had not even started trials or pilot schemes. Some 45 million smart meters had already been deployed, notably smart electricity meters in Italy and Sweden. Potentially there could be up to 350 million smart meters in the European Union (including smart meters for electricity, gas, water and heat).

The standardization work of the SM-CG focuses on meeting the needs of the residential (household) and small and medium-sized enterprise (SME) sectors. This corresponds to the focus of Mandate M/441 and the need to improve consumers' awareness of their energy and water usage (or 'consumption').

An initial review of existing technologies revealed some 110 different applicable standards for smart meters and their communication infrastructure. It was obvious that focusing on a single technology or communication type would inhibit technological development. There is a distinction to be made between battery and mains powered meters, and it is also necessary to take into account the differences between architectures related to the distribution of electricity, gas, water and heat in different countries.

In parallel, SM-CG also produced the first list of common high-level additional functionalities in Europe (F1 to F6). The six additional functionalities defined were and are still the basis for regulatory and standardisation work today.

The first phase of the mandate requests the ESOs to produce a European standard for communications. In this context, the Smart Meters Coordination Group developed a technical report, 'Functional reference architecture for communications in smart metering systems' (CEN-CLC-ETSI TR 50572:2011), which identifies the functional entities and interfaces that the communications standards should address. It is intended to support the development of software and hardware architecture and related standards and assist the active participation of consumers.

The fulfilment of Mandate M/441 also focused on the following aspects: identifying standards to facilitate interoperability across different technical requirements, and providing routes for implementation in different countries.

The second phase of the mandate focuses on the development of standards containing harmonized solutions for additional functionalities within an interoperable framework using, when needed, the reference functional architecture for communication protocols defined in phase 1.

Considering data models for smart metering, there are various data models in use in those countries which have already implemented smart metering.

To organize the standardization activities, a work programme was produced and specific tasks were allocated among four Technical Committees at European level. These include two CENELEC Technical Committees, dealing with 'Equipment for electrical energy measurement and load control' (CENELEC/TC 13) and 'Home and Building Electronic Systems' (CENELEC/TC 205), as well as the CEN Technical Committee on 'Communication systems for meters and remote reading of meters' (CEN/TC 294) and the ETSI Technical Committee on 'Machine to Machine Communications' (M2M).

A number of new standards have already been developed by the ESOs in the framework of Mandate M/441. For example, CEN has recently published new European Standards in relation to communication systems and remote reading of meters (EN 13757-3) and additional functionalities of gas meters (EN 16314). These are just two examples from a long list of standards published by CEN, CENELEC and ETSI.

At the end of 2012, a report was published, containing information about standards that are either already available or under development. This report is intended to assist the responsible authorities in different countries to implement national smart metering programmes, whilst ensuring connectivity and interoperability, and also helping to ensure fair competition among potential suppliers of smart meter equipment.

METHODOLOGY

The overall aim of the work undertaken in the framework of standardization mandate M/441 has been to ensure that suitable standards are available regarding all the aspects that are necessary to implement the deployment of smart metering in relation to electricity, gas, water and/or heat.

The approach has been to build on existing standards that are already available (including those published and maintained by CEN, CENELEC and ETSI), and to identify needs leading to the development of additional standards.

Standards are different from regulations in the sense that they are not normally legally binding. This leaves room for innovation, for example in relation to remote reading protocols. Standards are also designed to be neutral as regards market structures and outcomes. They should promote open and fair competition by preventing restrictive practices that could lead to closed markets and monopolies.

The standards published by the ESOs do not impose identical solutions on all smart metering projects in member states, nor do they provide a "best practice" solution or recommendations. The standards which have been developed should rather be seen as a kind of common "toolbox" of standards to facilitate smart metering deployments.

This approach recognizes that different countries (including the member states of the European Union) will each have their own priorities and will undertake their own cost-benefit analyses. Also, there are important differences between electricity, gas, water and heat, which inevitably lead to different solutions in different countries.

Given the plethora of communication technologies – both wired and wireless, and using different modulations – the approach of the SM-CG is to work towards semantic interoperability on the data model level. Using a media-independent data model that can be used with different communication technologies will not constrain the adoption of results from the rapidly developing technological developments in media-specific communication technologies. To provide a migration path, mapping may be necessary between this data model and other data models used with power and resource constrained devices.

Furthermore, the standardization bodies should provide protocol stacks (e.g. profiles) that cover various technologies such as PLC, in order to provide interoperable solutions within one local/wide area network.

USE CASES

In response to the need to determine functionalities in more detail, a repository of use cases for smart metering was developed in order to clarify standardization requirements. These provide insights into the functionality and technical requirements of the data communication that standards should support, help identify where new standards might be required, and facilitate interoperability and consistency in the smart meter data flows.

SECURITY AND PRIVACY ISSUES

The ESOs (a subgroup of the SM-CG) have produced a separate report addressing issues of security, privacy and data protection in relation to smart metering, as these issues are also covered by the mandate from the European Commission. This report sets out the principles that have been followed by the four Technical Committees which have been developing standards within CEN, CENELEC and ETSI.

Information about privacy and security requirements in different European countries has been collected and compiled in a repository. This will provide a basis for the review of relevant standards and will also be useful for countries that wish to define or review their own requirements in this area.

Each member state decides its individual security solutions adapted to their national specificities and what is technically and economically efficient, taking account of EU recommendations in the interests of promoting interoperability. Solutions proposed in the standards should be compatible with any of the architectures and solutions deployed by member states and must be in conformity with member states' national regulations. Security solutions must be considered holistically, taking account of relevant aspects such as the infrastructure required for key management.

European activities to develop standards for smart meters are being pursued in close coordination with experts who are working on privacy and security issues in relation to smart grids. Cooperative work in this area continues with the application of the Data and Privacy Impact Assessment Template (DPIA) to smart metering use cases.

LINK WITH SMART GRIDS

The work undertaken in response to Mandate M/441 considers the high level smart metering functionalities, which are additional to the traditional metrological requirements that apply to electricity and other meters. Some of these functionalities, and the communications infrastructure which supports them, are also relevant to the concept of a smart electricity grid, which is the subject of a separate mandate from the European Commission (M/490). There is continuous dialogue and cooperation among the technical bodies responsible for developing standardization activities in the framework of these two mandates.

NEXT STEPS IN STANDARDIZATION

Smart electricity meter implementations in Europe are required to be undertaken between 2013 and 2020 and new technologies and standards will be created during this period. Thus even though the deliverables requested by the mandate are completed, ongoing support of standardization is required until 2020 and beyond.

It has therefore been agreed to continue the SM-CG work programme, together with maintenance and frequent updates with SM-CG reviewing and agreeing the need for the work programme to continue on an annual basis. The work programme will be aligned with the parallel work being done for smart grids under the M/490 mandate and e-mobility under the M/468 mandate and will include further work on standards and on privacy and security requirements for smart metering.

This list of standards will be continuously updated by CEN, CENELEC and ETSI as this becomes necessary during the coming years, taking account of new technologies and other relevant developments. MI

For further information, please see: ww.cen.eu/cen/Sectors/Sectors/Smartmetering/Pages/default.aspx

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Catherine VIgneron is Programme Manager, Industry, Technology and Infrastructure Standards at the CEN-CENELEC Management Centre and Secretary of the CEN-CENELEC-ETSI Smart Meters Coordination Group.

ABOUT THE ORGANIZATIONS

CEN (European Committee for Standardization), CENELEC (European Committee for Electrotechnical Standardization) and ETSI (European Telecommunications Standards Institute) are officially recognized organizations responsible for developing and defining standards at European level. The members of CEN and CENELEC are the national standards bodies and electrotechnical committees (respectively) of 33 European countries. ETSI is an independent association with more than 700 members around the world.
www.cencenelec.eu / www.etsi.org

DEMAND RESPONSE DEVELOPMENT IN EUROPE

OPPORTUNITIES AND BARRIERS

By Jessica Stromback and Marcelo De Moura Torres, Smart Energy Demand Coalition (SEDC)

The loss of up to 80% of share value in some major utilities, the large scale integration of intermittent renewable resources along with ageing grid infrastructure, will drive a profound transformation in the European energy systems in the coming decades. These factors coupled with the development of the smart grid will necessitate the participation of demand side resources – through demand response programs – to balance the grid and act as an intelligent partner to generation[1].

At approximately 3,500 TWh per year, the overall EU electricity market is nearly the same size as the US market, at about 3,800 TWh per year. The demand response market in the USA is generating approximately €2 billion per year in direct revenues for the industry, local businesses and households[2] over and above savings on investment costs for grid upgrades. In Europe, as electricity prices continue to rise and the macroeconomic uncertainty is extending, decision makers are now interested in bringing comparable revenue stream for local communities in Europe.

Yet despite the stated support for demand response of the European Commission and member states, Europe's market and regulatory infrastructure still contains barriers that will require fundamental remodelling in order to allow the participation of load in the capacity, system services and wholesale markets. Demand response and/or aggregation remain illegal in the majority of European member states and in the majority of system services and wholesale markets. Basic contractual requirements are missing, basic technical descriptions are neglected and balancing market descriptions arbitrarily favour generation, no matter the potential of national consumer flexibility or system requirements.

The reasons for these barriers seem to be historical – demand response is a form of balancing capacity, but electricity regulation is written assuming generation resources (not demand side resources) will be providing balancing capacity. This means that tender requirements and documentation are written for power generators, effectively blocking the ability for demand side resources to participate, through requirements designed around power plant limitations and cost benefit for power plant owners.

Consumer groups and industry stakeholders are now beginning to work with policy makers to change this dynamic. The Smart Energy Demand Coalition (SEDC) is one such organization. The SEDC is based in Brussels and includes some 45 companies serving over 200 million consumers around Europe. The goal of this article is to describe the work that stakeholder groups, such as the SEDC, are carrying out, the current status of demand response in Europe and some of its main opportunities and barriers.

WHAT IS DEMAND RESPONSE?

'Demand response or demand side response are programs and activities designed to encourage consumers to change their electricity usage patterns, including timing and level of electricity demand, covering all load shape and customer objectives. Demand response includes time-of-use and dynamic rates or pricing, reliability programs such as direct load control of devices and instantaneous interruptible load, and other market options for demand changes, such as demand side bidding.'[3]

Demand response (DR) includes loads, storage as well as distributed (behind-the-meter) generation, the latter includes emergency (back-up) generation and/or cogeneration (CHPs). It normally enables a reduction in load but in fact can act as a flexible resource either decreasing or increasing consumption, as may be needed for certain balancing services or for the deployment of intermittent resources. This enables customers to consume more electricity when large amounts of wind generation are available for example, and wholesale prices are low.

DRIVERS FOR DEMAND RESPONSE IN EUROPE

With the EU energy and climate package the member states agreed to reduce greenhouse gas emissions to 20% below 1990 levels and to increase renewable generation to 20%. These objectives are adding significant strain to an already ageing electricity system, causing transmission and distribution capacity issues, increasing system instability and forcing network operators to look for new and innovative solutions.

Within this, demand response can become a dependable, low cost, low emissions balancing resource, which can be deployed relatively quickly and without the public backlash caused by new generation or distribution lines. For example, in the last decade, 29.5 GW of demand side resources were deployed in the USA and are now available to market participants, lowering the number of peaking plants and increasing efficiency. As a result demand response is now attracting increasing interest among policy makers and network operators, particularly in member states with generation capacity issues and/or high levels of renewable generation. This includes the UK, Belgium, Ireland, France, Denmark and Finland.

DEMAND RESPONSE AND FINANCIAL BENEFITS

Demand response delivers the abovementioned benefits through providing consumers, residential, commercial[4] or industrial, with the opportunity to benefit directly from the smart grid. The majority of revenue from demand response programs flows to end users and stays within the local communities and builds local businesses. European policy makers are becoming aware of the billions of euros generated today for local businesses, and industry in markets such as the USA, Canada and Australia. In an era of financial crisis and increasing electricity costs, blocking consumer access to such revenue streams is increasingly understood as unacceptable.

Over and above the direct financial benefits, it is estimated that one trillion euros in investment will be needed within the next 30 years in transmission and distribution. European policy

1. The main source for this article: Demand Response Action Plan For Europe, SEDC 2013. http://sedc-coalition.eu/
2. Joule Assets 2012
3. International Energy Agency 'Integration of Demand Side Management, distributed generation, renewable energy sources and energy storages. State of the art report'.
4. By the term commercial is meant all buildings and businesses which are not directly industrial or residential; in other words, municipal buildings, SMEs, businesses such as hotels, office spaces, etc.

makers understand demand response can lower these long term investment costs through increasing the efficiency of the system. That said, this knowledge has led to little concrete action or regulatory support. The immediate and urgent need to access every possible revenue stream for local businesses and communities is a stronger policy driver.

REGULATORY DRIVERS FOR DEMAND RESPONSE

The European Commission has demonstrated strong support for demand response. This was reflected in the Third Energy Package (2009), which required network operators to take into account the potential of demand response and consider the possibility of third parties seeking access to the system when planning system upgrades. However, the directive lacked binding language on demand response and has proven relatively ineffective in motivating substantial regulatory change.

The Energy Efficiency Directive (EED), ratified in 2012, included robust stakeholder input from the demand response industry and consumer groups. It creates the explicit requirement that demand and supply side resources should compete on an equal footing. The EED mandates consumer access to the energy markets, either singly or through aggregation. EED Article 15.8 states:
"Member states shall promote access to and participation of demand response in balancing, reserves and other system services markets, inter alia by requiring national regulatory authorities […] in close cooperation with demand service providers and consumers, to define technical modalities for participation in these markets on the basis of the technical requirements of these markets and the capabilities of demand response".

Important as this support is, the application of Directives is relatively open to member state interpretation. Its impact can therefore vary from country to country depending on how it is implemented. However the language in Article 15 is now also being supported through the network codes which aim to unify the European electricity market. These codes are currently being drafted by ENTSO-E (European Network of Transmission System Operators for Electricity). Once ratified, they will override national law and unify regulation within the balancing markets across Europe. The language of the Directive is now being applied to further regulatory initiatives at European level.

The SEDC and other stakeholders are interacting intensively with ENTSO-E, pushing for the equal treatment of consumer loads and third party aggregators to ensure demand response is enabled within the network codes.

Two codes have been the particular focus of demand side stakeholder input: the Demand Connection Code and the Electricity Balancing Network Code. After an extended period of drafting, the Demand Connection Code is now at the comitology stage. This Code enables aggregation and consumer participation in the cross border balancing markets.

ENTSO-E is currently working on the Electricity Balancing Network Code, which was receiving stakeholder comments until mid-August 2013, preparatory to its final draft. The Code establishes common principles for procurement and common methodology for the activation and settlement of frequency containment reserves, frequency restoration reserves and replacement reserves. The SEDC is working closely with the ENTSO-E on this Code, to assure that the requirements of demand response programs are included in the Code. The Coalition has underlined that the Code needs to include a broader, comprehensive settlement description for imbalances and provide stronger contractual protection between balancing responsible parties, balancing service providers and TSOs.

DEMAND RESPONSE IN EUROPE TODAY

European governments are eager to support the idea of demand response, in principle as a means for citizens to benefit directly from smart meter rollouts and the smart grid. It is no longer seen as acceptable to ask end-consumers to pay for technological upgrades and smart grid development, while denying them access to consumer-oriented programs.

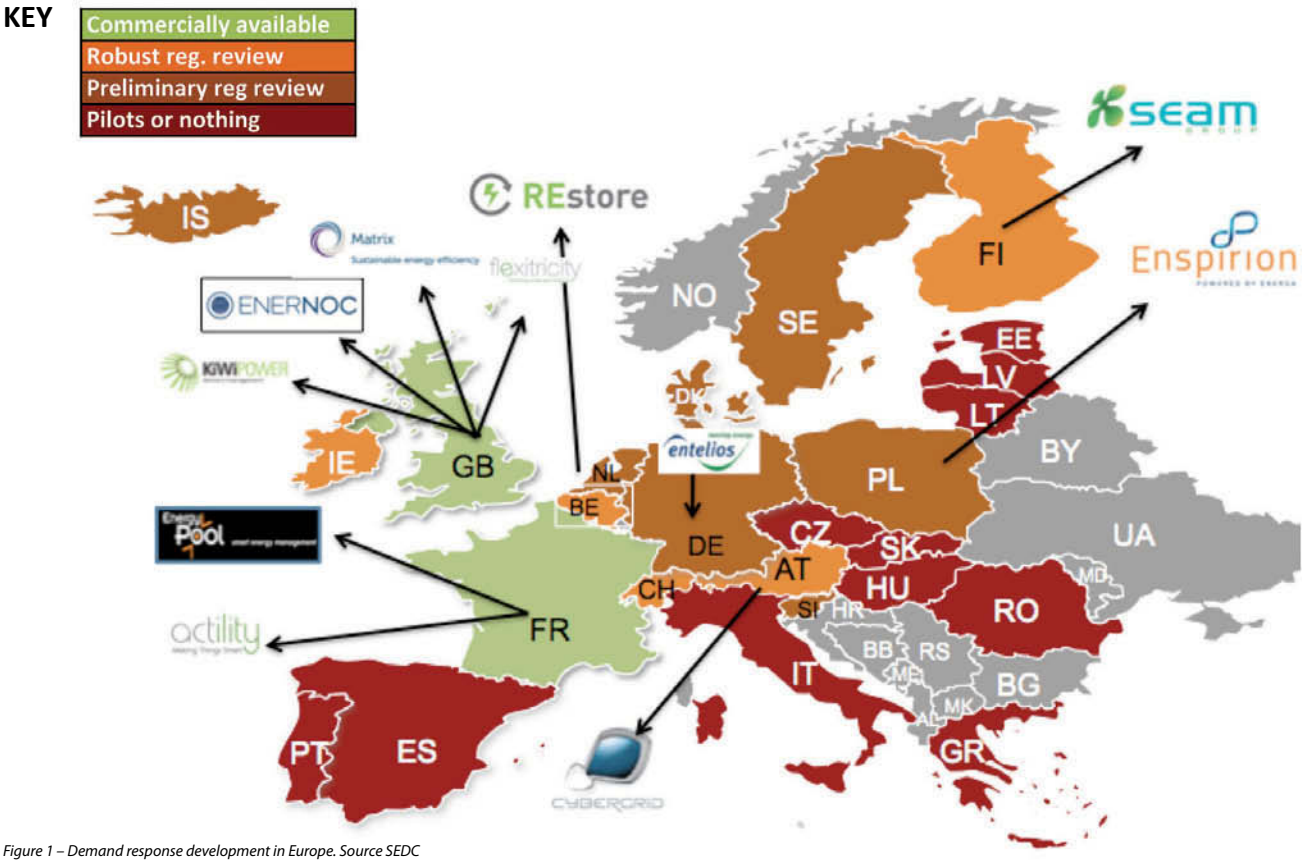


Figure 1 – Demand response development in Europe. Source SEDC

That said, fewer than 5 out of the EU 27 member states have created regulatory and contractual structures that support aggregated demand response (Figure 1). France and the UK have established demand response programs and both countries support aggregation, and are also establishing capacity markets which (in theory) will be open to demand response. Ireland is in a thorough review of legislation, while Finland, Belgium and Austria are developing their balancing markets for demand response and will soon provide commercial potential even though they are small markets. The vast majority of member state regulations block consumer participation in balancing, reserves, system services and energy markets. These regulators and TSOs either have done nothing or are only now beginning to review their national regulatory structures.

STEPPING UP TO ENABLE DEMAND RESPONSE ACROSS EUROPE

Over and above working on direct legislation initiatives, Europe requires an overall roadmap and vision for demand response. The SEDC has prepared and presented to the Commission a complete Action Plan, in which it outlines four steps leading to the development of demand response in Europe:

1. Allowing for service providers to work/exist in the markets
2. Ensuring those markets include products appropriate for both supply and demand side resources
3. Establishing the appropriate measurement and communication protocols to safeguard reliability, and
4. Ensuring fair reliable payment for services provided.

These steps are achievable and well within reach. However, they will require coordination between member states, planning, and commitment as they represent a diametric shift in thinking from generation focused markets to multi-party, multi-resource markets.

TIMING IS KEY

Demand side programs form part of a private public partnership. Wind generation is increasing and new back-up generation and grid investments are being planned and implemented. New demand side sources are also appearing: server farms, heat pumps, cooling units, and air conditioners. To fully realize the potential of demand response and other demand side programs, the programs must be implemented during this phase of the European electricity market development, so that they can be built as an integral part of the new system. Not only are European consumers and businesses being shut out of smart grid benefits and losing money, but as unnecessary investments are made – i.e. peaking plants built – part of the potential value of demand side programs, both to European consumers and to the electricity industry, will be lost. The Commission's, member state and stakeholder determination and active involvement will be of utmost importance here. MI

ABOUT THE AUTHORS

Jessica Stromback was a co-founder and is Executive Director of the Smart Energy Demand Coalition (SEDC). She is a Chairman at VaasaETT, Global Energy Think Tank based in Finland. She specializes in smart metering and demand response as well as market structure and regulatory requirements for program development, and has participated in or led consultancy and research projects surrounding demand response and smart metering issues globally.

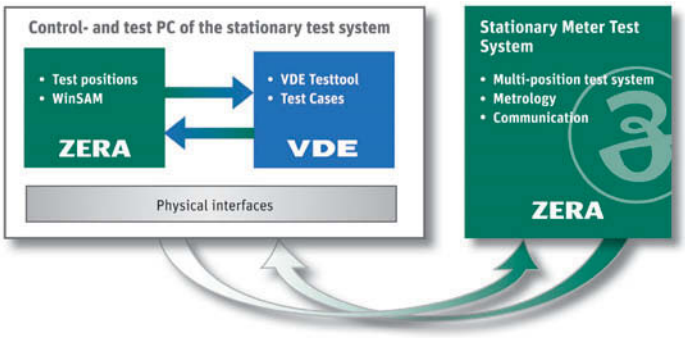
Marcelo De Moura Torres has a background in Political Science and in Environmental Economics. He works as an energy policy researcher in the Smart Energy Demand Coalition (SEDC). He is participating in an ongoing research on the development of demand response programs in Europe run by the SEDC.

http://sedc-coalition.eu/

SECURE SMART METER ROLLOUT WITH NEW TEST SYSTEM

By Matthias Bormann and Neander Pütz

Launching of information and communication technologies in modern energy supply networks has many advantages. For example, information such as meter readings and actual consumption data from the measuring systems installed at the end user can be collected and evaluated in order to regulate the network capacity by applying variable tariffs. Furthermore, the integration of a communication infrastructure is an important condition for linking the domains of smart metering, smart grid, smart home and e-mobility. By linking these areas, innovative value added services can be developed and offered.



In addition to the above mentioned advantages, however, the integration of a communication infrastructure into the power supply network also requires more complex new end devices (e.g. smart meters) or the development of new devices for the transmission of the information (e.g. smart meter gateways). To ensure smooth interoperability, the communication interfaces and routes must be tested for compliance with the applied communication protocols.

Information security and data protection of personal data during transmission via a communication network is a crucial factor for users accepting such measuring systems. The provisions and required testing standards are defined by national bodies, e.g. in Germany, the BSI (German Federal Office for Information Security).

The functional requirements for the communication interfaces are usually defined by national and international consortia and committees by means of performance specifications. Simultaneously, relevant concepts for securing interoperability are being developed, and testing standards, the so-called "test cases", are derived from the requirements stated in the specifications.

In collaboration with the VDE Testing and Certification Institute (Association for Electrical, Electronic & Information Technologies), ZERA GmbH has developed a new testing system for type and acceptance tests in order to support meter operators at public utilities and energy suppliers in the transition to the next generation of smart meters and smart meter components. The goal of this cooperation is the design of a multi-station system for the testing of metrology and communication interfaces.

For the implementation, approved stationary meter test systems by ZERA used in accredited laboratories were expanded to include additional communication channels with the purpose of retrieving, e.g. the readings of all test positions via the control and test computer. The interfaces required for performing the communication tests (test cases) are provided for each test position. Existing test systems can be equipped and expanded with the latest generation of devices/interfaces.

Simultaneously, the test cases developed by the VDE Testing and Certification Institute are compiled and made executable with the aid of TTCN-3 (Testing and Test Control Notation). TTCN-3, which was developed and standardized by the European Telecommunications Standards Institute (ETSI), is a programming language specially developed for testing communication interfaces; it has proven its reliability in securing the interoperability of communication networks in mobile communications and in the automotive sector.

The focus of the integration of both systems was the easy application of the complete system, which consists of a meter test system by ZERA and the software tool (TTCN-3+test cases) developed by VDE. The well known software WinSAM by ZERA, for the control and operation of meter test systems, was functionally expanded to enable the automatic call up and execution of the test cases of the VDE software tool via a new control element. This means that both the metrology tests and the communication tests of the interfaces can be executed via the intuitive, usual interface. This also includes the integration of the communication test results in the test protocol compiled by WinSAM.

Once the EDL concept for electronic household meters could be implemented in accordance with the FNN specifications (smart meter of the first generation for the Germany market) and was successfully tested in the market, the modular structure of the complete system allows for an expansion in terms of new requirements. To comply with these new requirements, e.g. test cases for DLMS meters, work on a new version of the VDE-ZERA test system has already started. The concept and a prototype will be presented at a joint stand at the European Utility Week 2013 in Amsterdam. MI

ABOUT THE AUTHORS

Matthias Bormann works at the VDE Institute as project manager and is responsible for the development of testing methods and tools for smart meter communication systems. He is specialized in testing protocols and services of communication systems and holds a Master of Philosophy degree from the University of Glamorgan, UK.

Neander Pütz, sales director for ZERA GmbH Germany, is specialized in meter test systems of the latest generation. He is also the responsible sales manager for Southeast Asia, Australia and Germany.

ABOUT THE ORGANIZATIONS

The VDE Testing and Certification Institute is accredited on a national and international level for the area of testing and certification of electrotechnical equipment, components and systems. Testing of electrotechnical products is conducted for safety, electromagnetic compatibility and other characteristics.
www.vde.com/smartmetering

ZERA has more than 90 years' experience in providing equipment for generation, measuring, testing and calibration of electric variables worldwide. The product range covers portable meter test systems, stationary meter test systems and instrument transformer test systems. Typical customers are located in the field of electricity supply and instrument transformer manufacturing.
www.zera.de

SMART METER TEXAS: SETTING THE STANDARD

By Donny Helm, Director, Technology Strategy and Architecture, Oncor and one of four TDSP project leaders for Smart Meter Texas

The proliferation of smart grid technologies has brought forth a need for a variety of secure advanced meter data transmission, storage and access solutions. An early example of success is Smart Meter Texas™ (SMT), which is an interoperable smart grid solution that stores electric meter usage data received from participating transmission and distribution service providers[1] (TDSPs) and provides market participants access to that data, and enables customer home area networks (HAN).

Texas has been a frontrunner in the deployment and testing of smart meter technology. The Texas deployment of advanced meters began in 2008 and, by the end of 2012 more than 6.3 million[2] advanced meters had been installed by the participating TDSPs.

The Advanced Metering Implementation Team (AMIT), a collaborative stakeholder driven process initiated by the Public Utility Commission of Texas (PUCT) in 2007 to support the advanced metering system (AMS) deployments in the Texas competitive electricity market, included representatives from market participants (TDSPs and retail electric providers), PUCT staff, consumer advocates, advanced meter manufacturers, HAN device manufacturers and service providers, AMS solutions vendors, the Electric Reliability Council of Texas (ERCOT) staff, and third party entities seeking to provide energy management services.

SMT is the product of the AMIT. Although uniquely designed and developed for the Texas electricity market, SMT is relevant to other jurisdictions that have smart meter deployments and seek to develop similar customer and market enabling solutions or use one common interface among multiple utilities to allow access to customer energy usage data or communicate with customer HAN devices over multiple utility AMS communication networks.

Later in 2013, AMIT will publish a standards document to provide other electric industry participants with an understanding of SMT – how it was developed through a standard consensus process, how it conforms with national US smart grid standards – and to provide interested parties with access to key SMT artifacts (i.e. business requirements, use cases, etc.).

METHODOLOGIES AND STANDARDS

The process of developing SMT followed widely recognized smart grid methodologies like the IntelliGrid Methodology for Developing Requirements for Energy Systems and the use of the GWAC interoperability layered categories, known as the GWAC stack. SMT and its development was also consistent with each of the National Institute of Standards and Technology (NIST) guiding principles for identifying interoperable smart grid standards for implementation and satisfied the NIST architectural goals for the smart grid and the NISTIR 7628 Guidelines for Cyber Security.

The collaborative work of AMIT, resulting in the business requirements that became the basis for the design of SMT, occurred in late 2007 through 2009. This was a little before and concurrent with the US national effort to identify and develop interoperable smart grid standards. Figure 1 shows the timeline showing how the development of SMT fitted in with national smart grid policy and regulatory directives and the national smart grid standards effort.

Additionally, the process of developing and implementing SMT followed other widely recognized smart grid methodologies,

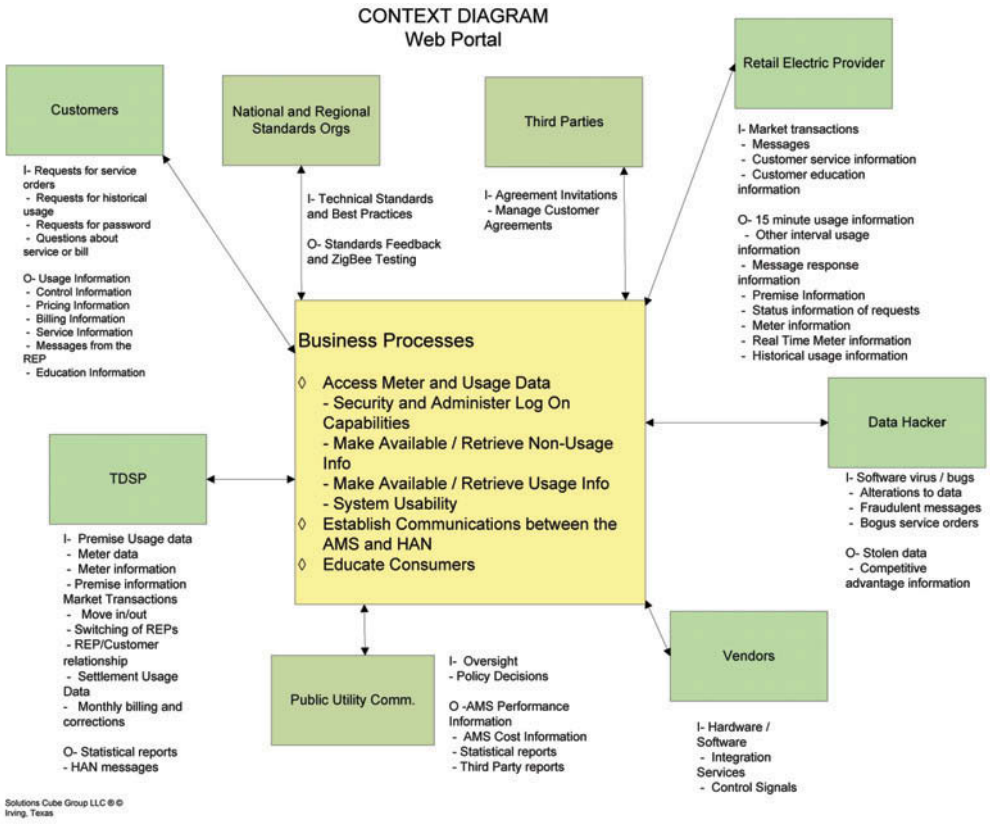


Figure 1 – Timeline of SMT and national smart grid standards development

1. The participating Texas TDSPs are AEP Texas Central Company and AEP Texas North Company, CenterPoint Energy Houston Electric, LLC, Oncor Electric Delivery Company LLC, and Texas-New Mexico Power Company, collectively referred to as the "joint TDSPs".
2. From the December 2012 TDSP Monthly AMS Compliance Reports for AEP Texas Project # 37907; CenterPoint Energy Houston Electric, LLC - Project # 36699; Oncor Electric Delivery - Project # 36157;and TNMP - Project # 39772

guiding principles, architectural goals, best practices, smart grid standards and web standards, including:

- Green Button Initiative
- PCI and NERC CIP cybersecurity standards
- ZigBee Smart Energy Profile
- NAESB third party access to smart meter-based information
- UCAIug Home Area Network System Requirements Specification
- Web standards.

By following industry methodologies and standards, the work produced an interoperable solution providing users with access to smart meter usage information and HAN device communication through standardized and secure interfaces.

AMIT MEETING ATTRIBUTES AND DESIGN PROCESS

The functionality of SMT was developed in facilitated meetings attended by a broad set of stakeholders who formed the AMIT. In the AMIT meetings, the stakeholders participated by sharing viewpoints and working towards consensus regarding SMT's functionality. The AMIT meetings had the attributes of openness, balance of interest, due process, a process for appeals, and consensus. The AMIT meetings were open to any interested party and publically announced on the PUCT Project #34160 website and through emails sent to those on the AMIT distribution list. All meeting attendees were encouraged to participate and share their views on the topic at hand. No view was discounted and each issue was thoroughly discussed or researched until a consensus was reached by the participants.

The process used by AMIT to determine the design and functionality of SMT substantially conformed to the methodology set forth in the IEC 62559 IntelliGrid Methodology for Developing Requirements for Energy Systems standard[1]. This process included defining high level business processes, creating context diagrams, identifying actors and their roles and interactions, defining projects, creating business requirements, and prioritizing those business requirements with the help of use case scenarios.

CREATING CONTEXT DIAGRAMS

AMIT created a context diagram for SMT. The context diagram identified the external entities, their high level conceptual "inputs" and "outputs", their applicability to the SMT business process that was being diagrammed, and the applicability of that high level business process. The context diagram for the SMT is depicted in Figure 2.

The context diagram's external entities were the starting point for identifying the actors associated with SMT. Through the use case process, a more specific list of actors and their roles was developed. Additional actors identified in the use cases included devices and systems that interact with SMT, as well as expanding the types of SMT users. The use case process also clarified each actor's role, which determined the type of SMT functionality the actor could access.

DEVELOPING BUSINESS REQUIREMENTS

To further develop the functionality and technical requirements associated with SMT, AMIT used a use case-based process to ensure that a robust set of business requirements was developed. A use case describes the functionality and requirements a stakeholder group has for a system, and how the system will behave to meet those needs. The use case process is a recognized tool for system

1. *IEC 62559 Publicly Available Specification http://webstore.iec.ch/webstore/webstore.nsf/Artnum_PK/38920*

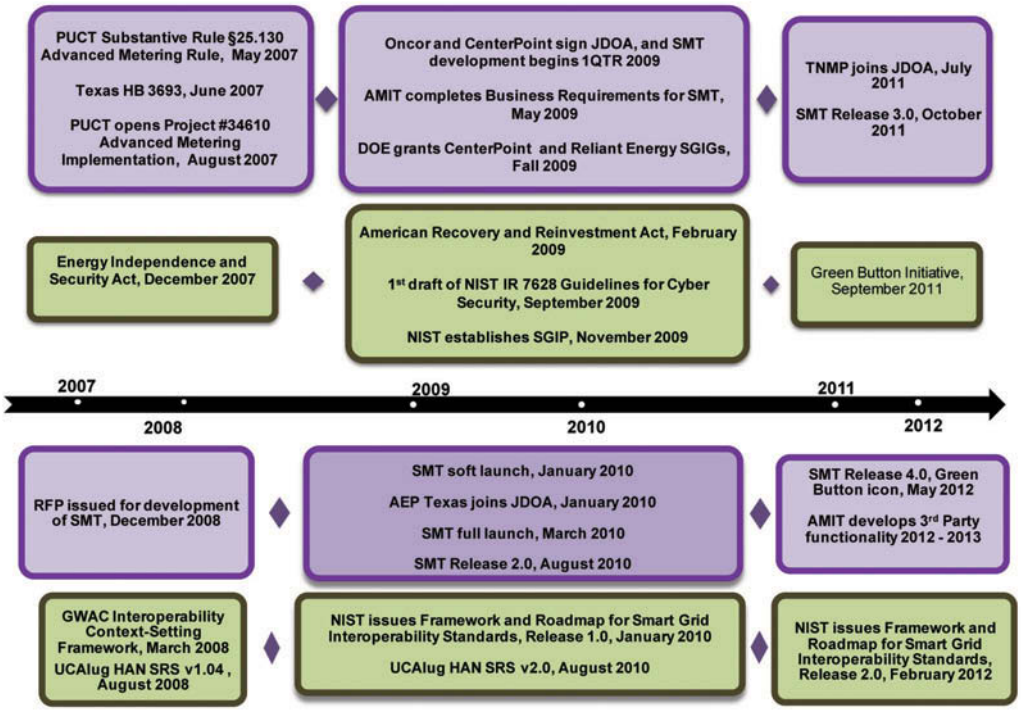


Figure 2 – SMT context diagram

and smart grid standards development and has been used in many large smart grid projects worldwide.

Through the facilitated, stakeholder-driven process, AMIT created a set of use case scenarios which expanded the original business process functions into well-defined business requirements. The requirements went through multiple reviews and edits, and AMIT provided input into the prioritization of each requirement for implementation.

In addition to the core business functions and requirements associated with smart meter data access, an additional set of business processes and requirements related to the deployment of HAN devices was developed and prioritized as to when they would be delivered. Market transactions related to changes in the relationship between the meter, customer, and REP were also addressed in the SMT requirements, as well as requirements for customer education and on-screen help for certain SMT features.

DEPLOYMENT, OPERATIONS AND GOVERNANCE

SMT became operational in early 2010 with a base set of requirements to meet a core set of functionality. The SMT functionality was prioritized by AMIT using the established consensus process to guide the system integrators in their development work. Follow-on releases occurred which upgraded the SMT system and provided additional functionality that was identified during the original system specification, but considered to be of a lower priority.

Prior to 2013, SMT was supported by AMIT, a standards setting organization[2], as that term is defined by NIST.
In early 2013, with the majority of smart meters deployed and three years of SMT operational experience, the AMIT activities and governance of SMT were evaluated. There was a need for a more permanent governance structure to support SMT to move into its operational steady state. A plan was drafted to close Project 34610, sunset the AMIT meetings and associated task forces, and move the governance of SMT to the ERCOT Retail Market Subcommittee (RMS).

2. NIST defines an SSO as "the broader universe of organizations and groups – formal or informal – that develop standards, specifications, user requirements, guidelines, etc." Page 61 of the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0

RMS is an ERCOT subcommittee that serves as a forum for resolving retail market issues that directly affect ERCOT and retail market participants. The SMT change request, reporting, and user guide activities would move to an Advanced Metering Working Group formed under RMS. Requests for changes to SMT would be submitted to the RMS Advanced Metering Working Group and would flow through the existing RMS approval process before being submitted to the PUCT SMT Development Oversight Project[3]. The SMT Development Oversight Project would review the request and approve it before sending to the TDSPs. The TDSPs would perform a cost analysis on the requested change and retain ultimate authority for approving or rejecting any proposed modifications to SMT.

ACCESSING THE STANDARD

The standards document published by AMIT is intended to provide a broad understanding of the SMT web portal, including the context in which it was developed, the methodology used for its design and development, the functionality it provides to users, and the benefits that have been realized from its deployment. By making information about the SMT solution publicly available, this standard serves to testify to the potential power of a consensus-based, stakeholder-driven approach to smart grid solution development, producing an interoperable solution that meets the needs of all stakeholders.

SMT AND GREEN BUTTON INITIATIVE

The Green Button is a United States initiative created in 2011 by the Office of Science and Technology Policy and the US Department of Energy (DOE). The initiative challenged the electric utility industry to give consumers access to their energy usage information by downloading it in an easy-to-read industry standard format.

SMT implemented the concept of the Green Button initiative over a year prior to the issuance of the Green Button challenge and shortly after the challenge was issued, SMT strategically placed a Green Button icon on several portal pages. On the SMT web portal, customers can request 13 months of 15-minute usage data in the industry standard XML format and a file will be emailed to the customer. Customers may then easily load the information into programs that help manage their electricity use or share their usage information with Third Parties who want to provide energy management services to customers. MI

3. PUCT Project #41172 Staff Monitoring of Final Releases for the Joint TDU Web Portal

ABOUT THE AUTHOR
Donny Helm manages technology strategy for Oncor, which operates the largest transmission and distribution system in Texas. He is an active participant in the Smart Grid Testing and Certification Committee as part of the NIST initiative under the Energy Independence and Security Act (EISA) of 2007.

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EUROPEAN SMART METERS DEMAND WM-BUS AT 169 MHZ

By Milen Stefanov, TI System Applications, and Olivier Monnier, Worldwide Marketing Manager, Smart Grid Solutions, Texas Instruments Incorporated (TI)

Since its introduction in 2005 with the EN13757-4 document, the wireless MBus (wM-Bus) protocol has become the choice for many smart meter deployments in Europe due to its simple star network topology on a sub-1 GHz wireless link in the European ISM band at 868 MHz.

The mass deployment of heat cost allocators in Germany in the past 6 years has proven that a wM-Bus solution at 868 MHz delivers good range even in densely populated areas with high rise buildings that are quite common in most European countries. It also allows for battery powered meters and submeters, which can work up to 10 or 15 years on one battery.

The European Telecommunications Standards Institute (ETSI) 300 220-1 V2.4.1 (May 2012) is a regulation for sub-1 GHz communications in Europe, defining a 75 kHz narrow band at 169.400 MHz for meter reading applications, with maximum allowed ERP power of +500 mW (equals +27 dBm) and a duty cycle of less than 10%. In this 75 kHz band, a new wM-Bus N-mode has been defined, enabling long range communications in urban environments. N-mode based RF systems were adopted for the deployment of residential gas meters in both Italy and France, leading to a huge demand for 169 MHz radio solutions with the highest RF performance and optimized battery lifetime.

This article will present an example implementation for a full wM-Bus N-mode compliant system at 169 MHz and will focus on how to optimize various system parameters to achieve market-leading blocking and selectivity performance, combined with minimized battery power consumption.

HARDWARE ARCHITECTURE OF wM-BUS N-MODE SUBSYSTEM

The N-mode compliant system described here is based on a CC1120 sub-1 GHz high performance RF transceiver from Texas Instruments and an ultra-low power MSP430G2x55 microcontroller that runs the wM-Bus N-mode protocol stack, communicates with the CC1120 transceiver over the SPI interface and controls the external power amplifier (PA) thru signal lines. A UART or SPI connection to the application MCU of the smart meter enables the configuration and the data exchange with the RF subsystem. An external power amplifier is used to achieve up to +30 dBm transmit power (conducted measurement).

BEST BLOCKING AND SELECTIVITY PERFORMANCE FOR A ROBUST AND COST-OPTIMIZED SOLUTION

The wM-Bus standard defines for each N-submode that products with the highest possible receiver class (Hr) should meet ETSI Category 2 receiver blocking requirements. In practice, designers will need to target the significantly more challenging ETSI Category 1 receiver system performance to cope with the implementation requirement variations from country to country.

TI's CC1120 transceiver supports preamble lengths of only 4 bits, features an integrated 4-GFSK modulation and delivers the industry's best blocking and selectivity results for all N-modes. By applying an optimized set of register settings, called "best blocking", an ETSI Category 1 receiver system performance is achievable without needing to add a costly external surface acoustic wave (SAW) filter component.

Additionally, a unique digital filter inside the CC1120 handles the image rejection and delivers the same performance, regardless of changes in the ambient temperature or supply voltage, which leads to easier and quicker system implementation and optimization.

OVERCOMING PACKET LOSS SIGNIFICANTLY IMPROVES BATTERY LIFETIME

A robust and reliable RF link means the packet loss caused by noise or interference from other meters, which may transmit at the same time on adjacent channels, is reduced to a minimum. If a receiving unit loses a packet, it may also have to do re-transmissions because of the bi-directional nature of the wM-Bus protocol. Reducing packet loss with better sensitivity or higher robustness against interfering signals will directly improve the battery lifetime of a smart gas meter. With smart gas meters having an expected lifetime of more than 15 years, it becomes evident that every unnecessary transmission will ultimately cost energy and reduce the battery lifetime.

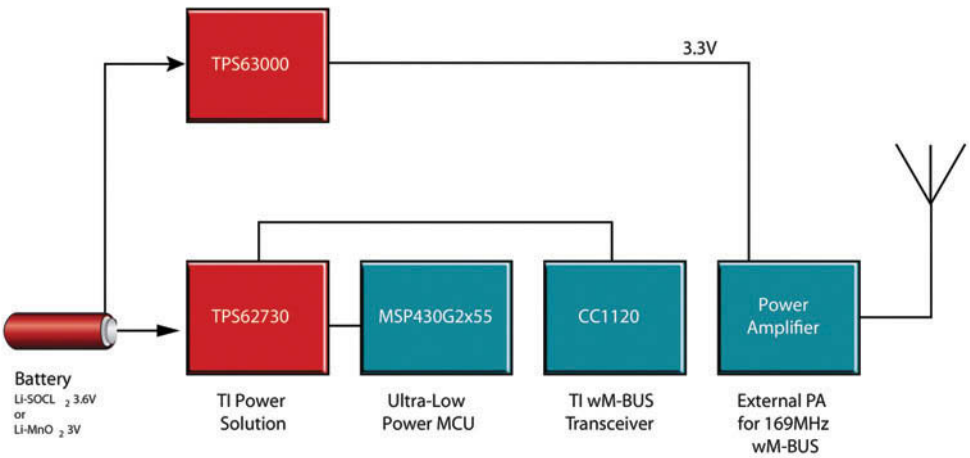

Figure 1 – Block diagram of a complete wM-Bus N-mode RF system including high efficiency battery management solution

The lower the blocking performance and/or lower sensitivity and selectivity of a RF device, the higher the packet loss and the average power consumption.

Packet loss is difficult to predict, as the RF channel behaviour in the field is generally unknown and will vary over time. One can run field trials in different geographic locations to gather statistical information about *received signal strength indicator* (RSSI) values over time on the used RF channels. In many areas, that field data shows the background noise in or close to the 169 MHz band is above the sensitivity limits

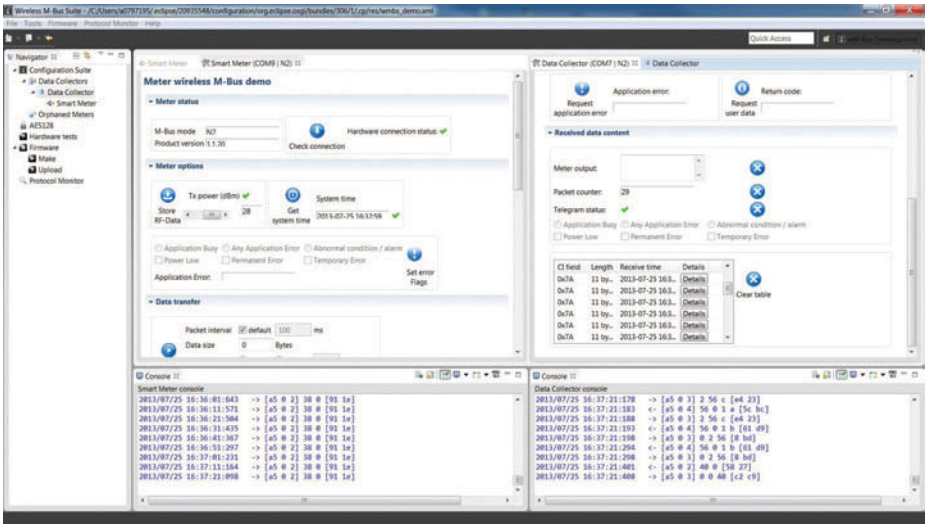

Figure 2 – TI's wM-Bus PC suite enables fast time-to-market development and supports smart meter and data collector functions

for the 2.4 and 4.8 kbps data rates. In such cases using the "best blocking" settings is the recommended solution.

Developers now have the option of implementing a flexible algorithm and deciding when to use the "best blocking" and the "best sensitivity" settings. The flexibility of dynamic switching between "best sensitivity" and "best blocking" performance can significantly reduce the packet loss of the N-mode subsystem. A CC1120-based N-mode solution supports this flexibility thanks to two optimized register sets accessible via software, that can switch between those during runtime.

RX SNIFF MODE: MAINTAINING BEST PERFORMANCE WHILE REDUCING POWER CONSUMPTION

The CC1120 transceiver contains a special feature called RX Sniff mode. It allows the transceiver to autonomously wake-up and check for RF activity (RSSI or preamble detection) and go back to a sleep state to save power if no energy is detected. If the detected RSSI is above the programmed threshold, the transceiver will stay active and complete the reception of the incoming frame. In fact, an RX Sniff mode can be viewed as a quick duty cycling of the CC1120 receiver, enabled by its extremely fast settling time. The effect of such "pulsing" receive approach is the reduction of the average current consumption during reception, regardless of the supply voltage.

OPTIMIZING POWER CONSUMPTION AT THE SYSTEM LEVEL

Due to the low peak current (typically less than 50 to 100 mA) that batteries can provide without being damaged or degraded, a dedicated battery management solution becomes mandatory for all wM-Bus 169 MHz systems with high transmit power. Two main types of primary batteries for smart metering applications exist today – the Lithium Thionyl chloride (Li-SOCl2) with 3.6 V and the Lithium Manganese Dioxide (Li-MnO2) with 3.0 V nominal voltage.

The battery management solution of a smart meter should handle the following tasks:

- Provide current of several hundred mA for a period of few hundred ms (maximum current depends on the TX output power of the external PA)
- Remove the pulse load during RF transmission away from the battery
- Reduce the effective buffer capacity needed to protect the battery from high peak currents
- Allow full flexibility in the selection of battery chemistry (3 V vs. 3.6 V)
- Provide stable supply voltage at 3.3 V for the external PA
- Provide lower voltage to both MCU and transceiver (typically between 2.1 and 3.0 V).

The CC1120 transceiver has a voltage supply range of 2.0-3.6 V and uses an internal LDO to provide power to all blocks inside the device. Providing a supply voltage of 2.1 V will reduce the losses inside this internal LDO without degrading the RF performance of the device. In addition, using a high efficiency low power DC/DC device to supply the transceiver has been shown to reduce the peak battery current by up to 35%. This reduction applies for both RX and TX directions and using such a DC/DC device with more than 90% efficiency is the way to go. While choosing a suitable DC/DC looks simple, it's essential to know that the switching frequency of such device can interfere with the RF device and severely degrade its RX sensitivity. To avoid such negative impact on the RF parameters, it is mandatory to measure and prove the RF friendly behaviour of the switching component.

TI's sub-1 GHz RF high-performance line family is perfectly suited to fulfill all requirements of the wM-Bus standard (EN13757-4), including all RF requirements in the Italian and French gas meter specifications. The transceiver fully supports reception of all N-mode telegrams with 16 bits preamble (including the 4-GFSK submodes) without packet loss due to its WaveMatch™ feature. The extremely fast automatic gain control settling in only 4 bits, combined with RX Sniff mode, makes the CC1120 transceiver the best choice for N-mode compliant wM-Bus solutions.

A dedicated battery management solution for the external PA is required, which draws up to several hundred mA at 3.3 V power supply for several hundred milliseconds. The exact implementation of this PA battery management will depend on the battery type and topology used in the smart meter.

Combining the CC1120 with an RF-friendly DC/DC device like TI's TPS62730 significantly reduces the peak current drawn from the battery without penalizing the transmit spectrum or the sensitivity or blocking performance. With the addition of RX Sniff mode, which is useful when the smart gas or water meter is waiting to receive a telegram, the average battery current drawn by the radio is additionally reduced.

It is the first integrated transceiver in the industry that can achieve ETSI Category 1 compliance without an external SAW filter in wM-Bus N-mode. The ability to tweak the performance of the CC1120 for "best sensitivity" or "best blocking" with a few register changes enables a wM-Bus N-mode system, which can smartly adapt to a changing RF environment in the field. MI

ABOUT THE AUTHORS

Milen Stefanov is a System Applications Engineer at Texas Instruments, leading TI's activities in the wM-Bus field and is a system expert for sub-1GHz RF solutions for smart grid. He has 10 years of experience with TI's Semiconductor Group, during which time he has held positions in field and system applications. He holds a Master's degree in Electrical Engineering (data communications) from TU Chemnitz.

Olivier Monnier is the Worldwide Marketing Manager for TI's smart grid solutions team. He studied energy conversion and power electronics at the Ecole Nationale Superieure d'Electricite et de Mecanique (ENSEM, Nancy). He has more than 14 years experience in industrial energy related applications.

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WHO SAID DRAGONS CAN'T DANCE?

A SUCCESS STORY ON EUROPEAN SMART METERS, DEVELOPED AND PRODUCED IN CHINA

By Alex Bouw, Jan Oost and Stephan Gibiino

Schiphol airport, The Netherlands, December 2010: Netbeheer Nederland working group DSMR launches its newest release of the Dutch Smart Meter Requirements (DSMR). Two Dutch IBMers are in the meeting room together with 37 other smart meter vendors to witness the occasion with enthusiasm and curiosity and see what this development could bring for their innovation agenda and for IBM´s global strategy to build a smarter planet.

IBM, is that Big Blue working on mainframes, computers and software…? Well not only that. With a strong belief that more and more of our world will be equipped with smart sensors, interconnected with systems and made intelligent – IBM brings innovation power to the table. As a result, in mid-2011, IBM together with a strong Chinese development and manufacturing partner, Shenzhen Kaifa Technology Co., Ltd., were selected as one of the suppliers for the development and delivery of the latest generation electricity meters that meet DSMR. This means that for the first phase rollout and on behalf of all Dutch distribution grid operators (DSOs), IBM will deliver meters as one of the four preferred suppliers (together with Landis+Gyr, Itron and Elster; Landis+Gyr and Itron for both electricity and gas meters, IBM and Elster respectively for electricity and gas meters only). The product development, contract negotiations with Netbeheer Nederland and pricing were started soon after. IBM qualified for this project due to – among other factors – the development and product capabilities of Shenzhen Kaifa Technology Ltd, a large and renowned original equipment manufacturer in all kind of electronics, including metering systems for electricity, gas and water. And YES, this Chinese Dragon, with its European partner, can dance.

IBM´s cooperation with Kaifa had already existed for over 15 years with a history in manufacturing for hard disc drives. For the past 8 years, IBM has also had a strong collaboration in the area of smart meter developments and mass metering deliveries. Now, with this latest success story for The Netherlands, Kaifa has been able to develop a private owned branded meter product for the European market, whereas in the past the company acted as an OEM with a third party owning and reselling the intellectual property. This quite unique and new position of Kaifa´s brand in Europe was enabled by the resumed model of cooperation with IBM. Now, as of July 2013, IBM and Kaifa are the first smart meter vendor to fully comply with DSMR4 (version 4 of DSMR) requirements with an accepted single phase and polyphase electricity meter product and an audited and released production process since July 2013.

BACKGROUND

Smart metering in The Netherlands is like that for the majority of European countries, originating in European legislation that was initially driven by the necessity to change the European energy market model. This changing energy market, as it was argued, requires a modernization of the European energy infrastructure, which in itself requires the introduction of more intelligent meter systems. On the European level this principle is agreed in two Directives – the Energy Services Directive (2006/32/ED, ESD), and Third Energy Package and more particularly the Directive on the internal electricity market (2009/72/EC).

Modernization of the electricity grids is the key for the integration of highly volatile sources of electricity such as local and large scale wind and PV. An intelligent grid does not stop at electricity production but includes flexible customers that help to balance demand and supply. Because it is said that more intelligent meters are essential for the DSOs' grids of the future, let's see what this future grid looks like, following the US Department of Energy (DOE) definition:

- Be able to heal itself – anticipate, detect and respond to system problems in the network, and avoid or mitigate power outages, power quality problems and service disruptions
- Motivate consumers to actively participate in operations of the grid
- Resist attack
- Provide higher quality power that will save money wasted from outages
- Accommodate all generation and storage options
- Enable electricity markets
- Optimize assets
- Enable higher penetration of intermittent power generation sources.

It is clear that more intelligence seems the prerequisite to fulfil these characteristics. Although a lot of definitions exist on what a more intelligent "smart" meter should look like, the common understanding seems to be that this generation of meters, which are digital instead of analog and support 1 or 2 way communication, have some new features like anti tamper, optional breaker, local communication ports for HAN, wired and wireless ports for other energy metering points, register logs etc., all with highly secured communication.

It´s obvious that not only forces driving the positive side of acceptance exist. The downside of introducing smart meters is mainly represented in e.g. social discussions on privacy and more technical discussion on security and radiation. Since a new generation of meters will be on the intersection between public energy networks and customer premises, additional information and communication technology is introduced. This increases risks. These risks are (to be) assessed and mitigated by DSOs. In general the proposed smart meter infrastructure in The Netherlands is described in NTA 8130 from NEN (Nederlands Normalisatie Instituut) and in DSMR4. Privacy and security requirements are an integral part of this, although the level of requirement is a mix of functional and technical requirements.

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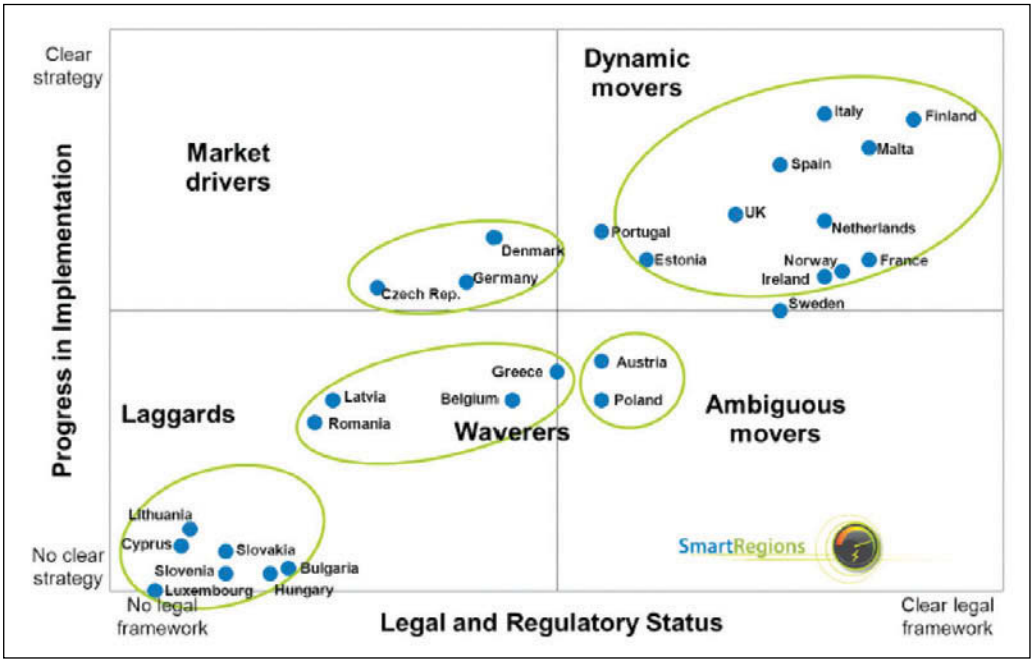
It is obvious that for new smart meters one of the objectives is to protect the privacy of the customers and to fulfil requirements related to WBP (Wetboek Bescherming Persoonsgegevens: the Dutch Act in Constitution to protect personal data). For this reason, privacy and security guidelines were already agreed within Netbeheer Netherlands by 2010 and the code of conduct has been proposed to and was accepted by the "College Bescherming Persoonsgegevens" (CBP), a Dutch institution guarding privacy for citizens and advising the Ministry of Justice in privacy related cases. These discussions are likely to continue and privacy and security requirements are likely to be maintained as the technology is maturing.



Overview of smart metering progress in Europe
Source: European Landscape Report 2012

SMART METERS – THE EUROPEAN CONTEXT

The latest publication of the project "SmartRegions – Promoting best practices of innovative smart metering services to European regions" (funded by Intelligent Energy – Europe, source: http://www.smartregions. net/default.asp?SivuID=26927) in the best way assesses the overview of the variety of legislation among European countries. It is made clear that the legislative push by the European Union is currently the main driver for the introduction of "smart" metering systems in Europe. As a consequence, the smart metering landscape is highly dynamic at the moment with many member states adjusting their energy legislation to comply with the third EU energy market package and the Energy Services Directive. As the report says, across the European Union countries are moving towards electronic energy metering as a way of modernizing electricity grids and improving the information that is available for grid operators.

There are various layers of action in and between EU member states and different EU institutions that are currently working on standardization, regulatory recommendations, technical functionalities, and other issues of importance. While some member states are awaiting the results of these various working groups and task forces, others are actively moving towards smart metering and starting with a rollout independent of existing barriers to the deployment of smart grids.

Due to the regulatory push and the efforts of market actors, the development of legislation and regulation for smart metering in Europe is highly dynamic. The Smart Metering Landscape Report analyzed all countries on the dimension of this legal and regulatory status: it was evaluated whether or not a framework has been created not only to provide clear guidelines to utilities for installing meters but also to do so with the goal of achieving energy savings and/or peak load shifting. For each country the status quo has been assessed on the following dimensions:

- Cost-benefit analysis and rollout plan
- Timeline for the rollout
- Barriers from additional legislation and regulation, e.g. privacy and data protection, measurement and calibration of meters
- Legal minimum functional requirements.

Combined with the progress of smart meter implementations per country, including the assessment of an existing and clear roadmap per country, the overview in the Figure was abstracted.

The Netherlands can be seen as a dynamic mover because of a clear path towards a full rollout of smart meters with a major pilot project that is paving the way. The Netherlands has been proactive in translating EU legislation as a framework into general administrative acts (AMVB´s – Algemene Maatregel van Bestuur), by the Minister for Economic Affairs and Innovation, who submitted an alteration (Novelle) to the legislative amendment. The Ministry of Economic Affairs and Innovation then asked TNO to give an opinion on the implementation regulations. Implementation regulations set out the details of legislation and stipulate the requirements that smart meters must comply with. The House of Representatives agreed with the Novelle in 2010, as did the Senate in February 2011.

SMART METERS IN THE NETHERLANDS – DSOs ARE LEADING THE WAY

The Dutch DSOs are well prepared for the introduction of smart meters. They undertook major smart metering pilots in the late 2000s and have spent several years developing system solutions to support advanced data applications. During 2012, installations of smart meters were started on a small scale in replacements and new constructions to gain experience for the upcoming large scale replacements. Smart meters have been offered to consumers for many years by energy retailers to enable flexible tariffs. The alternative energy retailer Oxxio, since 2011 part of Eneco, has provided over 200,000 smart meters using GPRS as the communication technology of choice. IBM has led this program and provided an end-to-end service. Now, the revised Dutch Electricity Act and the Gas Act, that was accepted in 2011 in the House of Parliament and came into law in 2012, obliges DSOs (as owners of the meters) to offer all households a smart meter.

Households still have a choice in accepting a smart meter with full functionality, having no smart meter at all or to make the choice to have a smart meter but not to provide interval data to the DSO (and consequently a service provider of choice). The DSOs need explicit customer acceptance. With the revised Act, energy retailers or suppliers have to provide customers with bi-monthly consumption and cost statements. More detailed energy insight services for households, provided that it is ensured that individual

measurement data is only used for the specific purposes, are considered a market responsibility that supports the overall business case for smart metering.

In 2009, the initially proposed mandated introduction of smart meters was not approved by the Dutch Senate and the original proposal had to be changed to allow a voluntary rollout. As a result of that development, the Ministry of Economic Affairs instructed KEMA to perform a revised cost-benefit analysis and recalculate the consequences of the changed circumstances with respect to the business case for the introduction of smart meters in The Netherlands. Quoting Berg Insight, there are three major differences that prompted the new analysis:

1. The smart meter will only be read once every two months in the standard situation
2. The customer will have the option of refusing the smart meter, or can have the smart meter treated like a traditional meter by registering it as 'administrative off'
3. The need to get an understanding of the possible measures the Dutch government could take to influence the social costs and benefits in the desired direction.

Now, an updated and positive business case is still expected of approximately € 770 million, considering that almost 100% of the households will accept the smart meter (with almost 100% standard readings). The benefits considered are first and mainly energy savings, secondly savings on call centre costs, and lastly lower cost for executing the market mechanisms like customer switching, moving and saving meter reading costs. As a consequence, the rollout of smart meters in the Netherlands will continue with a small scale rollout from 2013 until 2014/2015. Mostly regular meter replacements or new house installations or renovations will be addressed in this phase to get experience for the mass rollout. This mass or large scale rollout aims to get a smart meter in at least 80% of households.

THE ROLE OF NETBEHEER NEDERLAND

In order to support the small and large scale rollouts more effectively, the DSOs have joined forces by cooperating under the Netbeheer Nederland umbrella. Netbeheer Nederland promotes a dialogue with government and market parties about the contribution that DSOs can make to the transition to a sustainable energy system. It consults with the Office of Energy Regulation (ACM) about how gas and electricity supply can be maintained and extended at socially responsible and efficient levels with security of supply and safety in mind.

One of its project groups, 'Uitrol Slimme Meters', coordinates activities for the national smart meter rollout. Within the program the Smart Buying project is responsible for the selection of the preferred suppliers, as described in the introduction.

With the ambition 'Smart Buying = Smart Delivering', the Smart Buying program executed an extensive preferred supplier selection process. The initial pre-qualification result was audited by Netbeheer Netherlands in 2011, including a factory visit at Shenzhen Kaifa Technology Co., Ltd. After the final decision by Netbeheer Netherlands to select IBM-Kaifa as one of the preferred suppliers, the development-test project and contract negotiations started. Due to requirements discussions and complex interoperability tests the development and test project was more time consuming than expected. Although contractually all was agreed in 2012, final product release was only given in 2013. Since then the production is up to speed and first deliveries have been planned from September 2013. By having the newly released meters available in the Dutch warehouses for rollout, Dutch DSOs can fulfil their obligations of starting rolling out of the latest DSMR4 meters in The Netherlands from 2013.

THE IBM-KAIFA COOPERATION

As one of the preferred suppliers for Netbeheer Nederland, IBM works closely with Shenzhen Kaifa , founded in 1985 and operating the Metering Division since 1995. Kaifa operates various other divisions, and thus has profound experience in e.g. storage products and microelectronic s products. Until now Kaifa has shipped over 22 million smart meters to Europe, 8 million anti-tampering meters to Asia and provided several million meters for China´s enormous domestic market. For 2011 Kaifa was ranked 7th of MMI Top50 EMS Providers. Since 1994 it has been a stock company, the number of employees increased to beyond 17,000 and today is in 10 locations worldwide: China, Hong Kong, Australia, Singapore, UAE/Dubai, USA, UK and Italy. In 2012 its sales revenue exceeded $2.64 billion.

In 2004, IBM Global Business Services and Technology Services and one of the biggest European utilities entered into an alliance in the area of advanced metering management (AMM)/advanced metering infrastructure (AMI). Since then, IBM has delivered, together with its mainframe and software solutions, more than 2 million PLC and GPRS smart electricity meters for almost 30 European projects (for example to Enemalta, WSC Malta, Oxxio The Netherlands, A2A Brescia Italy, etc.).

The metering hardware is sourced, procured and quality controlled by an IBM Smart Energy Technology Procurement Centre of Competence (CoC) that was built up in Mainz, Germany at the same time IBM stepped into this alliance. This Procurement CoC is engaged whenever such metering hardware is needed to be procured, and it then manages all necessary procurement and supply chain management activities.

When the Procurement CoC started sourcing activities in 2004, Shenzhen Kaifa Technology Co., Ltd, headquartered in Shenzhen, China and part subsidiary of China's giant Great Wall Technology Co., Ltd, already had a long history of collaboration with IBM especially in the area of storage hardware. Many years of manufacturing experience with the e-meter technology needed by IBM at their start into the first European AMM/AMI engagements in 2004, made Kaifa a perfect fit for cooperation in this area. Now, after almost 10 years of excellent win-win collaboration in the smart metering hardware business, it is no surprise that Kaifa was chosen by IBM as an early development partner and supplier of the final products for this project. YES, the Dragon can dance! MI

ABOUT THE AUTHORS

Alex Bouw is Senior Managing Consultant for the Energy & Utilities industry in Europe. He has worked exclusively for this industry for the past 14 years and has increased focus on smart energy systems since he joined IBM in 2008. For this project he has been responsible for sales and R&D. He has a master's degree in Engineering and an Academic degree in Industrial Automation.

Jan Oost is Senior Managing Consultant for the European Energy & Utilities industry. With more than 12 years of industry experience his focal point is new business development for IBM Global Business Services, with smart meters and meter data as core business area. For this project, Jan acted as the IBM program and contract manager. He has a master's degree in Business Administration and a master's degree in Business of Energy Systems.

Stephan Gibiino is Manager for Procurement Services in Europe. Within this responsibility, he is, amongst others, leading a team specialized in hardware procurement, supplier quality management and procurement consulting for smart energy projects in Europe. He has worked at IBM for more than 16 years in various international logistics, materials management and procurement positions. He has a Master's degree in Economics specialized in Information Management.

THE CHANGING DYNAMICS OF REVENUE PROTECTION: SMART METERING AT BELD

By Joe Morley, Engineering and Operations Manager, BELD, and Zac Canders, Program Manager Emerging Technologies, SAIC

Ever since electrical engineer Otto Blathy patented the alternating current (AC) kilowatt-hour (kWh) meter in 1889, a key component of the meter-to-cash process has been revenue protection. While metering technology has changed dramatically since 1889 and vendors have come and gone, one thing has stayed the same: if the meter isn't recording energy used or produced, someone's not getting paid.

To track watts, prevent theft, and guarantee bottom lines reflect energy sales, myriad processes, sometimes manual, have been developed and shared between utility professionals across the country. In most cases, these processes are not dependent on the size or location of a utility. Most utilities aim to maximize revenue, minimize expenses, and improve reliability. An easy solution to help optimize the income statement and increase annual net income, while still improving system reliability, is to explore the benefits of smart grid.

At Braintree Electric Light Department (BELD), a Massachusetts utility, revenue protection has always been a daily part of the job. Robust strategies such as barrel locks on all meters and having meter personnel inspect all meter-related issues resulted in dramatic declines in energy diversion and minimal potential losses. So when it came time to upgrade its meters, BELD needed to understand how technology could complement its existing processes.

When considering advanced metering infrastructure (AMI), as a non-regulated utility that could not accept the risk of spending capital on unjustified assets and services, BELD had to make sure its business case mirrored the benefits of AMI. Working with SAIC, BELD identified smart metering, using AMI, as the first step in its smart grid systems roadmap. The selection and timing of AMI was the bi-product of cross-utility preparation, collaboration, and teamwork with the vendor community to understand both the current and modernized state of BELD. The solution would help the utility save money, realize efficiencies, and ultimately redefine how revenue is protected.

Together, BELD and SAIC identified how new AMI technology could complement its existing and proven revenue protection strategies:

- Capitalizing on metering technologies that identify theft and tampering the moment they occur
- Minimizing the number of truck rolls and customer visits associated with metering issues
- Maximizing the collections process and minimizing lost revenue that is written off each year
- Protecting metering assets without on-site inspections now that meter readers no longer visit meters each month for usage readings.

BEFORE SMART METERS AT BELD

Historically, revenue protection at BELD relied on proven, sometimes century-old techniques such as:

- Barrel locks and security rings
- Disconnecting service, which required sending a utility worker to each site
- Inspecting meter service for signs of theft, tampering, and other fraudulent activity
- On-site validation of non-metering or low energy usage
- Replacement of faulty metering equipment
- Leveraging historical monthly kWh usage for lost reads and bill estimation activities
- Credit and collection agency reporting with intermittent success.

An old BELD meter

Strategies similar to these can be found at practically every utility and are achieved via time intensive manual investigative and intervention techniques. Most of these familiar revenue protection tools require field personnel to be sent out to the customer premise to determine the correct action to re-align the meter-to-cash process. If a meter fails or a customer purposely steals energy, or an electric bill goes unpaid, the utility is forced to quickly resolve the issue or face placing the losses as a write-off on its balance sheet. BELD recognized that many of these strategies wouldn't go away although the enhanced granularity of meter data, near real-time alerts, alarms, and events could strengthen these exiting revenue protection strategies.

While BELD's original cost benefit analysis focused heavily on the obvious opportunities of AMI such as reduced meter reading expenses and fewer truck rolls, BELD recognized and used the information in Table 1 to show its utility board how advances in metering technologies would lead to better revenue assurance.

Before smart metering	After smart metering
Manual disconnecting of a non-pay service	Remotely disconnect service, track, and maintain non-pay customers – no truck rolls required
On-site inspection for inversions, bypasses, or tilts of meters	Leverage granular meter data channel information to track trends, inspect possible theft, and manage customer energy delivery
On-site validation of faulty metering equipment	Remotely troubleshoot, explore meter logs, and determine potential failure or missing reads retrieval without sending a truck

Table 1 – How smart metering can change revenue protection

AMI INSTALLATIONS AT BELD

Leveraging the expertise of its existing bargaining unit metering personnel, BELD adjusted deployment timelines to avoid the costs of employing an external installation vendor. This decision proved instrumental: with more than 11,000 customer premises to visit,

Lessons learned on theft in the field – an old meter socket with a jumper on one side that allowed the tenant to steal 50% of consumed power

the field team at BELD had an opportunity to identify customer premises and aged assets that were directly impacting revenue.

As installation numbers grew, BELD's field personnel, engineers, customer service personnel, and managers began to realize the potential of identified and unidentified revenue protection mechanisms.

Documented revenue protection efficiencies:

- Truck rolls associated with the disconnection and reconnection of non-pays, theft, tampers, and other meter security violations have dramatically dropped.
- Anomalies, missed reads, bill estimations, and fraudulent activity detection that once took extensive amounts of time to detect because of the manual metering process, are now captured and summarized in easy-to-understand reports and dashboards. If a customer or contractor pulls a meter from its socket, BELD instantly knows.

BELD meter installation

Unexpected revenue protection efficiencies:

- AMI allows BELD's customer service representatives (CSRs) to support customers with issues or questions on their monthly, hourly, and even five-minute interval based energy usage. Allowing CSRs access to the associated metering systems has enabled the team to understand the intricacies of meter-to-cash processes and has provided a new means to interact and interpret customer usage data when customers contact BELD. Follow-up calls and site visits, which were once status quo, have been virtually eliminated. BELD's CSRs are now able to handle nearly all customer calls by reviewing the customer's energy usage data over the phone.
- The team at BELD expected a significant portion of the aging electromechanical meters to be reading less than actual consumption and also anticipated the need to replace meter sockets. Upon completion, it was determined that this was less than 1% of all installs.
- BELD's metering team assumed they would come across locations where the metering socket or service entrance would need to be replaced. While a plan was in place to handle these locations with a contracted electrician, very few services required additional work — a true testament to their on-going system maintenance and customer communications programs.
- It was expected that the metering teams would locate a small percentage of customers stealing electricity, through diversion or other creative means. Since BELD already had aggressive revenue protection and theft identification strategies in place, this turned out to be less than 1% as well.

REVENUE PROTECTION TODAY AT BELD

After BELD completed its AMI installations in 2012, the utility began its implementation of a meter data management (MDM) system. MDM went live in July 2013 with a customer web presentation of usage data set for September 2013. The decision to implement MDM post-AMI was related to upfront systems planning and roadmap activities completed prior to AMI. This strategy allowed BELD to understand the benefits of its AMI investment, keep team members focused on one major project at a time, and fully explore new and forward looking systems integration.

BELD found that the capabilities of MDM enhanced and even created new mechanisms for revenue protection. MDM helped BELD make better business decisions about setting rates and performing analysis into events, alarms, and losses on the grid. It also allowed BELD to better understand where revenue protection problems were occurring and solve them quickly. For example, MDM allowed BELD to:

- Understand granular usage patterns over time
- Perform advanced analytics and algorithms to detect various advanced theft strategies
- Minimize the time of customer site visits once required to detect anomalies and fraudulent activity
- Provide advanced editing, estimation, and meter read validation techniques to mitigate and manage non-reads
- Leverage new dashboards and automatic reporting tools for a clearer understanding of revenue protection issues.

CONCLUSION

Revenue protection is more than just addressing energy theft. It is a comprehensive plan that includes a utility's metering, engineering, customer service personnel, managers, and utility customers, as well as the vendor community that provides the hardware, software, and integration tools required to promise that a kilowatt delivered is a kilowatt sold.

BELD recognized that the ultimate purpose of smart grid technology is to put customers first and that the smart grid journey should provide utilities with a new appreciation for the changing dynamics of defining revenue assurance strategies. The value added and associated savings realized from smart grid technologies will enable utilities across the country to shift their focus toward other efforts that optimize power delivery, utilization, and pass further savings onto customers. MI

ABOUT THE AUTHORS

Joe Morley is the engineering and operations manager at Braintree Electric Light Department. He has more than 43 years of electric utility engineering and management experience and was directly involved in leading strategy, implementation, and support of BELD's AMI and MDM systems.

Zac Canders is a program manager within the Emerging Technology division of SAIC. He has extensive experience leading design, development, and implementation of smart grid solutions at the nation's largest investor-owned utilities and municipalities, where he directly managed AMI, MDM, enterprise resource planning, and grid optimization projects.

ABOUT THE COMPANIES

BELD supplies electric service to approximately 16,000 residential and business customers in the town of Braintree, Massachusetts. The utility operates generation, transmission and distribution facilities across a 14-square-mile service territory that is served by 148 miles of overhead lines and 88 miles of underground lines. BELD operates three electric distribution substations and two 115 kV transmission interchange substations, and is connected to two separate 115 kV NStar transmission lines that are part of the ISO New England electric grid.

SAIC is a FORTUNE 500® scientific, engineering, and technology applications company that solves problems of vital importance to the nation and the world, in national security, energy and the environment, critical infrastructure, and health. Portions of SAIC are to be renamed Leidos, following SAIC's planned separation into two independent, publicly traded companies, subject to board of directors approval.

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THE CUSTOMER BENEFITS OF SMART METERING

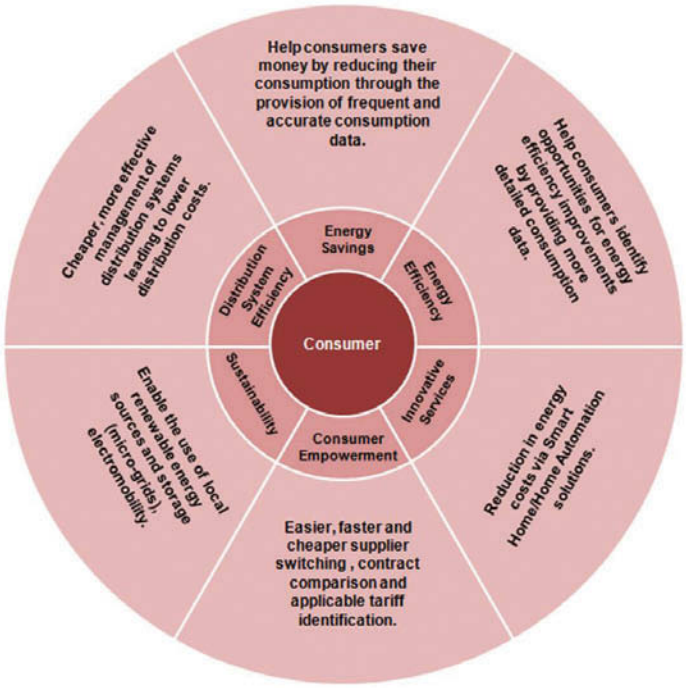
By Phillip M Kettless

With all the work being done by the various parties engaged in the GB smart metering programme and the enduring phase now approaching, albeit with a year's delay, it is easy to forget the most crucial party, the consumer.

Many of the documents produced by the government's Department of Energy & Climate Change (DECC) stress the importance of consumer engagement to the delivery of consumer benefits; indeed much of the cost-benefit case associated with the smart meter deployments is predicated on this. However, despite a DECC consultation undertaken on these issues in April 2012, even in the foundation phase to date, there is very little consensus on the consumer potential to achieve the predicted benefits. It is worthwhile exploring, in detail, the benefits enabled by smart metering both immediate and in the future.

BENEFITS OF SMART METERING

The most obvious and most talked about benefit is energy savings through accurate billing, consumer awareness of energy use and cost via an in-home display (IHD). This does not mean that consumers received inaccurate bills in the past. It means that actual consumption data can be regularly obtained from smart meters that are effectively 'always on' in terms of communication and actual bills produced rather than estimated ones (something that is often not possible with 'walk order' meter reading). This will mean fewer consumer meter reading and billing disputes. While it can be argued these benefit the suppliers more than the consumers, there will be a tangible benefit to consumers with a more transparent billing process and delivery of better and timely information. This, in conjunction with electronic billing (eBilling) means that consumers could receive their bills monthly rather than quarterly and be aware of their consumption and cost sooner rather than later. This with additional engagement, as we shall see later, could assist consumers in reducing their consumption or changing when they consume energy, resulting in a reduction in their bills.



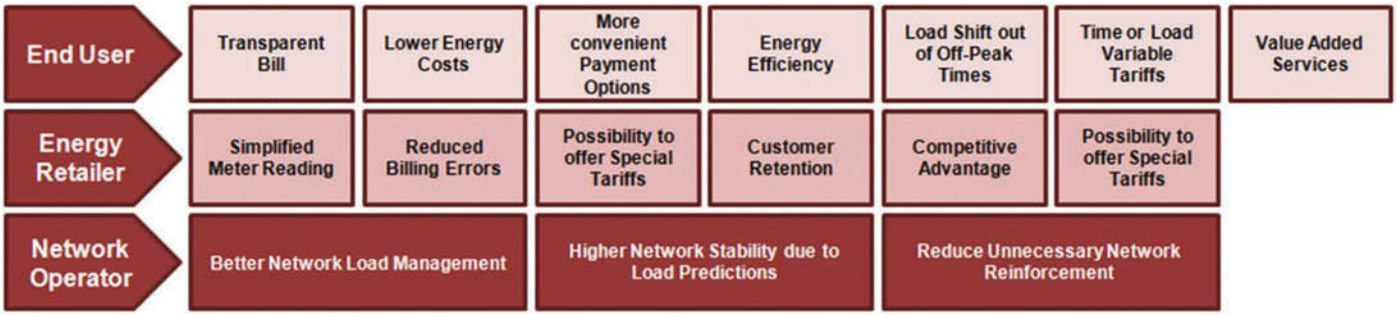
Consumer benefits of smart metering

Another much talked about benefit is the provision of a range of more convenient payment options, the obvious one being 'pay-as-you-go' or pre-payment. The use of tokenless pre-payment metering in Northern Ireland resulted in the prepay consumer base growing to three times its original size just by consumer satisfaction and 'word of mouth' recommendations. This was a result of a number of factors; introducing the same standing charge for pre-payment and credit meters and reduced consumer debt resulting in a lower cost to serve. The provision of new innovative vending channels such as telephone, internet and smart phone app vending empowered a whole new section of consumers who wanted to pay for their electricity as they did with for other goods, as they used them.

DECC perceives the consumer benefits occurring on four main levels: direct feedback in near real time, indirect feedback, advice and guidance, and motivational campaigns. All of these are crucial if the government is to achieve its ambitious energy saving targets and a positive payback on the smart meter deployment programme. Direct feedback in near real time will be achieved by consumption and cost data from the metering equipment displayed either on an IHD, mobile phone, online or via some other platform. Indirect feedback such as non-real time aggregated historical data (weekly, monthly and yearly) for comparative information can also be displayed on the same technologies or be provided on bills.

The third level, advice and guidance, are seen as being provided by paper, web, mobile, face-to-face or phone interventions. While these will certainly help consumers interpret their data and make better choices, simple consumer focussed messages sent to their IHDs could assist in this process, something which was trialled with some success in Ofgem's Energy Demand Research Project (EDRP). Similarly, such messaging could support the fourth level of behavioural change; motivational campaigns for energy literacy and consumption reduction alongside marketing and community delivered (smart towns and villages) initiatives.

IHD messaging and the interventions mentioned above will be crucial to the success of the GB smart metering programme as a reduction in energy consumption will not be delivered by just installing smart meters and IHDs alone. It will be the consumers' behaviour in relation to their energy consumption which will deliver the benefits. In Australia, for example, consumers receive a profile of their consumption with their bill. Provide this to consumers as part of the billing process, and there is a good possibility that consumption behaviour could be influenced. Add to this the highlighting of high levels of consumption and cost along with recommendations on energy efficiency actions and the interpretation of data to create household specific recommendations such as changing tariffs or consuming energy



Smart meter programme benefits

at a different time of the day could influence behaviour even more. Reinforce this with monthly, weekly or daily messages on IHDs as reminders and there is a good possibility that consumers could change how and when they consume energy. Careful thought will be needed on the presentation of this information in a simple, meaningful way if IHD messages and internet data is used to change behaviour and paper-based versions binned with other junk-mail.

WHAT NEXT?

If the rollout goes according to plan, 2015 will see the rollout of the enduring phase of the smart metering programme ending in 2019/20. So what happens next?

Well for a start there is a need to focus on delivering benefits faster, and pre-payment does this. There is a need to support consumers whose pre-payment meters are in inaccessible or hard to reach locations or in instances where a token has to be entered manually when, for whatever reason, it has not been received via the wide area and home area networks (WAN, HAN). DECC has proposed a device known as a pre-payment meter interface device (PPMID), an interface which remotely replicates the pre-payment meter functionality at an accessible point for the consumer irrespective of the meter's location. It is therefore possible for pre-payment consumers to have both an IHD and a PPMID in their homes. A simpler solution would be to integrate the PPMID functionality into an enhanced in-home display (EIHD) so that only one consumer interface is required.

Then there is micro-generation – wind, photovoltaic and combined heat and power. SMETS covers these rather simply by defining how the generation data and export data is measured and captured but that is about as far as it goes. Smart metering could help consumers make use of their renewable energy source more effectively, reducing the energy imported. Messages on their IHDs could inform them when they could make use of their renewable energy so that laundry, water heating or even electric vehicle charging could be done when it is advantageous to them in terms of energy cost and availability. For dual fuel households the smart solution could decide, based on the cost of the two fuels, which is the cheaper one to use when water heating is requested.

In the UK, the majority of off-peak domestic heating and water heating is currently controlled by around four million radio teleswitches or telemeters which contain a radio receiver controlled by a central radio network. Devices respond to messages sent with the correct group and area codes to either switch on or switch off the heating load. This dynamic control allows the demand on the network to be controlled and in some circumstances switched or moved when there is a network or generation issue or adverse weather warning. This service is due to come to an end in the next few years, but no replacement has been factored into the GB smart metering design. With the majority of the smart meters being accessible via the WAN it should be possible to replicate a similar service. Imagine a smart home with prioritised appliances which can be switched on and off via messages sent across the WAN, or be overridden and have their priority changed by consumers via an EIHD. This would allow consumers to have their loads prioritised and controlled by pricing or network (demand control) messages with incentives for allowing the control to take place and penalties for ignoring or overriding the control.

The Central Delivery Body (CDB), an organisation set up by the trade association of the large energy supply companies (Energy UK), will be responsible for building consumer confidence and awareness in the GB smart metering rollout and informing them of the benefits while overcoming the issues (data privacy, cost, health effects, etc.). This is an essential part of the consumer education process and suppliers must ensure that their message is delivered in a simple, easy to understand and informative way, to prevent IHDs ending up in consumer's drawers and informative bills and data being ignored and thrown away.

So much more could be written about the smart metering programme. As this article is focussed on technology as an enabler I have not touched on how smart meters can provide a platform for other energy policies and initiatives such as the Green Deal, which encourages the increase of the energy efficiency of homes. The programme is a very ambitious project which I often liken to Dorothy in the 'Wizard of Oz' starting out on the yellow brick road. The GB programme is just beginning its journey down a similar path. We think we know where it will take us but to paraphrase a famous Greek philosopher "change is the only constant." New technologies, the ever changing energy market, consumer drivers and attitudes, the learnings from the foundation stage (insights into consumer benefits, awareness of and attitudes towards smart meters) could result in our ending up in a very different place from where we thought we would be at the beginning of the process.

It is very easy to imagine a vast array of services and gadgets that smart metering could enable. The key message to be remembered however is that consumers want to lower their energy bills, as to them price is king. They want to maintain the lifestyle they have or aspire to and they want to pay as little as possible. Retailers in the future will need to build on the smart metering platform and innovate with their offerings and services and make products such as pre-payment, for example, a readily accessible engagement option for a much, much wider consumer base. MI

ABOUT THE AUTHOR
Phill Kettless has been involved with GB smart metering since its inception and is the Smart Metering Senior Requirements Analyst at Secure Meters (UK) Ltd. Previously he was the Metering Asset Manager at Eastern Electricity.

www.securetogether.com

CHILECTRA'S SMART GRID DEVELOPMENT

By Rafael Caballero and Hans Rother Salazar

Chilectra has undertaken a smart grid deployment strategy that has already provided important results in the field of smart metering, network automation and monitoring, electric mobility and distributed generation.

Concerning network automation, the company already installed 321 remotely controlled reclosers along its medium voltage lines.

Regarding smart metering, Chilectra implemented an automated meter reading (AMR) system for more than 2,000 big industrial and commercial users as well as for 168,000 residential customers. Among these 25,000 are equipped with remote disconnection and reconnection, and more than 70,000 residential users benefit from time-of-use tariffs.

The company is also moving forward in the field of electric mobility, with 29 charging points installed so far, and distributed generation, with 21 kWp PV panels connected to low voltage grid.

Chilectra's smart grid development testifies to its commitment to technological innovation, efficiency and sustainability that will enable a higher quality of life for the citizens of Santiago.

WHY A PILOT PROJECT IN SMART METERING?

Regulation of smart grids is in its first steps in Chile. In February 2012 the government noted in the National Energy Strategy 2012-2030 its intention to analyze the technical and economic feasibility of smart grid projects, considering and appraising their social advantages.

Accordingly, in the beginnings of 2013 the Energy Ministry hired an international consulting company to draft a road map for the implementation of smart grids.

At the same time, the Net Metering Law published in March 2012 enabled distributed generation by regulated clients. The regulation authority will publish during 2013 a regulation to properly apply the Law.

Anticipating the trend, Chilectra has pioneered since 2011 a pilot project in smart metering for 100 residential customers. The company obtained from the Superintendencia de Electricidad y Combustibles (SEC) the certification in order to use the meters for billing purposes.

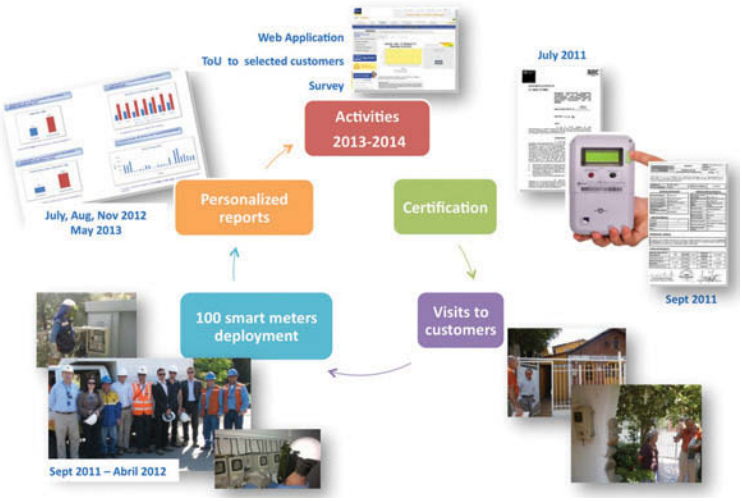
The objectives of the project were:

- Testing meter functionalities in Santiago's network
- Assessing the benefits for clients, and
- Identifying – together with the authorities – future developments and regulatory requirements in order to allow large scale development of the technology in Chile in the near future.

The technological solution, developed by Enel and Endesa, has been successfully implemented for about 35 million customers in Italy and is currently being deployed for 13 million clients in Spain.

Smart metering technology description and benefits

The smart metering system is composed of field components (smart meters and concentrators) and metering management software. The latter allows remote programming, reading and operation of the meters, coordinating with commercial information about the corresponding customers.

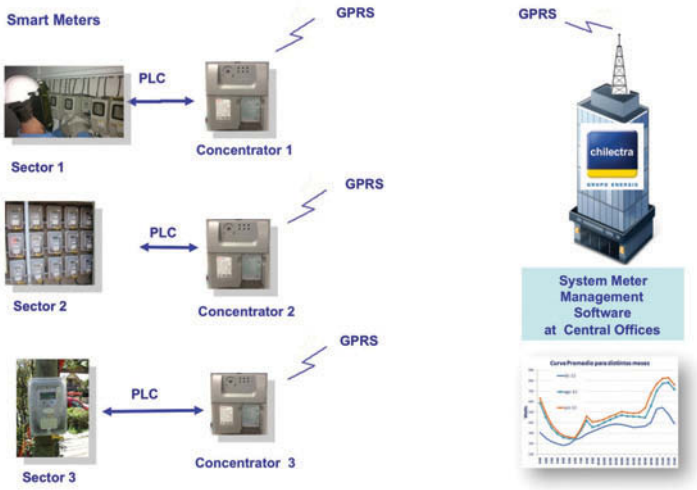


Smart metering pilot project activities

The smart meters for residential customers are the last generation electronic meters enabling bidirectional communication flows between customers and the company. They feature a wider range of functionalities than electromechanical or traditional electronic meters, which only register active energy consumption.

Smart meters represent a gate for a new form of interaction between Chilectra and its customers, enabling the following benefits:

- Automatic and remote reading that avoids human errors and in-field presence of company's personnel at the customer´s premises



PLC: transmission of data by the electrical grid (Power Line Communications)

Overview of smart meter project

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- Availability of further relevant information, registered every 15 minutes, like reactive energy, active and reactive power, average voltage, current and power
- Individual metering of quality of supply, since the number and duration of interruptions are registered
- Remote programming of time-of-use tariffs that encourage efficient use of energy, i.e. the shift of energy consumption from peak to off-peak hours, when the cost of energy is lower
- Management of distributed generation, since both customers' own consumption and net energy are registered
- Higher efficiency in the detection and management of faults in the service
- Remote execution of commercial operations like increase of contracted power
- Real time reactivation after disconnection in case of late payments
- Push towards the adoption of demand management tools, such as domotics systems that enable remote load control (e.g. remote switch-on and switch-off of domestic appliances).

"The information and communication technologies, such as GPRS and the PLC open protocol, enable the remote operation of a wide spread of functionalities"

The concentrator is an intermediate communication element between the smart meters and the company's commercial systems, and it is generally located on the transformers.

Information flows from smart meters to concentrators are safe and encrypted and are based on a powerline carrier (PLC) protocol. In Chilectra's pilot, the communication protocol is the open Meters and More. Finally, information extracted by concentrators, is sent to the distribution company's systems through GPRS protocols.

FEATURES OF CUSTOMERS FOR THE PILOT

Chilectra implemented the smart metering pilot project for 100 residential customers in the municipality of Huechuraba. Three different customer clusters, representing different socio-economic groups, were chosen to test smart metering for different patterns of consumption.

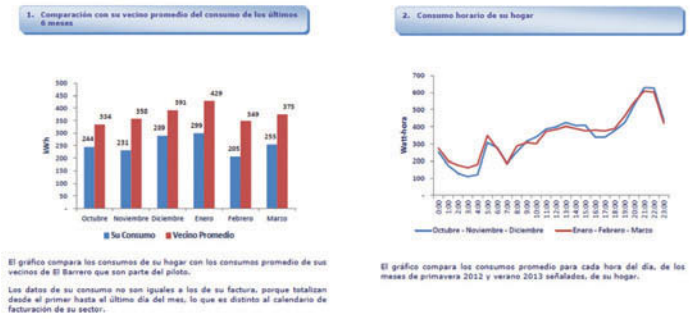
PILOT PROJECT RESULTS

The smart metering pilot project has been carried out successfully. Technical and functionality assessments were satisfactory under network conditions and compliant with Chilean regulation.

The main achievements of the pilot project are as follows:

- It is technically feasible to implement a smart metering system on a large scale in Chile. The information and communication technologies, such as GPRS and the PLC open protocol, enable the remote operation of a wide spread of functionalities (e.g.15-minutes readings, hourly and daily consumption profile gathering, disconnection, reconnection, contractual modification, time-of-use tariffs programming).
- A 99.09% success rate in the remote reading activity was observed between May 2012 and May 2013.
- No faults have been detected in the system, either in billing or in consumption registration, thus no complaints have been presented by participating customers.
- Personalized reports have been sent to the participants, giving information about their consumption profiles and suggestions for increasing energy efficiency in their final uses.

An example of a report delivered to customers is shown in the accompanying figure. In response to customers' requests, the graphs included a comparison with the average consumption of their neighbours participating in the pilot.



Example of a report for customers participating in the pilot showing individual consumption compared with the average neighbour consumption on monthly and daily bases

FUTURE CHALLENGES

Even though the technical test stage has been completed, Chilectra will keep on monitoring the smart metering system and pursuing the following activities:

- Communication to and feedback from customers
- Development, by the end of 2013, of a web interface to be used by customers to view their consumption data
- Implementation of a time-of-use tariff to several customers, in order to analyze possible changes in their consumption patterns
- Realize surveys on customers' perception and satisfaction with the technology
- Disseminate to the community, opinion leaders and authorities the results and advantages of the tested technology.

Without any doubt, the massive implementation of smart metering in Chile still requires attention by the Authority and needs regulatory changes in some aspects, such as:

- How to remunerate investments in technological improvements and to support the substitution of traditional meters with smart ones
- Changing the rules about property of the meters. As at today, 72% of meters are owned by clients – this makes social acceptance difficult and jeopardizes the transition to a more efficient system operated by the distribution company
- Presenting in a concrete way the advantages of the smart metering system, including its social and environmental benefits, to the community as a whole. MI

ABOUT THE AUTHORS

Rafael Caballero is Head of Energy Efficiency at Chilectra, with responsibility for smart grids pioneering projects in Chile (photovoltaic generation and smart meters).
Previously, he worked as Head of Commercialization in Chilectra, as an independent Consultant and for the Colombian Government. He is an Electrical Engineer and has an MBA and MPA from Universidad Los Andes in Bogotá.

Hans Rother Salazar is Chief of Measurement and Telemetry at Chilectra. He has specialized in energy measurement systems at Schlumberger in France, gas measurement systems at Mercury Instruments in US, and trading platforms for smart grid and smart meters with Actaris in Brazil. He is an Electrical Engineer and is studying for an MBA at Pontificia Universidad Católica de Chile.

ABOUT THE COMPANY

Chilectra is the major Chilean electricity distribution company, operating in the country's capital Santiago, and delivering electricity to 1.6 million customers located in the 2,118 km² concession area.
It is part of Enersis Group, subsidiary of Endesa España, the main multinational private electricity company in Latin America, controlled by Enel, energy giant with presence in 40 countries.
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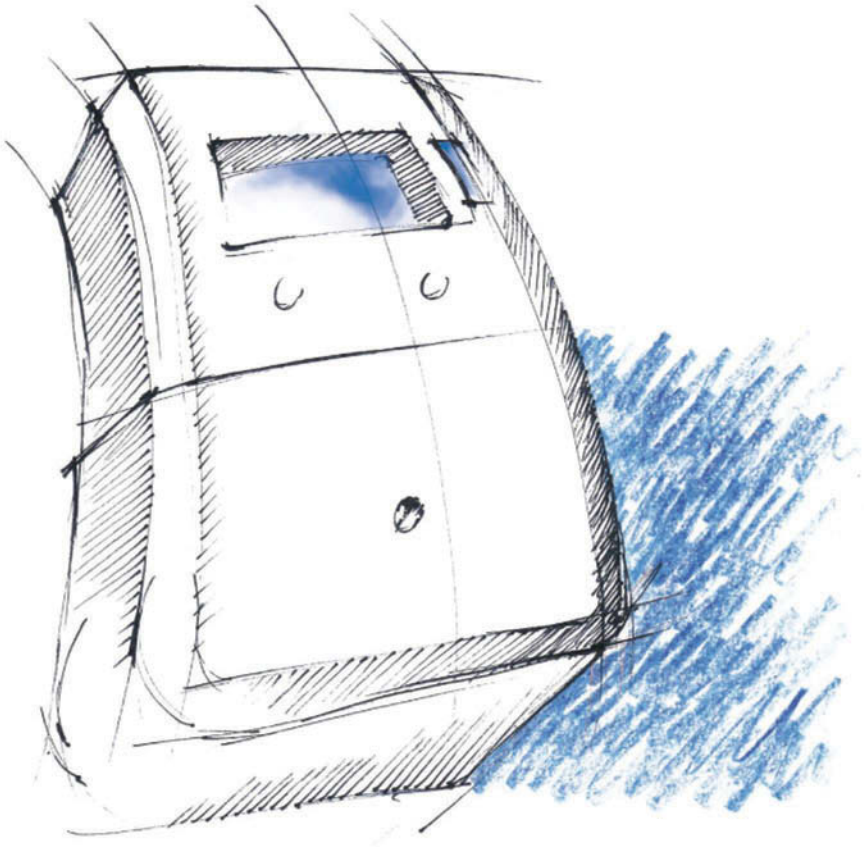

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SMART METERS: A NEW VISION

By Ali Benabdelmoumene

Smart meters are requiring more expertise in telecommunication and metering. Sagemcom is a metering company present in telecommunications with significant experience in smart meters. These two key aspects help us to renew our vision of smart meters enabling utilities to have confidence in their deployment and to secure their support of a working system.

In order to provide utilities with the best technologies, we have changed the way we design smart meters but more importantly we have changed the way we specify and qualify smart meters using a new strategy, new tools, and new skills.

FROM STATIC AMR METERING TO NEW SMART METER SOLUTION: DIFFERENCE AND EVOLUTION

Over the last 25 years, utilities have really developed metering with the integration of electronic measurement and communication devices. Smart meters now need to be able to handle complex protocols and cost effective communications with a central management server. The market is calling for open standards to ensure interoperability and multi-sourcing that implies deployment in heterogeneous networks. Growing utilities requirements with regard to the amount of data collected and reactivity call for a service-oriented approach through deploying multiple applications to access meter data and change the meter settings of millions of units.

This is a significant jump in the amount of technology used at all levels, from the meter to service management, compared to the paperwork required for static meters.

SMART METER SYSTEM FUNCTIONS AND SERVICES: WHAT UTILITIES EXPECT

Smart meters could provide the key to tomorrow's challenges with the diversification of production means to reduce CO^2 emission, provision of automatic processes for utilities, and end user service delivery. By deploying smart meter solutions, utilities expect the following services from a central management platform without needing local access to the meter:

- Periodic collection of metering data to automatically perform customer billing
- Remote setup or subsequent configuration of delivery points through smart meters (reference power, tariff structure, etc.)
- Remote control of the latching relay
- Alarm notification
- Grid monitoring through better understanding of low voltage networks ("last mile")
- Firmware upgrade for evolution and maintenance.

The first challenge for manufacturers is to implement these advanced features. This requires increasing storage capacities and processing power. Smart meters are part of a network that is operated by the utilities themselves without depending on, or with limited dependence on, a telecom carrier. The operation of such a network requires the guarantee of a certain service quality level. Service quality is defined by the reactivity and reliability of communication but how can this be ensured with limited bandwidth, noise, attenuation, cross talk, and power consumption restrictions?

Standards are designed to handle these constraints but the real challenge is to fully master communications between the system and the meter, whatever the technology used, and be able to fully qualify the system in a production environment.

Aspects that need to be addressed in a smart meter system to enable utilities to deploy the solution that is best suited to their needs include:

- Understanding the impact of interoperability
- Controlling network engineering through the number of service messages maintaining topology (to balance network optimization and reactivity to changes, and limit overheads for metering data traffic)
- Finding the best packet fragmentation rule (to avoid bandwidth saturation)
- Choosing the most suitable modulation according to SNR (compromise between data rate and transmission reliability).

The scalability of systems proposed is also a key element which is strongly dependent on the system strategy for LAN, WAN networks and services to be delivered. An optimized spread of functionalities in the system, limited volume of data exchanged between all elements of the system, and asynchronous communication between concentrators and front end ensure central management system offloading and reduce any WAN traffic caused by end-to-end management of this task.

Leading manufacturers have truly evolved the way they manage smart meter design. New teams of engineers and experts in system, telecommunication, and security are now deeply involved in the design process and new skills are required.

QUALIFYING A SMART METER SYSTEM FOR MASS DEPLOYMENT: TOOLS AND STRATEGY

The challenge in qualifying smart metering systems for Sagemcom was to set up a team of diverse talents that included everything from original metering engineers to fully experienced IT experts.

Wall of meters for system performance measurements

Since a quarter of a century, we help our customers in the approach and the implementation of their energy management projects, deploying secure and sustainable metering solutions, from the meters to the System (HES and MDMS). Through this positioning, Sagemcom is committed to support its customers in their global energy challenges.

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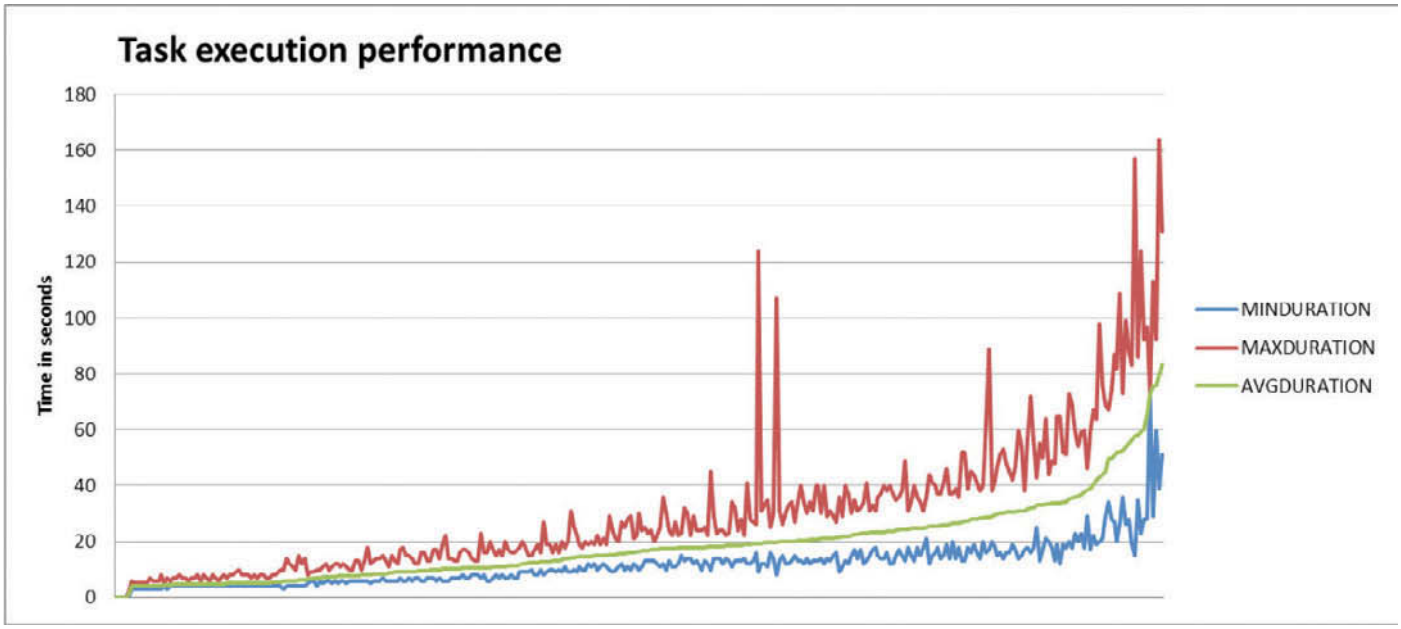

Example of performance result: mMin, mMax, and average delay to retrieve a load curve for all meters

Smart metering system qualification starts by checking products with high degree communication protocols, complex data models, and complex configuration schemes. Sagemcom has invested in an automatic test tool strategy to significantly save time and ensure high reliability, which allows us to qualify various solutions within a timeline compatible with our customer's requirements.

Before setting up a large network to verify overall performances, the first step is to check that all unitary products in the network (meters, data concentrators, front end servers) are correctly doing their job. With regard to meters, this is no different from the procedure for static meters. However, due to the current complexity of data models and configuration capabilities, the number of test cases has reached around 2,000 for a residential meter and over 7,000 for system testing. In order to secure and accelerate the validation process, automatic test scenarios have been developed to verify functional meter behaviour. This step is necessary; however, end to end performance is not the main objective of this phase.

The second step needs a full end-to-end test network, with a dozen meters. With this test configuration, all end-to-end mechanisms can be verified in an integrated way. Performances are now observed as they can reveal certain inconsistent behaviours but the network is not yet fully loaded. Electric power distribution stays very simple. Therefore a PLC network behaves perfectly on such a configuration.

The third step is implemented when everything on the limited end-to-end configuration is running correctly. This step involves building a three phase network with hundreds of single phases, three meters, line attenuation capabilities, and artificial phase-to-phase cross talk control. Tests are performed on different network topologies. These topologies are simulated using specific equipment such as PLC signal attenuators, filters, and LISN (line impedance stabilization network). Noise is simulated by a signal generator and cross talk between phases is simulated by drums with a realistic cable length.

Scenarios for measuring end-to-end performance require hundreds of thousands of elementary measurements. Automatic scenarios have been developed, along with automatic test data processing for good repeatability and high level performance indicator reporting.

This equipment enables line distances to be simulated through signal attenuation that will force the PLC network to create a meshed topology. Using variable attenuators that can be remotely operated allows a dynamic topology change (link disturbance and temporary isolation of a part of the network) to be simulated to verify PLC network reliability.

OSI layers	Test tools
Performance application	Test case automatic generator
DLMS	DLMS decoder, statistic analyzers
MAC	Mac decoder, statistic analyzers
PHY	Noise generators, attenuators, spectrum analyzers

Some examples of tools used to test each OSI layer (PHY, MAC)

The various field experience in our teams helps enhance a lab platform. Comparison between the performance of real networks and lab platforms is used to adjust lab configurations as new major issues are discovered in the field.

CONCLUSION

Smart meter systems could be the answer to the expectations of utilities but must be perceived in a different light. It is not a metering point that communicates with a system; it is a whole new system that includes metering points. A global overview of the system architecture including performance, specifications and interoperability is key in delivering a working solution to the market.

Sagemcom has adapted its tools, developed new qualification strategies, integrated new skills, and developed others to support its customers with functional and effective smart meter systems. MI

ABOUT THE AUTHOR
Ali Benabdelmoumene is Sagemcom Activity Manager for Smart Meters and Smart Grid. He started as a system engineer in defense and security R&D and developed his career in the group through experiences in software development, system architecture and project management for smart metering. For the past several years, he has developed smart meter products lines for the worldwide market. He holds a MA Degree in Signal Processing and Telecommunications.

ABOUT THE COMPANY
A French high technology group with an international dimension, Sagemcom operates on markets of broadband (digital home, digital set-top box, broadband and residential terminals), telecom and energy (telecommunications infrastructure, smart grid and metering), and management of documents (printing terminals, software and solutions, digital production workflow). Sagemcom is strongly committed to sustainable development through the life cycle of its products: eco-design, energy consumption, ethical code of all its suppliers.
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THE CHALLENGES FOR SMART METERING IN EMERGING MARKETS

By Dr Sean Cochrane, Cyan Technology

Smart metering is the way forward. Or so we are told. Since the mid-noughties, utility companies worldwide have been increasingly focussed on the rollout of smart metering technologies. But with the UK implementation of the smart grid delayed by another year, what is the situation for the less developed, but rapidly expanding countries such as India? What solutions are being trialled to bring these emerging markets 'up to speed' and, if successfully implemented, is it possible these markets could become 'smarter' than the UK?

According to the Organisation for Economic Cooperation and Development (OECD) the Indian economy has recently overtaken Japan to be the third largest economy globally[1]. In addition, it has one of the world's fastest growing populations, creating a constant and critical need for housing and putting greater strain than ever on India's power networks.

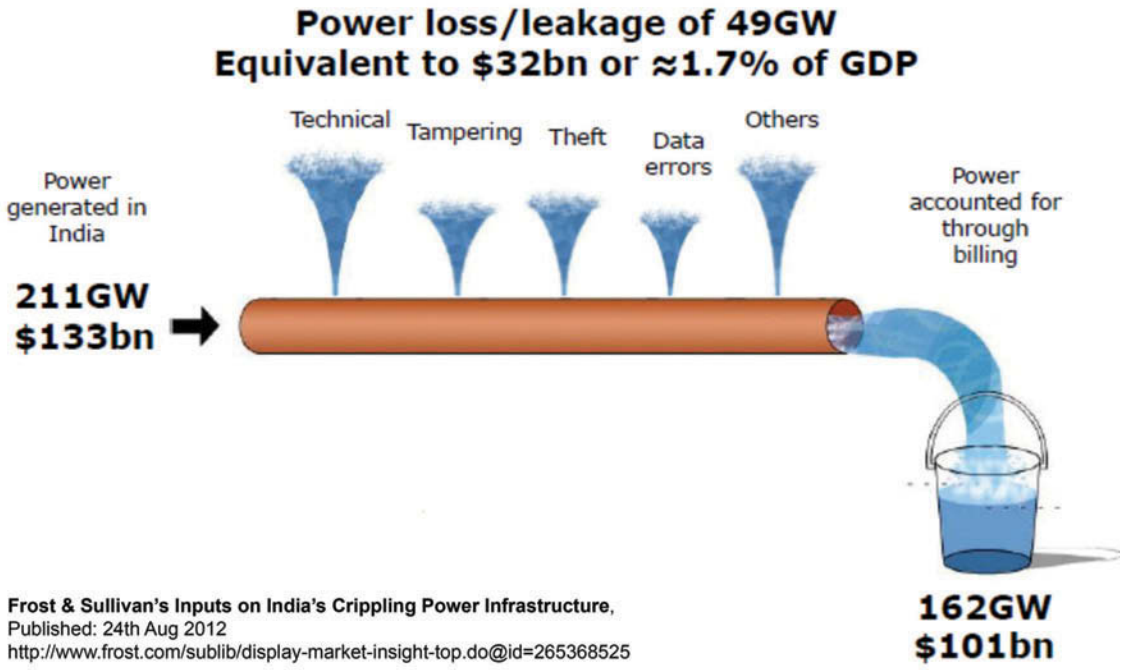
Due to rapid, unplanned urban growth and chaotic infrastructure, demand is far outpacing supply in many areas of India. This means regular power cuts especially during the hottest months when people turn on fans and air conditioning systems. With a population hitting the billion mark in the year 2000, and surpassing 1.2 billion in 2012, India's 50 year-old electricity distribution network is struggling under the weight of an incredible surge in both domestic and business requirements. Its annual GDP has risen sharply in the past five years, from $949 bilion in 2007 to over $1.8 trillion in 2012[2].

Whilst 211 GW is being generated (equivalent to $133 billion each year), the aggregate technical and commercial losses (AT&C) through technical issues, tampering, theft and data errors amount to a colossal 49 GW leakage worth $32 billion. These losses are equivalent to approximately 1.7% of India's GDP.

TAMPERING AND OTHER BARRIERS TO ACCURATE METER READING

Tampering represents a significant impediment in the Indian market. Those who are unwilling to pay for electricity have developed methods, both basic and sophisticated, of tampering with their domestic meters in order to obtain a significant reduction in recording accuracy. From the use of powerful magnets, to high voltage electrocution of meters, people will go to great lengths to ensure that the utility companies receive the bare minimum of a household's hard-earned cash.

However, even when meter readers successfully access a property, they may have difficulty locating the meter, as many were installed wherever the power supply entered the building. Meters behind cookers, in bathrooms, under beds and in outdoor boxes are all common in the vast sprawl of suburban India. There is also no guarantee of the condition of the meter once located. The sight of an electricity box on a pylon with dozens of lines connected is also commonplace in many urban areas, as theft is another substantial problem. Many households within reach of an electricity box will illegally 'tap into' the power grid with their own cables.



Frost & Sullivan's Inputs on India's Crippling Power Infrastructure, Published: 24th Aug 2012
http://www.frost.com/sublib/display-market-insight-top.do@id=265368525

Power losses in India

These factors, combined with variable quality maintenance of existing transmission and distribution (T&D) infrastructure and demand exceeding supply have led to staggering losses for Indian utility providers. So what can be done in this rapidly expanding society to ensure that spiralling demand does not lead to similarly escalating losses for those providing the electricity?

1. http://articles.economictimes.indiatimes.com/2013-05-30/news/39603030_1_gdp-growth-third-largest-economy-economic-growth-projection
2. http://www.tradingeconomics.com/india/gdp

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DEMAND FOR ELECTRICITY

One cannot underestimate the impact of technology on the Indian market. Whilst electricity supply is insufficient to meet demand, there is no shortage of technology in the daily lives of the Indian population. A village in India's most populous state of Uttar Pradesh recently got electricity for the first time – 65 years after independence.[3] The lives of the village's inhabitants have changed remarkably – with one villager explaining that previously he had to visit a neighbouring village to charge his mobile phone. Clearly, a lack of convenient power supply is not prohibitive to the ownership of mobile technology. The article goes on to state that whilst power cuts are frequent, "people say they are happy with even eight to 10 hours of electricity a day" with many families buying bulbs, fans and refrigerators for their homes within days of having electricity available.

Clearly a solution is needed to provide more reliable power to those on the existing network as well as extending the network to those who are not yet connected. The investment needed to achieve this must, in part, come from billing and collecting payments from all those consuming power today.

COMMON METER READING INSTRUMENT (CMRI)

In order to combat losses through tampering and improve accuracy, optical meters have been installed in many Indian households. These meters have an optical port and are read via an LED connection with a Common Meter Reading Instrument (CMRI). The data collected is more accurate, but meter readers must still gain access to the property and locate the meter in order to take a reading. This relies heavily on the meter reader's detailed knowledge of the local area, as postcodes and accurate maps may not be available. Meter reading therefore remains time consuming and inefficient.

Moving to a direct meter-to-utility interface, as used in the USA and being trialled in parts of the UK, would appear to make sense. However, this implies expensive equipment, and with many consumers spending less than $10 per month in India, meters costing more than $100 each are not a viable option. Any solution must therefore meet the cost constraints of the mass Indian market, and scale with their increasing demands for electricity.

AUTOMATIC METER READING (AMR)

AMR technology, based on the existing CMRI is a natural starting place. An effective improvement would be the addition of a radio interface that allows the meter to be read outside the customer premises, ideally from a street or alleyway leading to the property. This removes the need to gain physical access to the meter and makes finding meters (along a street or alleyway) much easier.

This would improve reading speed and reliability. More frequent readings would be taken, which would lead to more rapid detection of tampering and act as a deterrent to persistent tampering.

ADVANCED METERING INFRASTRUCTURE (AMI)

Any radio technology (that is built into the meter for AMR) has to be future-proof. As energy demands increase it should be possible to connect radio enabled meters directly to the utility. An AMI has to be considered from the start. A migration path between AMR and AMI is therefore essential.

Upgrading to AMI enables meters to send messages automatically to the utility providers, removing the need for both estimates and meter readers. A 21st century network could be built, eventually installing new meters to properties as the old ones become damaged or ineffective. It would enable utility providers and consumers to monitor power consumption on a daily basis and allow consumers to adjust their usage. AMI also allows utilities to tackle important issues such as demand side management (DSM), where smart rationing of supply can be achieved (rather than blanket blackouts of entire districts).

How the figures line up:
Population of India: 1,210,192,422 (2011)
Overall population growth in India 2006 - 2012: 8%
Power generated in India: 211 GW ($133 billion)
Power accounted for through billing: 162 GW ($101 billion)
Total loss/leakage: 49 GW ($32 billion)

In addition, an AMI network would automatically detect tampering and leakage, allowing repairs and replacements to be made efficiently and resulting in accurate readings and billing. Should frequent failure to make payments or tampering be detected, AMI also provides the possibility of remote disconnection, which could act as a powerful incentive for homes to 'play by the rules' in order to stay connected.

INDIAN GOVERNMENT INITIATIVES

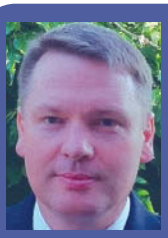
The first steps towards smart metering are tentatively being taken in test states across India. The Indian government is providing funding to upgrade pockets of infrastructure over the next five to seven years, including the replacement of 18 million single-phase consumer meters. Despite its many challenges, if these trials are successful, more and more Indian homes could experience 24-hour electricity by 2017. This would allow children to carry out their homework during dark evenings, supporting improvements in literacy and education nationwide. A nation of cricket lovers could watch the Indian Premier League on television whilst charging their mobile telephones in their own homes without the threat of a power cut.

Other emerging markets worldwide will be watching the Indian transformation carefully. South America faces a distribution loss rate of 15.5%[4] – the highest in the world – due to pervasive theft and power outages are an ongoing issue. Ecuador is aiming for full smart meter deployment by 2017 and Chile is currently developing smart city pilots.

AND FINALLY…

The UK government recently postponed the introduction of smart metering to households in the UK from Summer 2014 to Autumn 2015. The demands of a separate screen and interoperable standards are delaying implementation and increasing the cost of the smart meter. With the local electricity boards in some of the Indian states about to start their smart meter rollout, it may turn out that India, and not the UK, will be the world case study for implementing high volume, urban smart metering. MI

3. http://www.bbc.co.uk/news/world-asia-india-22679692
4. Source: Editors of Electric Light & Power/POWERGRID International



ABOUT THE AUTHOR
Dr Sean Cochrane is the Product Director for Cyan. Dr Sean has recently returned from his 20th trip to India, where he has been working with the energy utilities, meter manufacturers and system integrators. In this article, he shares his insights into the challenges and solutions currently being discussed in the world's second most populous country.

ABOUT THE COMPANY
Based in Cambridge UK, Cyan provides innovative solutions that reduce energy consumption for the utility and lighting markets. Cyan's core technology is a platform for the rapid and cost effective deployment of smart grid metering and energy efficient lighting. This includes CyNet™ wireless mesh networking protocol for communication with remote units as well as Cyan's enterprise software for full end-to-end system integration.
www.cyantechnology.com

APPS ARE BRINGING SMART METERING CLOSER TO US

By Wei Liu

Apps are bringing smart metering closer to us by providing a relatively easy way to understand our energy footprint and save energy, but there will still be a lot of work to do in regard to making apps remain attractive to users over the long term.

INHEMETER's iSmart II meters

Smart meters are an important tool for helping people understand and quantify their energy use. They differ from a traditional meter, by providing real time information on how much energy is being used and how much it costs.

In many smart meter schemes, an in-home display (IHD) is provided by energy suppliers to show the meter data in real time. However, some people have begun to question the value for money. After all, this cost will be finally passed on to customers and it is still unknown what proportion of the public is going to use it. By contrast, web portals could be a cheaper alternative to give feedback on energy use. Nevertheless, some people are not interested in and even against using web portals to monitor their energy data. Some of the reasons offered are:

- They are unwilling to share their own energy data
- In most cases network flow is charged, especially via wireless internet
- They are easy distracted by other online content
- They need to share the cost of the whole infrastructure including gateway (or data collector) and master station.

INHEMETER's iSmart II architecture, which can solve the above problems well, is designed to address the specific requirements from users and energy suppliers. With the aid of Wi-Fi direct technology and apps, an iSmart II meter is able to talk to smartphone, tablet, even TV locally and directly without requiring any extra devices. The iSmart II solution's components vary according to the applied option of exchangeable communication module (GPRS/PLC/RF/ZigBee/Wi-Fi). Users can freely choose a scheme suited for themselves and view their energy use locally or remotely via apps. As will be readily seen, the way that apps get and display energy data is more flexible compared with IHDs and web portals. Meanwhile, the cost can be cut to the lowest.

In spite of that the way we use energy is extraordinarily difficult to change because energy consumption is a deeply ingrained behaviour tied into work, shopping and family life. However, there is no doubt that if accompanied by some incentives, apps can play a more and more important role in energy saving.

For instance, the British Gas App is an energy management software available in the UK which supports comparing a consumer's energy usage with that of their neighbours in their area. Another typical example is GreenPocket, which has developed a smartphone app that connects smart metering with the social networking sites. All these functions prompt people to mimic the actions of their peers and the desire for social approval will drive people to change. In other words, if our neighbours or friends start saving energy, we will be more likely to follow suit.

However, it is difficult to keep apps attractive to users over a long period of time only relying on comparison with their neighbours and social networking sites. But perhaps we can draw some inspirations from some statistical data. Recently Flurry revealed that Android and iOS users spend 32% of their app time playing games, 20% in the browser, 18% in Facebook, and fourth, 8% in utility applications. Since games, information, social networking, and the utility have become the four parts which attract the most attention, why not integrate them into a public platform focusing on energy saving? With the aid of apps people could easily find the corresponding functions or entries of games, information, social networking and services related to energy on one platform. All the parts mentioned could be the reasons to take consumer engagement to the next level.

Certainly most people are not convinced that as a form of software tool, apps alone will be sufficient to change human behaviour to cut energy consumption, although they are starting to be used as an effective way to bring smart metering closer. In other words, realizing the aim of energy saving requires more parties to be involved, such as governments and social media, which will take quite a lot of effort. MI

ABOUT THE AUTHOR
Wei Liu holds a Master of Engineering degree and is currently employed as a Senior Engineer by INHEMETER's R&D centre. He is in charge of the research on smart metering and smart homes. He also has rich experience in on-line monitoring of substation and transmission lines as well as in wireless communications technologies. Prior to joining INHEMETER, he was with KAIFA, where he focussed on the design of STS compliant meters.

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TOPO-RELAY: A SOLUTION FOR LAST MILE PLC

By Xiao Mao

In order to deal with the global financial crisis, many countries are choosing smart grid to stimulate market demand. Meantime, low voltage power line communication (PLC) is being applied in the "last mile" communication channel.

The well-known "last mile" is a difficult problem in PLC worldwide. Because of the attenuation, interference and dynamic change of the power grid, the reliability is low and it cannot be qualified in the industrial control communication system. In the US the channel was rejected after trialling for many years, and Europe's PRIME organization is groping for a single frequency network.

China made a large plan for smart grid in 2008. There will be 500 million customers, with an investment reaching hundreds of billions of dollars. From 2008 to 2012, China has called for bids for about 184 million customers, with an investment of more than $100 billion. However, because of the "last mile" challenges, the outcome has not been good.

Currently there are some common networking technologies, such as memory history, neurons, and a single frequency network system. However, these are not suited for application on the low voltage channel, which changes dynamically with the communication environment.

The most promising solution for solving the "last mile" problem is relay communication, with its ability to expand the geometric coverage (Figure 1).

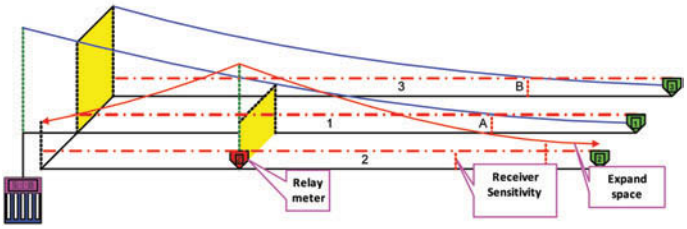


Figure 1 – Relay communication expands the coverage space

China has the biggest markets in the world. Based on many practical trials, the topo-relay ("Topological analysis on low voltage distribution network and differential routing algorithm") networking method has been developed. This design solution, as per the author's thesis for a Master's degree in Control Engineering at Tsinghua University, has passed expert review and dissertation defense. The technology has also completed on-site verification.

TECHNICAL CHARACTERISTICS OF TOPO-RELAY

From a technical point of view, the potential communication ability of the LV communication physical layer has been exhausted. However, if we can locate the PLC on the low speed data acquisition system communication channel, it is not difficult to find a technical solution. Data acquisition system communication can provide full coverage through relay networking – and because relay communication reduces the speed of data acquisition, it can be applied in a low speed data acquisition system.

The topo-relay design solution, based on the typical daily residential electricity load curve to support the physical layer and

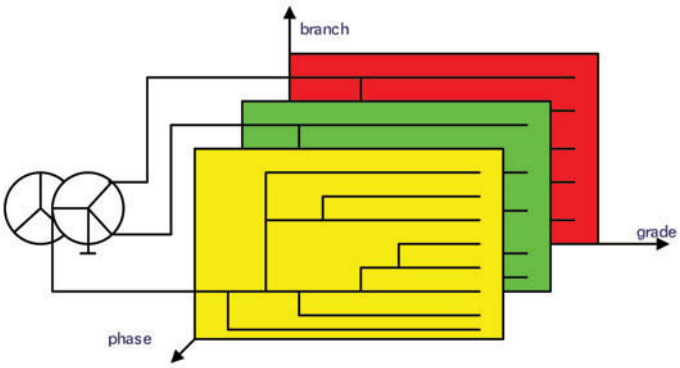


Figure 2 – Mathematical model of topo-relay. The location of the meter can be described in a three-dimensional rectangular Cartesian coordinate system using the phase, gradient from the concentrator, and branch

relay communication, has achieved phase discrimination of power meters, i.e. network partitioning and hierarchical order.

By locating the meters with the successive approximation algorithm and permanent system dynamic correction, the problem is reduced to one of two-dimension topological analysis and partial traversal. As a result, near real time data acquisition can be realized. In other words, the solution solves both reading success rates and relay efficiency problems. Essentially, relay communication has improved the communication system reliability from a time perspective with a lower reading speed and delaying the reading time in a discrete way.

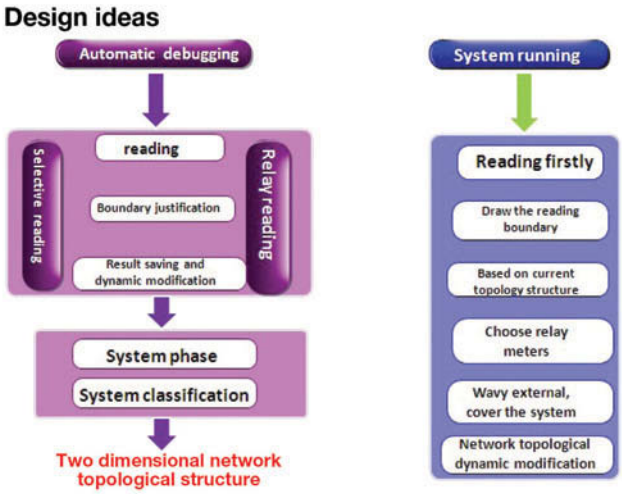


Figure 3 – Topo-relay design concept. The design includes two aspects – automatic debugging, in which the meter is positioned in phase and gradient, and system running, in which, based on the previously established network topology, the concentrator performs a succession of functions to refine the topology

SYSTEM VIEW

The entire solution is contained in the concentrator, i.e. the concentrator is intelligent, but the meter is simple. It can communicate with a variety of physical layer chips. This solution is suitable for installation on a failed system, with the relay and a software update in the concentrator with low voltage power network topological analysis and dynamic correction software.

Note that topo-relay (centralized networking) is different from lonworks (distributed networking). It is suitable for a large market,

Figure 4 – Distribution transformer room

Figure 5 – Topo-relay installed on a concentrator

Figure 6 – Smart meters

with its high system reliability. It is also applicable to reform China's failed system. China had bid for 200 million units, but only about half of these have been installed with the remainder left unused in a warehouse.

The topo-relay has been tested in a pilot in the LouYang XingYuan district (Figures 4-6).

The project partner could not obtain 100% reliable data collection using PLC and were forced to add a wireless channel to achieve their goals. However, shutting down the wireless channel, 100% data collection could be achieved via physical layer communication and relay communication protocols, thus verifying the effectiveness and feasibility of the technology.

The technology is now in the process of commercialization.

Shu Shan, a senior engineer long engaged in PLC networking technology research, was the supervisor of this project. MI

ABOUT THE AUTHOR:
Xiao Mao acquired a Master's degree in control engineering from Tsinghua University. She is now pursuing her second Master's degree in engineering management at Tsinghua University. She has five years' experience in the PLC industry.

INTRODUCTION OF LINYANG AMI SYSTEM

General Introduction
The LINYANG AMI System is an entire network and system of measuring, collecting, storing and analyzing users' power consumption information, composed of smart meter, concentrator, communication network and master station.

The system tightly connects power users with power utilities, providing a firm foundation for power distribution automation, smart grid and power demand side management, and promoting the utility's operation system and asset management procedures.

I. CORE TECHNOLOGIES AND FEATURES

1. High-Efficiency & Large-Scale Remote Data Acquisition Technology

The system supports popular communication channels, including GPRS, CDMA, 3G, Ethernet, fibre, Wi-Fi, ZigBee, PLC, RS485, RS232, M-bus, IR, etc. It can automatically recognize several communication protocols, such as Q/GDW 376.1-2009, IEC 62056.51-1998, DL/T 645-2007, ModBus, etc.

The front-end server applies IOCP technology and can connect terminals of maximum over 40,000 units to realize limitless extension by adding extra front-end servers. Key modules in the system can dynamically realize load balance to promote system responding and processing. The system applies high speed and storage cache technology, so it can automatically cache the data in case of a disconnected or faulty network, and upload data after fault recovery.

2. Intelligent Big Data Processing & Mining Technology

Based on the data types, the system will respectively store the big data in a data warehouse or file system with reference to application and structure type. Meanwhile the system owns the independently distributed data access layer to promote data enquiry efficiency. By means of ETL, EAI, etc., the system can extract data quasi-real time or real time from various business systems and it will then form core system data by converting, loading, computing and mapping the extracted data.

Through our experience in industrial applications and advanced data mining technology, LINYANG is capable of helping our clients to mine and sort out data useful for their business and conduct deep analysis.

3. Human–Computer Interaction Technology

UCD (User-centred Design) is based on overall customer experience matching with professional UI design to design attractive products that are easy to use. With mobile middleware technology applied, it can bring real high performance and safety, and is compatible with Android and iOS platforms. With a combination of creative design aesthetics and rigorous engineering science, it can bring boring and tedious data alive when displayed in the form of illustrations.

4. Energy Measurement & Monitoring Technology

With years of industry experience accumulated, high reliability energy measurement technology, ASIC design and A/D conversion technology, etc. have formed the most competitive measurement products of LINYANG to provide tools for accurate energy measurement.

Through online monitoring of parameters which may affect grid power quality, such as voltage quality, phase imbalance, high order harmonics, fluctuation and flickering, frequency, etc., it can help customers to manage grid environments. Through high speed analog sampling techniques and optimization algorithms matched with shielding and isolation technology, it can make data collection more secure and reliable.

II. COMPONENTS OF LINYANG AMI SYSTEM

1. Smart meter

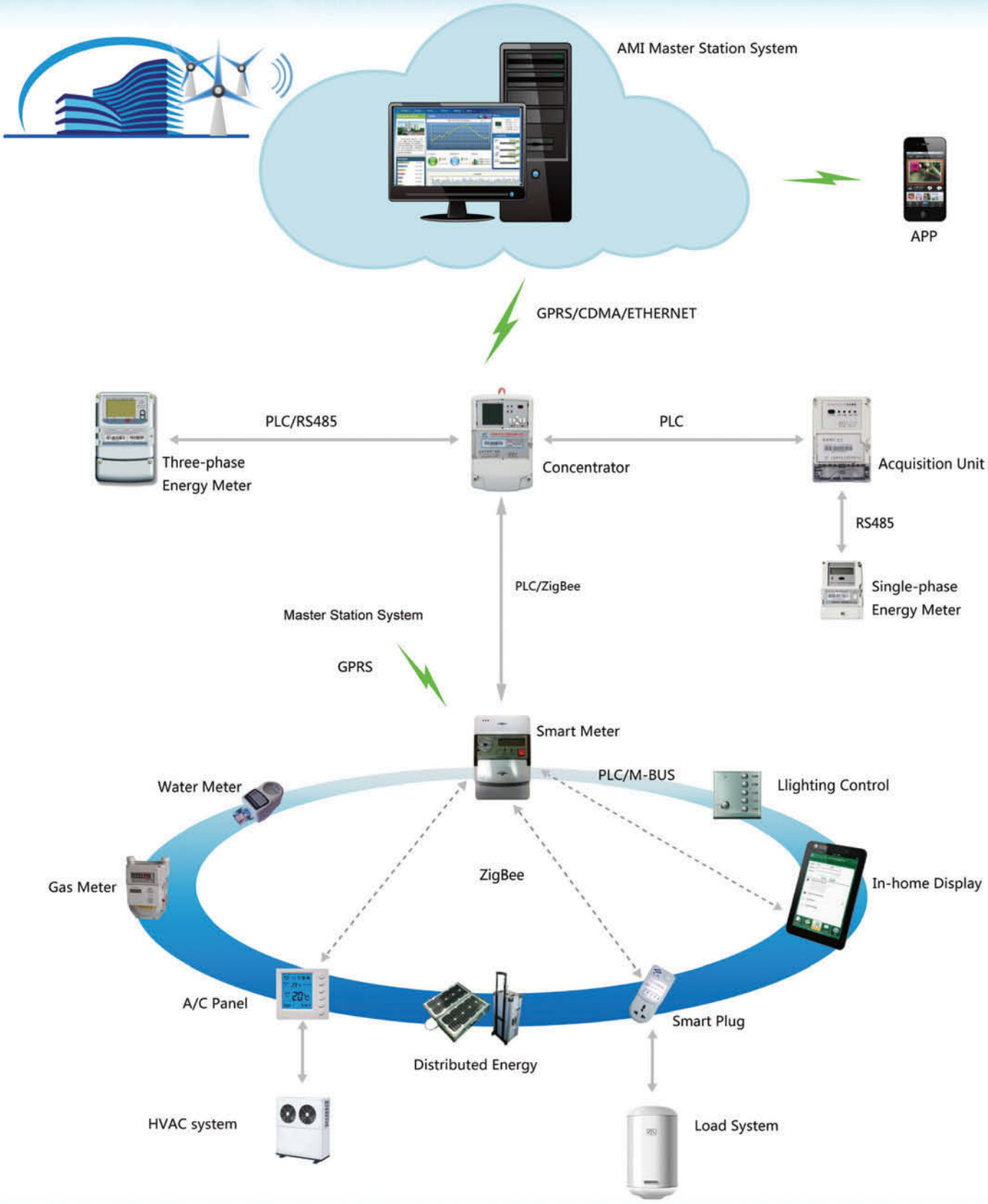
LINYANG's Smart Meter integrates functions of high accuracy energy measurement, remote bidirectional communication gateway, multiple energy measurement data acquisition and strong power demand management, etc., with the capability of upgrading to meet future requirements.

The main features include:

- Bidirectional active and reactive four quadrant measurement
- Built-in relays for remote load control
- Pluggable PLC and GSM/GPRS modules
- Local communication ports connecting to water meter and gas meter, etc.
- DLMS/COSEM protocol applied
- Anti-tamper and event logging functions
- Automatic registration
- Remote upgrading
- Easy maintenance.

"The system applies high speed and storage cache technology, so it can automatically cache the data in case of a disconnected or faulty network, and upload data after fault recovery"

LINYANG AMI SYSTEM



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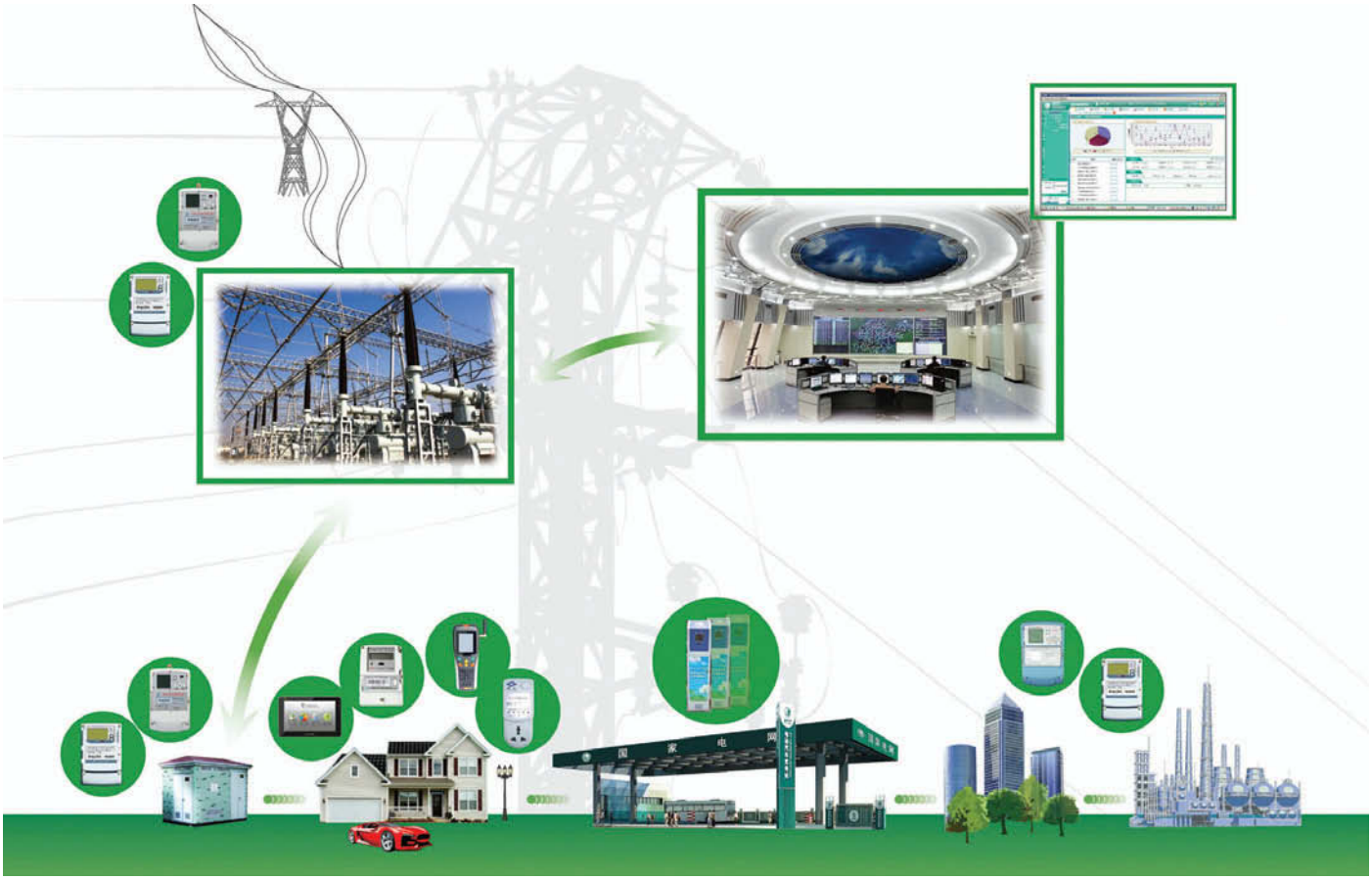

2. Communication Network
The LINYANG AMI system applies a fixed two-way communication network to read data from the meters or concentrators several times per day, and report data and fault alarms to the master station in real time. Upload communication network is known as GPRS/CDMA/3G, optical fibre or Ethernet and the local communications network usually includes powerline carrier (PLC), RS-485, ZigBee, IR, etc.

In multiple layer system networks, smart meters communicate with the concentrator via LAN, while the concentrator communicates with the master station via WAN. The concentrator can collect or receive data from nearby meters, and then upload the data to the master station via WAN. The concentrator can relay a master station's directive or information sent to the meters and customers. The open networking standard TCP/IP is usually applied in WAN.

3. AMI Master Station System
The LINYANG AMI Master Station System is composed of data collection platforms, database, business function modules, system interface, and cloud computing platforms. The system applies B/S structure and Java language, compatible with the J2EE framework, with very good cross-platform performance and multiple language support. The system is highly automated and reliable, and is capable of fault self-detection and self-recovery mechanisms.

The main functions include system file management, device management, data collection and management, communications management, fault alarm management, meter reading management, load management and forecasting, distribution transformer management, power quality management, policy information issuance and interaction, prepayment management, line damage management and a geographic information system (GIS).

4. Data Concentrator
The LINYANG Data Concentrator makes the data acquisition and storage from all smart meters, and then uploads the data to the master station via WAN. The data concentrator has functions of signal collection, data analysis and computing, data communication, parameter configuration, storage and management of data including real time power, curve, and alarm and configuration parameters. It applies DLMS/COSEM protocol, compatible with international standards such as IEC62056 and IEC61334-4.

SUMMARY
Many international utilities are implementing or planning an AMI system to face the challenges of smart grid construction, power supply and demand balancing, low asset utilization rate and higher demand of power supply reliability and quality.

LINYANG's AMI system can easily acquire power users' detailed power consumption data to realize TOU tariff and their direct participation in power demand side market. Through its communications network, the system tightly connects power users with power utilities, and helps them finally step forward into the smart grid era with construction of an AMI system. MI

ABOUT THE AUTHOR
Eric Yang, with 15 years' experience in network communication and system integration, is the Vice President for Strategy Planning & System Application Projects of LINYANG Electronics Co., Ltd.

LINYANG Electronics Co., Ltd. is a Solution Provider in China for Products & Solutions of Smart Energy (Energy Measurement & Management), Energy Saving (LED Lights) and Renewable Energy (Solar PV Products & Systems). Founded in 1995, the company now has over 3500 employees and is a Public Listed Company in Shanghai Stock Exchange of China (www.sse.com.cn) with stock code 601222.
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WHERE SMART BUSINESS BEGINS

ISSUE 3 | 2013

SMART ENERGY INTERNATIONAL

Transactive energy

Smart grid ROI

Amsterdam Smart City

TRANSACTIVE ENERGY

by Paul De Martini

Demand response as originally conceived and implemented over most of the past 30 years to provide emergency response and peak load management has become an important power system resource. However, fundamental forces are creating dramatic changes in the operation of markets and the electric transmission and distribution grids, creating additional opportunities for a new class of fast, flexible and continuously responsive distributed energy resources (DER). Customer energy resource options may include flexible onsite generation, demand response, storage, power electronics and electric vehicles.

These forces are:

1. An evolution in customer behaviour and expectations, with greater demand for reliable electricity and self-reliance, including becoming both an energy consumer and producer, or "prosumer".
2. Policy driven reliance upon renewable, intermittent resources and a shift to more decentralized energy resources.
3. Massive energy efficiency investments and structural changes related to codes and standards are yielding greater energy productivity relative to GDP.
4. Technological advancement leading to alternative methods and designs for providing and integrating services to the grid that are provided by customers' responsive resources, including demand management, onsite generation and energy storage.

The success of demand response was recognized in the North American Reliability Corporation's (NERC) 2012 Long Term Resource Adequacy (LTRA) report. The report identified that increased availability of demand side management (DSM) over the next 10 years to reduce peak demands will contribute to the deferral of new generating capacity or improve operator flexibility in day-ahead or real-time time operations.

The electric power system is evolving to become one of enormous complexity combined with local constraints. The US Energy Information Agency (EIA) projects renewable energy, excluding hydropower, will account for 32% of the overall growth in generation from 2011 to 2040. Meanwhile, US electric distribution systems may need to integrate over 150 GW of distributed solar photovoltaic (PV), combined heat and power (CHP) and storage by 2020. This, in addition to over 170 GW of back-up generation already installed. Market and system variability is increasing and operational temporal dimensions are declining across transmission and distribution.

This transformation of the electric generation mix and the rise of prosumerization are driving the need for changes in both market designs and grid operations (Figure 1). This is driving the need for a new set of responsive capabilities at greater scale than existing demand response programs and with distinctly different characteristics to support the need for flexible market and grid resources. US Federal Energy Regulatory Commission (FERC) chairman Jon Wellinghoff discussed this evolution in his remarks at the White House Demand Response Forum earlier this year and again at the recent US Department of Energy (DOE) sponsored Transactive Energy Conference. This objective could be described as:

"The ability of flexible distributed energy resources including responsive demand, onsite generation, energy storage and electric transportation to provide dynamic and continuous response based on direct or indirect value information to the mutual benefit of customers and a broad range of parties including load serving entities, services firms, aggregators, grid operators, and wholesale and local balancing markets through economic transactions."

POWER SYSTEM EVOLUTION

Demand response has proven its ability to successfully compete with generation in these markets. Load as a capacity resource was reported to total over 19.3 GW in 2012 and forecast to grow to over 35 GW by 2015 in the 2012 FERC DR survey. Last year, the PJM independent system operator (ISO) reported a record 14.8 GW of demand response cleared their reliability pricing model auction for 2015-16.

The maturity of load as a capacity resource is an important step in the evolution of demand response and other flexible distributed energy resources to potentially provide a broader range of bulk power system services. These include a growing set of ancillary services:

- Spinning reserve: portion of unloaded capacity from units already connected or synchronized to grid that can deliver energy in 10 minutes and run for at least two hours.
- Non-spinning reserve: extra generating capacity not currently connected or synchronized to grid that can be brought online and ramp up to a specified load within 10 minutes.
- Regulation: used to control system frequency that can vary as generators access the system and must be maintained very narrowly around 60 Hz.

While the total amount available in 2012 was comparatively small at over 1.3 GW, the projection in the FERC survey data suggests a strong growth pattern.

Also, the collective effect of wind and solar PV generation patterns may create very large transitions several times each day. As depicted in Figure 2, the California ISO (CAISO) has determined that net load from variable and customer energy resources in the state will create several short dramatic swings daily, reaching as high as 13.5 GW in 2 hours. The swings, or ramps, have traditionally resulted from load patterns that rise in the morning to a mid-to-late afternoon peak and subsequent decline in the evening.

To address these two fundamental operating challenges a range of new and expanded bulk power system services are needed. Services

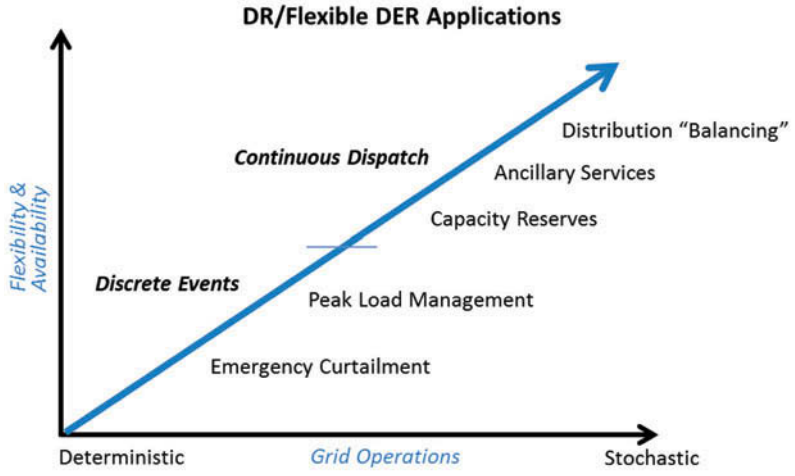

Figure 1 – Evolution of DR/flexible DER

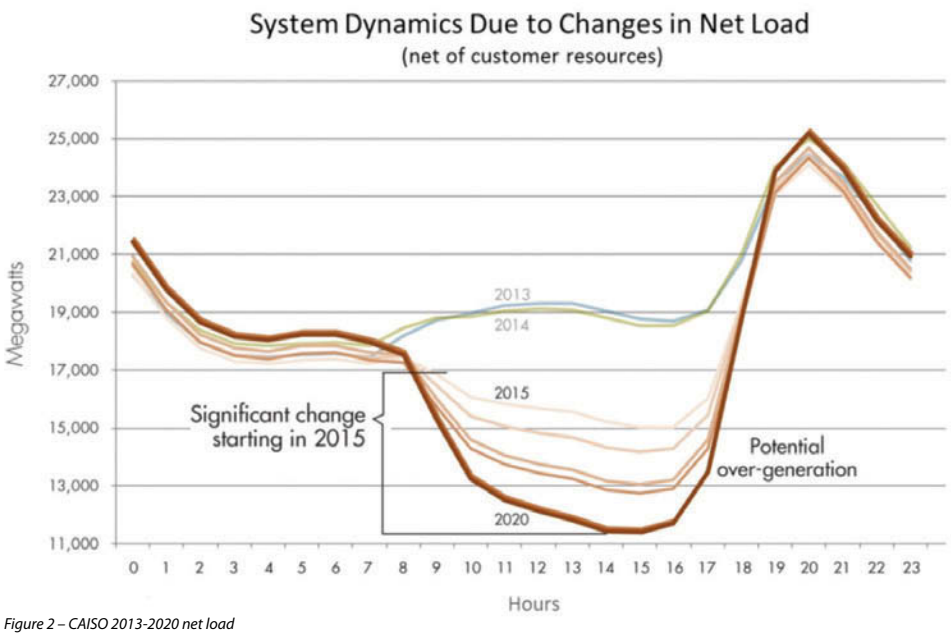

Figure 2 – CAISO 2013-2020 net load

such as regulation and contingency reserves should be expanded and new services for frequency (including inertial response), ramping and unit commitment introduced. These services will primarily come from existing and new flexible fossil fuelled plants. However, constraints across sub-regional transmission corridors and into load centres will require local resources as well. As such, it will be necessary to tap a wider range of resources, including responsive demand, energy storage and dispatchable distributed generation.

As such, a new class of responsive distributed energy resources will be needed as part of the policy and engineering alternatives to help manage the power system both in terms of economic efficiency and reliability. These new services will expand on current growth of ancillary services provided by demand response in the US and represent an evolutionary approach to the potential for customers' to provide market and grid services. However, the inability to create and monetize value through additional differentiated services for the grid is impeding development. Addressing this is essential to providing compelling value to customers and enabling new business models. One way to create value is to open up opportunities for responsive DERs to participate in a broad range of services required across the grid. This requires transparent pricing and monetization methods. While simple in concept, it is much more complex in practice as the response characteristics to meet bulk power and distribution operational needs are more stringent and complex than those for most traditional demand resources.

DIFFERENTIATED SERVICES AND VALUE

The range of services that responsive DERs may be able to provide is broad. It spans the bulk power system, distribution operations, and customer actions. The table in Figure 3 was adapted and expanded from an energy storage value assessment by Southern California Edison (SCE) in 2011. Thirty different value streams are identified that conceivably may increasingly be met by DR 2.0 resources over this decade. Today, however, customers can only monetize a handful of these services. The challenge and opportunity is to continue to unlock services that will fully maximize the value potential for customers and other stakeholders.

The challenge for several of these services is that responsive resources must be able to meet a prearranged level of measurable and observable operational performance during a contract period. Services to reduce peak demand or balance real time system operations need to meet very different performance requirements. As the use of responsive demand and other flexible DER expands beyond reliability and peak management programs to market-based balancing services the criteria for performance guarantees will become more stringent. Many of these services do or will require clever techniques to continuously tap the potential of customers' distributed loads, generation, storage and electric vehicles without negatively affecting customers' operations, comfort or convenience while also providing compelling financial compensation.

The power system is comprised of end-use devices and increasingly distributed resources (e.g. onsite generation, power electronics and storage) that are inherently flexible. This flexibility can allow energy consumption or production to be shifted to another time without impacting customers' operations. Similarly, many temperature sensitive loads exhibit flexibility in power demand, as their temperatures are not restricted to a single value, but rather are allowed to float within a specified band of temperatures. In both cases, flexibility in demand amounts to a continuum of potential response to satisfy grid operations and customer need. The same is true of other customer resources like CHP, which often has some flexibility in output that won't affect customer needs. An issue is how to design market rules to "extract this flexibility". Markets allow energy resources to be valued, priced and monetized. As such, it will be necessary to develop market designs and controls architecture that align customer, services firm, grid operator and market operator interests. Efficiency of such markets will depend on designs that (a) allow simple choices and low transaction costs, (b) enable customer price and quantity risk management, and (c) offer final customer decision "control".

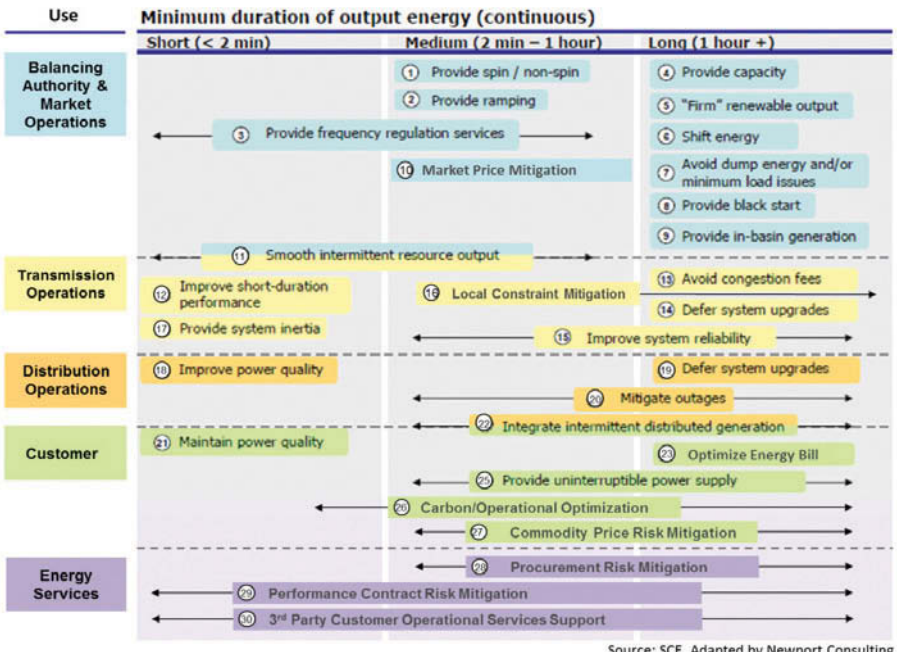

Figure 3 – Potential responsive DER value

TRANSACTIVE ENERGY

Transactive energy refers to the use of economic transactions to coordinate distributed energy resources to meet multiple generation, transmission and distribution objectives. It accomplishes that coordination using information regarding economic value across balancing markets and distributed grid control systems which results in the exchange of value signals among all participants, including customers. These signals can be sent via utility tariffs, power purchase agreements, real option contracts, market procurements or auctions. Transactive energy is a broad concept that ranges from existing automated incentive-based demand response programs through advanced value driven control techniques like those being demonstrated in the DOE co-funded Pacific Northwest Smart Grid Demonstration project.

The DOE-sponsored GridWise® Architecture Council (GWAC) formally defines transactive energy as,

"Techniques for managing the generation, consumption or flow of electric power within an electric power system through the use of economic or market based constructs while considering grid reliability constraints. The term 'transactive' comes from considering that decisions are made based on a value. These decisions may be analogous to or literally economic transactions."

The vision for the evolution of transactive energy over this decade is that optimization and control will increasingly be distributed and associated with various participants, devices and systems at the edges of the grid. Coordination is enabled through integrated and federated market and control systems. Increasingly, customers can transact with any other party including intermediaries. The approach also envisions an expanding range of services and values enabled through regulatory policy. Transactive grid oversight will continue through federal, state and local regulatory agencies and grid operators enforce market rules, grid security, reliability and grid standards and collect, analyze and publish information on grid constraints and capabilities to all parties. Structural market changes evolve through more customer participation in the markets, more distributed generation, transitions to competitive markets, and reductions in any market power. Coordination of changes in retail, distribution, transmission and wholesale markets will be helpful and often necessary.

In more advanced applications, transactive energy distributes decision making throughout the system. When done properly, distributed values incorporate prices and constraints across the system to achieve reliable results. As the Pacific Northwest National Lab identified, centralized approaches cannot scale to coordinate and dispatch hundreds of thousands of distributed energy resources. This is especially the case given that many of these resources will be integral to customers' operation like data centre management systems, building energy management systems or CHP units. The reason is that centralized approaches become unwieldy with increased numbers of responsive (or controllable) system elements. As the power system approaches millions of responsive distributed resources, the computational and timing complexity of trying to optimize through centralized dispatch becomes intractable. For example, trying to calculate such an optimum dispatch on a five-minute time interval to offset renewable resource variability is unlikely to work. This is further compounded with very short duration resources needed to manage distribution level power quality.

Engineering approaches, such as Cisco's ultra-large scale control architecture can help resolve the need for distributed and coordinated decision making that allows for individual optimization by customers, distribution operators and bulk power system operators. Also, GWAC is currently developing the necessary framework, guidelines and architecture to support this evolution and alignment with the fundamental principles of reliable grid operation. Likewise, the related protocols and standards, including OpenADR 2.0 and Smart Energy Profile 2.0 are also available or being finalized. Additionally, the more advanced control algorithms and methods are currently being researched in government labs and universities and corporate research centres globally. In several cases, technology development has reached initial commercial stage and being demonstrated in pilots around the world.

Over the coming decade a number of significant evolutionary milestones should allow customers' flexible DER to provide market and grid services. This envisions an evolution from today's use of load as a capacity resource and the emergence of opportunities for DR in ancillary services to expand to a much broader use of flexible DER. It could be that more than half the services identified earlier will be accessible to customers with qualified flexible distributed resources in California and in a Mid-Atlantic or Northeastern state by 2020. This projection is based on foundational rulings by FERC, including 745, 755 and 784, combined with state renewable portfolio standards and demand side management goals, and forecasts of 400+ GW of distributed resources by 2020. These all suggest that the fundamental forces of change are already in motion.

However, the pace and scope of market access and customer participation across the US will continue to evolve unevenly. Plus, customer participation in more advanced services will likely continue to face challenges regarding tangible financial value at perceived acceptable level of participation risk. This is why a primary focus now and continuing over this decade involves creating differentiated services, resolving market access issues and creating successful customer value propositions. More specifically, barriers to unlocking the value from flexible distributed energy resources exist including:

1. Lack of power system service definitions and performance requirements
2. Insufficient technology investment
3. Revenue availability and monetization
4. Market access
5. Customer adoption and engagement.

In addition, the transactive energy evolution requires the active and sustained support of policy makers to enact or change myriad rules addressing each of the five barriers above. This is not simple nor will it be quick. As such, flexible DER will only be part of the solutions, including flexible low cost gas fired generation and other more conventional means, to address the transformation of the power system.

While there is a wide range of solutions and issues related to the future grid, the potential engagement of customers' flexible distributed energy resources to provide a greater set of services to markets and transmission and distribution operations offers a real potential for low cost and clean options to manage the increasingly dynamic power system. MI

This article draws from a comprehensive report titled, "DR2.0: The Future of Customer Response" written by the author for the Association of Demand Response and Smart Grid.

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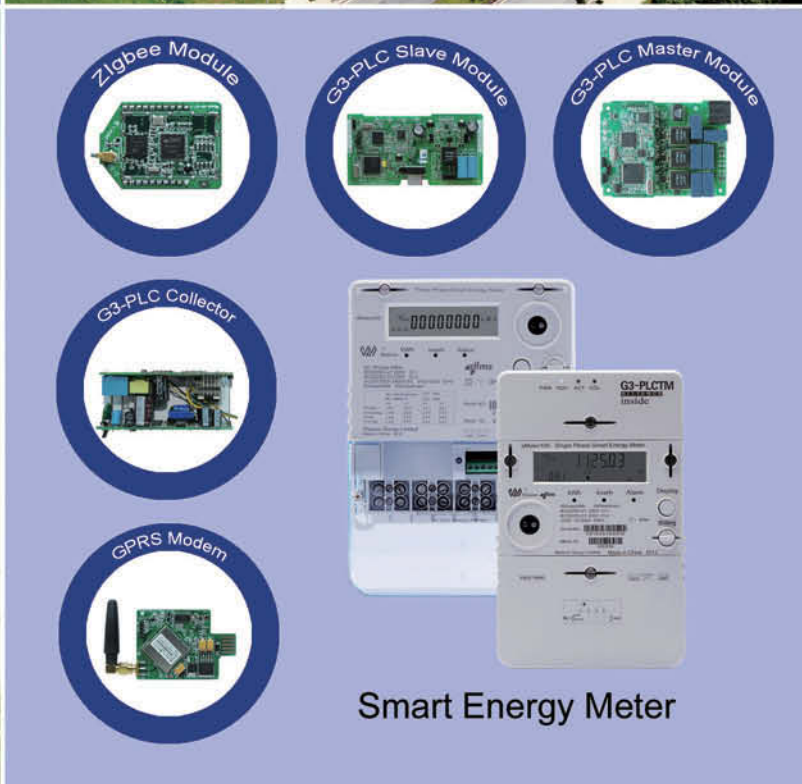

NEW RESEARCH REVEALS GLOBAL RETURN ON INVESTMENT FROM SMART GRID

By Philip Lewis, CEO VaasaETT and James Braatvedt, VP, Solutions Marketing Ventyx

To meet the world's future energy needs, utilities are under significant pressure to deliver more power, more reliably, efficiently and sustainably, while at the same time reducing and managing demand. Innovation in technologies like renewable and distributed generation, ultra-high voltage transmission and energy storage is starting to dramatically alter the way the grid operates – transforming consumers into generators and active demand participants.

For consumers, this requires a major shift in their understanding of energy supply and distribution and how to take control of their service and costs. For utilities, it requires complex forecasting, planning and control to manage existing networks and new technology, as well as the efficient integration of operational and information technology on a scale difficult to achieve – until recently. To support an empowered energy world of tomorrow, utilities are beginning to look seriously towards the role that smart technologies will play in transforming the grid.

GLOBAL BEST PRACTICE

To help identify and share best practices across the industry, Ventyx, an ABB company selected international energy think-tank, VaasaETT, to develop and undertake the first ever global comparative research into smart grid project outcomes, providing a benchmark of the returns from smart grid projects all over the world.

The Smart Grid Global Impact Report focuses on five pillars – a common set of smarter grid goals which deliver returns against some of the industry's biggest challenges. These are:

- Economic
- Environmental
- Consumer
- Reliability
- Innovation.

The report, supported by a series of events in key cities around the world, is being released soon and this article presents a preview of selected findings from this research.

THE SMART GRID IS HERE

Smart grids are no longer just small pilots in a few jurisdictions. Smarter grids are evolving as a truly global phenomenon. The Smart Grid Global Impact Report mapped more than 200 significant projects around the world.

The top six projects in 2013 span four continents, highlighting the global demand for smart grid solutions. The 30 leading projects in the world currently account for nearly US$10 billion in investment over just a few years. As the industry moves from feasibility studies and pilots to larger scale deployments, new challenges in information, technology and consumer management have arisen.

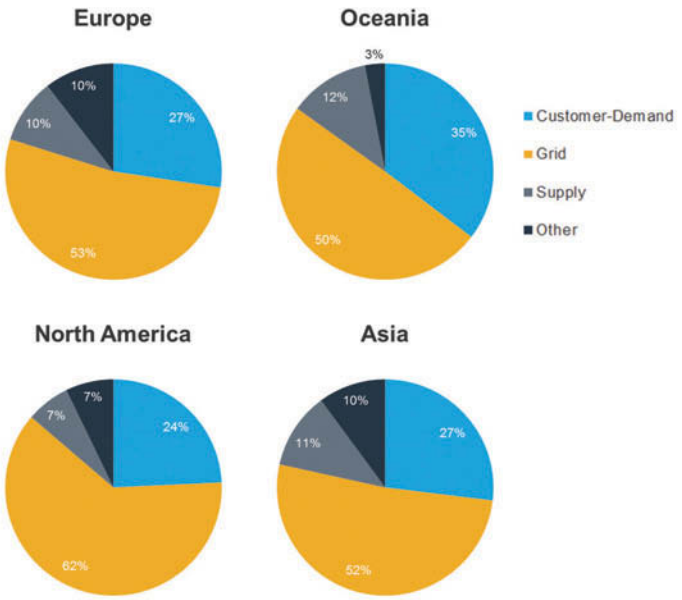

Figure 1 – Importance of components by region

Smart grid projects are surprisingly similar across regions. Grid-side technology components dominate most projects – regardless of the region, but the importance of customer and demand components is also a common objective, especially so in Oceania (Figure 1).

CUSTOMER IMPACT

Of the projects that were analyzed in detail for the Smart Grid Global Impact Report, financial and energy savings represent the greatest overall customer impact, but improved customer awareness was also significantly impacted in leading projects (Figure 2).

Customer impact in general, however, is concentrated in a relatively small number of highly customer focused projects. For this reason the average customer impact rating scores are relatively low at

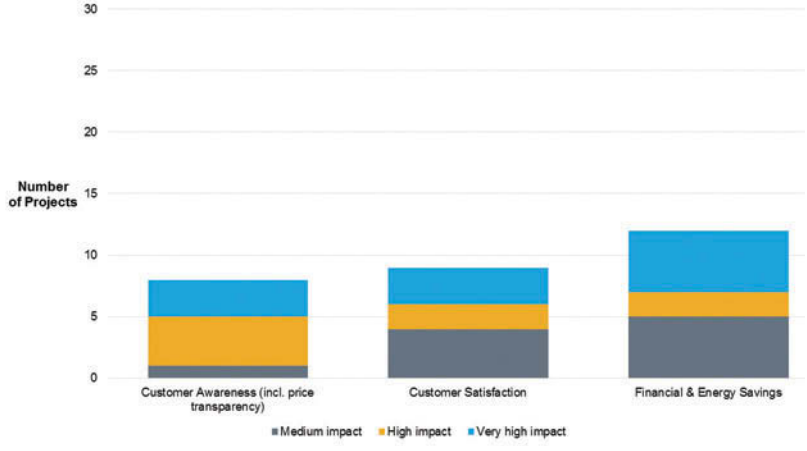

Figure 2 – Financial and energy savings represent the greatest overall customer impact

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less than 1.5 out of a possible 4. Only around a quarter of the projects analyzed achieved high or very high impact on customers.

Research into the 30 projects in the report indicates statistically a strong environmental impact from customer focused smart grid projects resulting from changes in customer behaviour, or at least changes in their consumption. The empowerment of and cooperation with customers for the purposes of reducing or shifting energy consumption results in enhanced customer support of smart grid efforts to reduce emissions.

For now, it is believed that many utilities have become more cautious around customer engagement due to customer reactions and negative media coverage of some smart metering deployments around the world. Results can be achieved with grid-side technology deployment which does not impact the customer and can still achieve results; however it is important to begin the education journey and build trust. It is believed that perhaps the best acceptance of smart metering will come at a time when there are other major drivers for customers to change their behaviour such as their purchase of an electric car, or having more 'smart' enabled appliances in their homes. If utilities can build trust through grid-side improvements with minimal negative impact on customers this will build trust and smooth the deployment of these technologies when they are sufficiently evolved and start to achieve broader mass-market uptake.

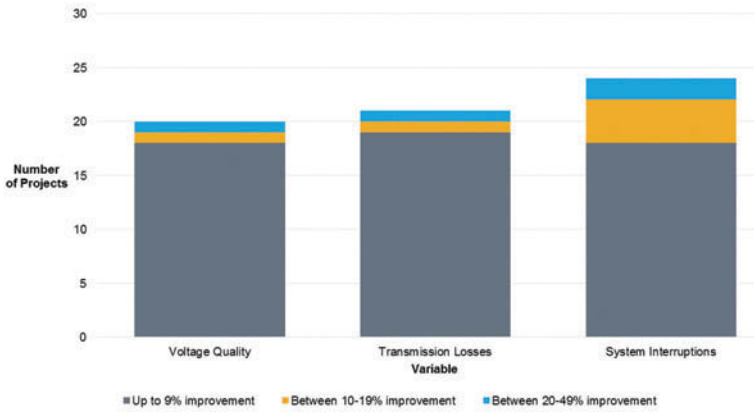

Figure 3 – More than 70% of smart grids surveyed achieved improvements in network reliability

RELIABILITY IMPACT

System reliability continues to be a challenge for many utilities, and one which can most significantly impact negative customer perception, or at worst, result in regulatory action and fines if minimum standards cannot be met. The greatest focus and success concerning reliability and resilience relates to reducing the impact of system interruptions, probably due to this public pressure. In developing markets though, voltage quality and transmission losses interruptions have at least equal importance and success.

More than 70% of the projects surveyed enhanced reliability and resilience through smart grid (Figure 3). What's more, most projects that focus on them, improve all three reliability and resilience elements, namely transmission losses, voltage quality and system interruptions.

The vast majority of projects have improved, or expect to improve, up to 9%. Typically this level of improvement is in grids that are already highly reliable and resilient, and thus a hugely significant achievement. In grids where the room for improvement is greater, the stated improvement increases to up to nearly 50%.

ENVIRONMENTAL IMPACT

Renewable energy integration and emissions reductions are arguably some of the most significant environmental benefits of smart grid, and these benefits transcend the regions: the four best projects for this pillar were located in four continents.

Demand response initiatives like consumption shifting and reduction received surprisingly low rankings in the research, despite their importance to the concept of environmental impact overall. The reason for this may lie in the complexity of demand-side management – something that many utilities are not yet highly prepared for. Demand response is also typically not yet fully enabled by market, regulatory and financial support mechanisms and behavioural energy efficiency and demand responses offerings are still in their infancy in terms of customer engagement and the cost of technology.

Most projects have achieved or predicted a diverse set of environmental benefits, but as with other pillars, a few outstanding projects rise above the rest when it comes to the environmental impact achieved through smart grid (Figure 4).

With the clear interest in demand side measures shown by most projects it is inevitable that an increase in the impact of such measures is imminent.

ECONOMIC IMPACT

Of the 30 projects analyzed in-depth for the Smart Grid Global Impact Report, investment costs ranged from a few million US$ up to nearly $5 billion. Altogether the 30 projects represented an overall investment of nearly $10 billion of initial project investment.

The cost per customer of smart grid projects is perhaps not as high as one might expect. Spread across the 24 million customers directly affected by the 30 projects, the average cost per customer was US$390. If smart metering is excluded the cost is reduced substantially to an estimated cost of under US$200.

Economic return on investment (ROI) has often not been the key priority during the feasibility or pilot phases of smart grid rollouts. But it would appear that we are now entering a new holistic, grid focused era and finally achieving positive financial results. Many projects have now realized or estimated positive financial ROI and the trend is clearly upwards in terms of the proportion that are positive and the degree to which they are positive. In the Smart Grid Global Impact Report we outline the operating cost rating and ROI rating for the 30 leading projects analyzed.

Overall, economically focused projects should not be conservative about innovation, or see it as a risk. While innovation should not be engaged in for the sake of innovation, it is an important driver of positive economic returns. Risk should be seen as a part of any successful business.

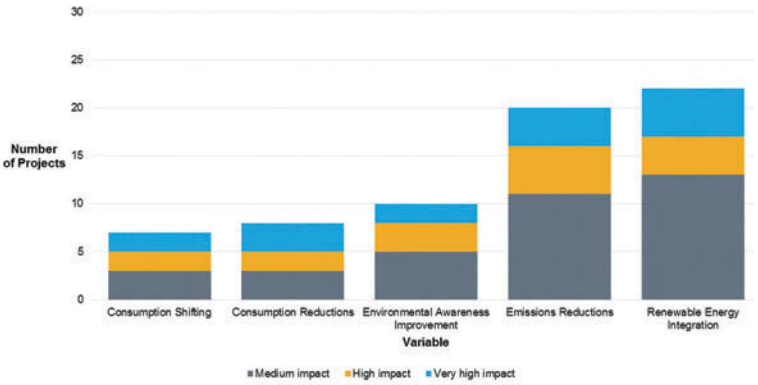

Figure 4 – Most projects achieved diverse environmental benefits including renewable energy integration and emissions reductions


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INNOVATION IMPACT
When considering aggregated results across all regions, there is still a skew towards innovation, with economic impact still the least successful pillar. It is hoped that this will change as more projects move from feasibility to maturity. However, the rapid pace of technological change is unlikely to slow. Significant developments in renewable generation, electric vehicles, storage and other areas will continue to evolve and have a dramatic impact on the grid. Utilities need to focus on securing a platform capable of supporting the broad range of components being deployed, as well as one with flexibility to incorporate innovation and change. To be flexible, a baseline platform for smarter grids will need to address both hardware and software technology integration, as well as be built on a strong foundation of forecasting and analytics to properly take advantage of the wealth of data created by smarter grids.

Essentially, the main reason for valuing innovativeness is that without it, cost effective solutions that address the challenges faced by electricity grids are unlikely to be found. As an industry we need to work together to meet the big challenges facing an energy hungry world. Not typically known as innovation companies, utilities need to begin organizational transformation to comprehensively change their approach to one that embraces a flexible, responsive and innovative culture.

2013 GLOBAL SMART GRID IMPACT RANKINGS
Typically the best projects are more holistic, capitalizing on functional synergies within the smart grid.

The Smart Grid Global Impact Report ranks ROI of the 30 leading projects studied.

THE SIX 'I' INSIGHTS FOR INTELLIGENT GRIDS

Invested
Smart grid projects are not just pilots anymore. The top 30 smart grid projects in the world currently account for nearly US$10 billion in investment over just a few years.

Intelligent
Intelligence is a primary driver of smarter grids. Utilities rate sensing, and monitoring as their first and second most important smart grid project components. Visibility within operational technology is key to getting connectivity to the real time conditions in the grid.

Interconnected
The connectivity between operational technology (OT) and information technology (IT) underwrites the efficient use of the assets of the electricity system. Integration is the second highest area for innovation in smart grid projects (preceded only by the sensing and monitoring technology itself).

Innovative
Innovation is a core component of the smarter grid as both hardware and software technology is advancing rapidly and utilities look at different approaches to deploying technology to solve their specific grid challenges. The best projects tend to deploy innovative solutions across a broad mix of components.

Inclusive
Most projects display clearly focused strengths, but the best six projects received top scores for nearly all pillars. Typically the best programs had a 36% more holistic approach to their smart grid project. Smart grids cannot succeed if developed through isolated ad hoc projects in the absence of a clear sense of direction.

Intentional
While the smart grid concept becomes ever more mature, only projects with clear economic and consumer goals from the outset achieve strong results.

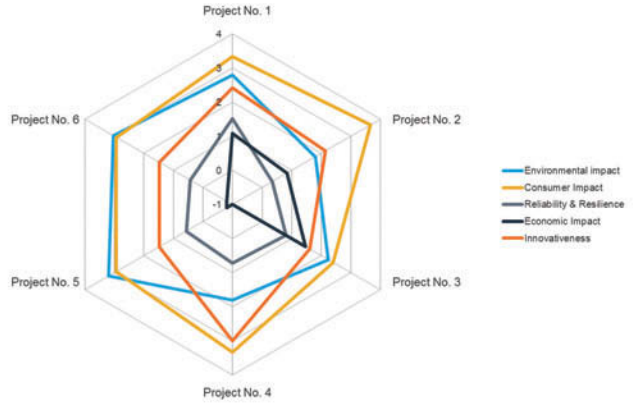

Figure 5 – Aggregated regional ratings by pillar

Despite smarter grids still being evolutionary in terms of approach and technology, some smart grid projects stand out in terms of their overall achievement. In 2013 the best overall project was a large North American utility, but a continuum of successful projects around the world has now emerged.

Most projects display clearly focused strengths, but the best six projects received top scores for nearly all pillars. Typically the best programs had a more holistic approach to their smart grid project. This is not simply a case of the methodology favouring projects that achieve benefits across all smart grid pillars. Rather, projects which take a broader view capitalize on the interdependencies and synergies between the many activities and functionalities of smart grid. For instance, reduced pressure on a network achieved through demand response will facilitate improved reliability and resilience, whereas improvements in reliability and resilience can enhance customer and public support and involvement in smart grids, including demand response programs. The full extent of interdependencies is not yet known, but is likely to be a major source of future increases in ROI.

We hope that in future more utilities will wish to participate in this project as a way to celebrate their success as some of the leading projects in the world and share their insights and learning – both in terms of what to focus on, and what to avoid as we work together as an industry toward a smarter energy future. MI

For the full report which includes the leading 30 project rankings, detailed regional analysis and leading case studies – or to nominate your utility for inclusion in the next edition – please visit smartgridimpact.com.

ABOUT THE AUTHORS
Dr Philip Lewis is a leading international expert in utility customer and smart energy related issues. During 16 years in the utilities industry he has conducted research and strategic support in over 50 countries in five continents for over 400 utilities and other market players. Additionally he has worked extensively for a large number of governmental, regulatory, industry and leading NGO bodies around the world.

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ABOUT THE ORGANIZATIONS
VaasaETT is a collaborative think-tank and consultancy that delivers consumer-oriented best practice, strategies and solutions to the global energy and utilities industry. We provide three kinds of assistance: research and consulting; data and analysis; and collaboration. Our world-leading expertise includes: customer lifetime value, smart energy issues and broader market issues.

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GRID MODERNIZATION DEMANDS

A FLEXIBLE APPROACH AMIDST EUROPEAN DIVERSITY

By Tim Wolf

Adopted in May 2000, the official motto of the European Union is "United in Diversity," or depending on where you live, "Unis dans la diversité" or "In Vielfalt geeint". Like the EU itself, grid modernization planning in the European Union could take on the same adage.

Most of the countries in the EU are committed to significant reductions in greenhouse gas emissions as part of the "20-20-20" directive, which also includes large infusions of renewable energy and increases in energy efficiency by 2020 and beyond. Achieving these shared outcomes will require innovation and a new brand of resourcefulness that spans technology, people, resources, business models and organizational culture.

But from there, the commonalities among countries and utilities begin to dissipate, and strategies for deploying smart metering and smart grid technologies to address a broad array of strategic and operational objectives vary significantly from country to country and region to region.

We've watched and participated over the past several years as utilities, regulators, technology vendors and standards bodies in France, Spain (and now the U.K.) have taken a very "hands-on" and prescriptive approach to technology requirements for smart meters. Whether it's the Linky meter in France or PRIME in Spain, the utilities in these markets, which represent some 100 million electricity meters, are pretty clear about what they want.

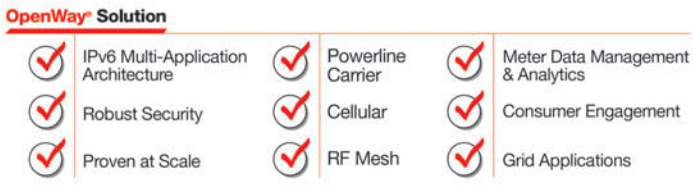
Yet in other markets in or adjacent to the EU, particularly those in Eastern and Southern Europe, and eastward to the former Soviet republics, there is significant opportunity to take a different approach to grid modernization. Utilities commonly face the need to:

- Increase energy efficiency
- Manage peak load through demand response
- Engage customers
- Address lost revenue due to theft
- Ensure reliability despite aging infrastructure.

OPEN GLOBAL STANDARDS SOLVE MANY PROBLEMS

In order to address specific business problems in different countries most cost effectively, and mitigate technical risk, it's important for utilities in the market to coalesce around some common standards to simplify and streamline deployments, ensure robust security and create a platform for future innovation.

For utilities in diverse markets around the world, the IP standard – which underpinned the explosion of growth, utilization and innovation with the internet – has proven itself to be a highly suitable umbrella standard for smart metering and smart grid network architecture.



IP architecture:

- Is widely utilized by utilities in North America and has a strong foothold in the Asia-Pacific market
- Provides a well-established protocol that offers a robust, common security model
- Offers the most efficient path to multi-application capability and device interoperability
- Behaves like an enterprise-class IT network with state of the art network management to prioritize traffic and quality of service (QoS).

Lastly, the beauty of IP networks is that devices can "plug and play," much like a new PC or printer or phone on a corporate enterprise network.

To achieve this vision of flexibility and expandability in smart grid networks, Itron has partnered with Cisco, the global leader in networking technology, to bring to market an IPv6 architecture for Itron's OpenWay network. There are four key industry objectives that drive standards-based networking:

- Reduce industry dependence on network architectures that have proprietary elements and still require vendor specific integration of devices/applications.
- Deliver true multi-service, multi-application capabilities over a common network infrastructure, with standardized and robust security that anyone can build to.
- Optimize the total cost of ownership of these networks by spreading the cost over a greater number of grid applications and devices.
- Unleash innovation in the marketplace by building a broad-based ecosystem of leading grid technology companies with diverse product and service offerings.

With more than 15 million OpenWay smart meters installed in North America, and initial deployments in both Asia and Latin America, Itron is now bringing its OpenWay network solution to the European market with specific enhancements designed to address requirements presented by utilities across Europe.

COMMUNICATIONS CHOICES

There are many different ways of communicating with a meter: wired and wireless, public and private networks, etc. Several key considerations go into selecting a communications solution: cost, bandwidth, latency, reliability and technical risk into the future.

In today's rapidly changing technology environment, utilities have choices in communications technology under a single unified network solution, including powerline carrier technology (PLC), RF mesh and cellular:

- PLC – due to the densities and the characteristics of distribution systems (e.g. number of customers per transformer) PLC, which transmits data over the utilities' power lines, will certainly play a central role in smart meter strategy for many utilities in Europe.
- RF mesh – has proven itself in North America and other markets as a cost effective and highly reliable option for not only smart metering but also today's grid applications such as demand response, distribution automation and grid sensing. These applications include volt/VAR optimization, conservation voltage regulation (CVR), transformer load balancing, fault detection isolation and restoration (FDIR), power restoration and remote switching.
- Cellular communications – has emerged as an increasingly attractive solution for not only commercial and industrial metering applications but mass market residential networks as well. Chip set technology has advanced, while hardware and monthly carrier costs have decreased dramatically. These macro trends have enabled several leading utilities – both in North America and Asia – to embrace cellular as their preferred communications transport choice for large-scale smart metering and smart grid projects. Or they have chosen a mix of communication technologies to optimize cost and performance for specific applications or territories.

Regardless, technology advances, open standards, distributed intelligence and network convergence are rapidly putting to rest the idea that utilities must choose a single, "one-size-fits-all" communications technology for their smart metering and smart grid initiatives.

FOCUSING ON USE CASES AND SOLUTIONS

Smart metering and the associated communication infrastructure is not an end in and of itself. When viewed from a solutions perspective, including communications, meter data management and analytics, the value of the investment becomes much more clear and compelling. Key uses cases and drivers broadly applicable in the EU include the following.:

Increasing operational efficiency

The automation of meter data collection enables the utility to reduce operational costs while collecting consumption information for billing more regularly and reliably. In addition, this enables the utility to automate millions of beginning- and end-of-service transactions annually, eliminating vehicle trips to the field and reducing traffic and the associated carbon emissions.

Consumer engagement to improve energy efficiency and manage increasing demand

Smart meters provide a platform and source of data for consumers to increase awareness of their energy usage. The right information at the right time delivered in an actionable format is a powerful tool for changing behaviour and driving efficiency. These outcomes can be achieved through a variety of programs, including prepayment, in-home devices such as smart thermostats and displays, as well as utility-sponsored demand response and dynamic pricing programs.

Improved distribution system efficiency

When utilized with analytic software tools, more frequent collection of customer usage data, including voltage data from individual meters, enables utilities to manage their distribution system and assets more efficiently. Programs such as conservation voltage regulation (CVR) and condition-based maintenance for transformers and other distribution equipment are becoming increasingly significant sources of business case value.

Integration of renewable resources

The proliferation of solar panels and other distributed energy resources poses significant challenges for utilities managing the grid. Measurement, monitoring and control of these resources through a common smart grid network are becoming increasingly important from both a programmatic and grid stabilization perspective. Renewable "Fleet Management" is also becoming a new business development opportunity for utilities that are concerned about erosion of energy sales revenues due to improved energy efficiency and adoption of distributed resources by customers.

Improving outage detection and response

Smart meters bring with them the ability to immediately signal a power outage at the customer premise as well as the ability to verify restoration of power. This capability adds a valuable new data stream to a utility's outage detection and response efforts. Several utilities in North America have integrated smart meter outage data into their outage management systems (OMS) and field workforce management tools. These utilities are seeing clear improvements not only in their ability to detect outages and understand their nature and scope more quickly, but they are also improving their restoration times as measured by CAIDI metrics.

INNOVATION IS A KEY INGREDIENT

Achieving the benefits and value of each use case requires a "solution perspective" to innovating and solving real business problems. This spirit of innovation is unleashed most effectively when there is a common standard, such as IP, for technology providers to build to and where there is flexibility to match best-fit technologies with specific business problems and objectives.

As utilities in Europe, Africa and the Middle East look for solutions to their most pressing challenges, focusing on the objectives and outcomes with trusted technology partners has proven again and again to be the most effective approach.

We face a world in which energy demand grows every year. Our industry can and will play an important role in helping address the challenges that lie ahead. We must develop a unified strategy, drawing on our common goals, to plot a more resourceful way forward. MI

ABOUT THE AUTHOR
Tim Wolf is the Director for Marketing for Smart Grid Solutions at Itron Inc. Prior to "rejoining" Itron in 2010, he spent three years as a senior consultant at R.W. Beck, an SAIC Company, focusing on smart grid consulting services for utilities. He is a frequent speaker and presenter at industry conferences, and writer in the industry trade press.

ABOUT THE COMPANY
Itron, a global technology company, offers a broad product portfolio that includes electricity, gas, water and thermal energy measurement and control technology; communications systems; software; and managed services. We're leading utilities down a sustainable path to manage and conserve energy and water, creating a more resourceful world.
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EUROPEAN TRANSMISSION NETWORK DEVELOPMENT PLANNING

MEETING THE 2020 CHALLENGES AND BEYOND

By Jean Verseille, Kai Adam, Chavdar Ivanov, Edwin Haesen and Felix Maire

Renewable energy source (RES) contributions and fluctuations play an important role and cause a growing need for smart grid-enabled demand response which will bid into the European markets, building on a strong Europe-wide transmission grid which remains necessary even if many RES and demand response capacities come from the distribution grid.

2020 CHALLENGES AND BEYOND

The European market operates in Europe's trio of energy policy goals – of ensuring security of supply, promoting the decarbonization of the energy sector and creating competitive, liquid markets which benefit consumers – is well known. However, it is also important to acknowledge the close interaction between the three objectives and to recognize that focussing on only one or two of them has the potential to have a detrimental impact on the others. As such, a comprehensive and consistent optimization needs to be undertaken. This consistency is particularly challenging when considering new European legislation. The three objectives converge at the transmission system level, which is the rationale for assigning the task of developing network codes to ENTSO-E. Hence, the network codes in development seek to set out a balanced set of rules which reflect Europe's desire to promote all three of these objectives equally.

Across Europe the generation mix is changing significantly. There is a greater potential for active consumer behaviour. Historically electricity customers were, in the main, passive users of energy whose behaviour changed little in response to prices or system conditions. Political vision coupled with recent technological developments and ongoing research in the field of smart grids and demand side response capabilities have opened up new potential. Smart grids have the potential to facilitate a change from national markets in which only generation is adapted to meet load, to a European market in which demand will also adapt to meet generation. In addition, the electricity system is becoming increasingly interconnected and the electricity market is becoming much more pan-European. This provides opportunities for generators to sell into different markets, based on price signals, and gives consumers a greater choice over who they buy energy from.

The Scenario Outlook and Adequacy Forecast 2013, released in April 2013, shows that 38 GW of reliably available capacity are needed in the European system until 2020 in addition to the confirmed investments in generation in order to maintain the current adequacy levels. Depending on the penetration of variable generation to the overall energy mix, this could imply that the level of needed investments in installed capacity is significantly higher. In addition, under the European TSOs' best estimates of the load and generation evolution, generation adequacy will be maintained in 2020.

This paper gives an overview of actions to ensure reliable European transmission network development planning in a system in which smart grids and in particular demand response will operate. The overview first summarizes the European forecasts, scenarios and visions for loads and generation mixes described in the ENTSO-E Ten-Year Network Development Plan (TYNDP) and its associated Scenario Outlook and Adequacy Forecast (SO&AF), for 2020 and 2030. The most important Europe-wide rules are implemented and enforced through the network codes which become binding European Regulations and which are drafted by ENTSO-E. A large consortium with ENTSO-E involvement is committed to realize the e-Highway2050 project. One of the objectives of the project is to define scenarios based on general assumptions and boundary conditions to cover 2020-2050 taking into account technology performance and prices. It will propose a set of the candidate solutions for grid capacity enhancement for 2050 in order to limit congestions over an entire year for the pan-European grid, facing the 2050 possible scenario.

PLANNING THE GRID FOR THE NEXT DECADES

Network development planning is a complex process which requires information from various parties involved in the energy sector. A set of forecasts of the future is necessary for creating reliable transmission planning scenarios. Successful realization of the planned grid reinforcements is dependent on public acceptance, funding and technological challenges. With the Third EU Energy package, the European Union took a step toward ensuring coordinated planning of the pan-European transmission grid. Regulation 714/2009 stipulates "ENTSO-E shall adopt a non-binding Community-wide 10 year network development plan, including a European adequacy outlook, every two years." The ENTSO-E TYNDP complies with the requirements of the Third EU Energy Package.

The objectives of the TYNDP are to ensure transparency regarding the electricity European transmission networks and to facilitate the decision making process at both regional and European levels. The TYNDP suite of documents consists of a pan-European report and six Regional Investment Plans as well as the SO&AF which aim to give a comprehensive and up-to-date European-wide reference to the anticipated development of transmission networks. Such development is a key step in achieving the European energy policy goals.

Released in July 2012, the TYNDP 2012 [1] highlighted that the major changes expected in terms of generation mix with large wind and solar capacities will lead to more volatile flows over larger distance across Europe, requiring the grid to adapt. About 100 bottlenecks were identified in the ENTSO-E perimeter by the end of this decade and above 100 transmission projects of pan-European significance have been designed to address the challenges described above. Several projects have been proposed using HVDC connections, with around 9,000 km of

HVDC subsea cable and 2,100 km of HVDC overhead lines for a total of 52,300 km of new or refurbished extra high voltage routes.

Getting public consent and the necessary authorization is very challenging, as the figures from the "Monitoring Update – Infrastructure Projects of European Relevance (TYNDP 2012)" [2] demonstrate with 27% of the investments from TYNDP 2012 being already delayed.

The scenarios used within the frame of the TYNDP are described and consulted with the SO&AF report. An annual publication, the SO&AF also assesses the adequacy between generation and demand in the ENTSO-E interconnected power system on mid- and long-term time horizons.

As a new element, SO&AF 2013 [3] contains quantitative data on two of the four visions for 2030, providing a bridge between the EU energy targets in 2020 and 2050. Visions 1 ("Slow progress") and 3 ("Green transition") are based on distinctively different assumptions, namely the actual future evolution of parameters expected to lie in-between.

Both visions assume a relatively low level of integration of the European energy market, and thus are based on national data (bottom-up approach), with Vision 1 assuming a general delay in progression towards 2050 energy roadmap goals, while Vision 3 is constructed to be "on track" towards these policy goals. The results of Visions 2 and 4, based on a well-functioning and strongly integrated market being constructed at a European level, are foreseen to be included in the TYNDP 2014 package.

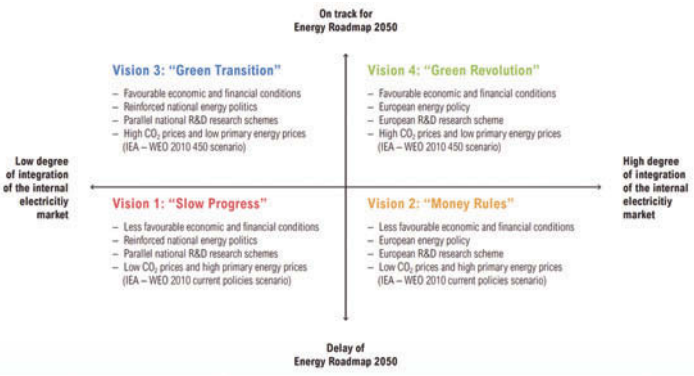

Figure 1 – Overview of the political and economic frameworks of the four 2030 visions [3]

The four 2030 visions show a different level of implementation of the smart grids, in lines with the assumptions of the penetration of the RES and the R&D efforts contributing to each vision.

In order to come to a consistent network development beyond the time horizon of the TYNDP and also the Visions for 2030, ENTSO-E has established a consortium which was officially approved by the European Commission on 27 November 2012 in the scope of the seventh Framework Programme – "e-Highway2050" [5]. The consortium combines partners from the TSO world, research institutes, universities, industry associations and a non-governmental organization. 15 ENTSO-E TSOs are involved as direct partners or third party partners in the project. The three-year project started in September 2012 and aims at delivering a top-down methodology to support the planning of a pan-European transmission network, including possible electricity highways, capable of meeting European needs between 2020 and 2050. The results will be presented and debated throughout the project with the whole electricity value chain as well as with representatives from all the impacted stakeholders in Europe, thus addressing the main drivers and potential barriers for the proposed grid architecture options.

Since there is a need of convergence of planning approaches towards an efficient and sustainable pan-European concept on an Electricity Highways system for the 2050 horizon, the approach will start from the pan-European transmission network by 2020, which is assumed to be known and in line with the 2020 EU energy targets. It will hence consider two important steps: the TYNDP, and also the ENTSO-E Visions for 2030.

The e-Highway2050 study project aims at:

- Developing future-oriented novel planning approaches, allowing a comprehensive but efficient Electricity Highways discussion
- Analyzing and justifying bulk power transmission needs taking into account future generation and its spread throughout the whole transcontinental region
- Proposing concrete implementation, operation and governance principles for needed grid investments throughout Europe and to neighbouring areas
- In the interest of security, efficiency, feasibility and sustainability, considering the whole energy supply chain including relevant technical/technological, economical/financial, ecological political/socio-political and geopolitical/security issues
- Following a modular approach: 2030, 2040 and 2050; and
- Proposing general strategic Electricity Highways architectures including technology options.

The initial e-Highway2050 work is composed of a detailed methodology to build possible energy scenarios and the selection of those that will be used during the whole project are illustrated in Figure 2. Additional details on the methodology can be seen in the e-Highway2050 website [5].

The modular long term planning roadmap will be provided by using two parallel approaches, based on the same macro-scale scenarios:

- A scenario approach using linear power flow approximations for the network modelling and semi-quantitative cost benefit analysis techniques to propose an expansion plan for 2020-2050
- Improvements for the above expansion plan taking into account critical issues using novel planning techniques (correlated uncertainties in energy and power scenarios, voltage problems and stability considerations, black-out risks) in order to make the above expansion plan more robust.

Both planning approaches will consider the whole energy supply chain, including all the relevant technical/technological, economical/financial and regulatory/socio-political dimensions needed to develop efficient, yet sustainable, grid architecture options meeting future energy supply requirements. Scenarios on generation, storage capacities and consumption patterns will be

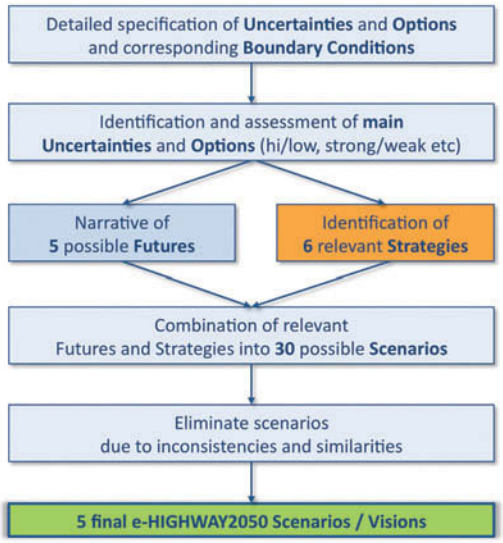

Figure 2 – e-Highway2050 scenario building process [5], source: e-Highway2050-project

detailed based on stakeholder consultations and in-depth work with professional associations. As part of the e-Highway2050 dissemination process, respective progress reports along the three-year study project will be included as outlook in TYNDP 2014, as the starting point for sketching intermediary steps reflecting the increase of decarbonisation of the electricity systems.

Long term grid planning requires carefully prepared process in order to cope with various uncertainties and challenges in transmission grid planning process such as:

- Identification of a set of scenarios to be considered in coordinated planning
- Gathering relevant scenario information
- Market data collection and preparation of market models
- Performing of market studies
- Network models data collection and preparation of reliable regional and pan-European network models
- Performing of network studies
- Assessment and agreements of the studies.

Therefore, a two-year process, the TYNDP process comports the realization of several market and network studies. As summed up in Figure 3, the TYNDP process breaks into three main steps:

Figure 3 – TYNDP 2014 study process

Throughout the process, collaboration with stakeholders is organized through several workshops and other formal consultations in order to increase the transparency and the acceptance of the plans. ENTSO-E believes that an increase in transparency on the development of the projects of European relevance is useful for all stakeholders, in particular national and European regulatory and political bodies, to understand the impacts of these issues.

The identification of the investments needs is done through the use of market and network studies to define the main bottlenecks encountered by the system. For TYNDP 2014, this assessment is done for the 2030 time horizon, grid development requiring the anticipation and consideration of the long-term.

For the assessment of the projects identified by the TSOs or proposed by 3rd party promoters, both market and network studies are performed to assess each indicator of the cost and benefits analysis (CBA) of each project.

Pan-European market studies are performed on different tools to quantify the scenarios developed. After this step, regional groups within the frame of ENTSO-E perform regional market studies, using the pan-European studies as boundary conditions to ensure consistency between the different regions. This two-step approach enables to perform more detailed market studies at the regional level while keeping the overall consistency. As an example, some regions use a further detailed modelling of hydro taking better into account the specificities of their region that would not be relevant for some other countries.

The regional market studies provide both the system indicators and possible planning cases for the detailed network studies. ENTSO-E selected to apply the IEC Common Information Model (CIM) standards for TSOs to exchange information, build common grid models and perform common studies in a harmonized way. Therefore, ENTSO-E is supporting an international standardization organization in defining better CIM standards to ensure interoperability between numerous power system analysis tools supplied to TSOs by various vendors [4].

The relevant planning cases are implemented within the network models to first assess the capacity brought by each project and the relevant CBA indicators. The capacity information is also used in a second iteration of the market studies to calculate the second part of CBA indicators.

EUROPEAN NETWORK CODES SETTING THE RULES IN THE ENERGY SECTOR

Europe has strong ambitions in pursuing a secure, competitive and low carbon energy sector and a pan-European internal energy market. Network codes are conceived as a tool to reach this objective by complementing existing national rules to tackle cross-border issues in a systematic manner. These codes are sets of rules which apply to one or more parts of the energy sector. The need for them was identified during the course of developing the Third legislative package for an internal EU gas and electricity market. Regulation 714/2009/EC sets out the areas in which network codes will be developed and a process for developing them.

Following a request from the European Commission, the Agency for the Cooperation of Energy Regulators (ACER) develops a vision on changes needed on a particular energy subject. This results in ACER issuing a framework guideline, after which ENTSO-E is mandated to draft a related network code.

During the drafting procedure, which can last up to twelve months, ENTSO-E gathers national experts on the subject to draft the network code. In order to ensure the support of all branches of the energy sector, ENTSO-E works in close cooperation with stakeholders and holds to a set of principles in the development of on-going and future codes, i.e. transparency, open engagement and ensured consistency across codes.

The network codes are assessed by ACER to ensure they are in line with the framework guidelines after which they are submitted to the European Commission. Finally the network codes go through the comitology procedure, in which they are scrutinized and agreed by member states, before becoming directly applicable European legislation.

An overview of the status of the nine network codes that are at present being developed is given in Figure 4.

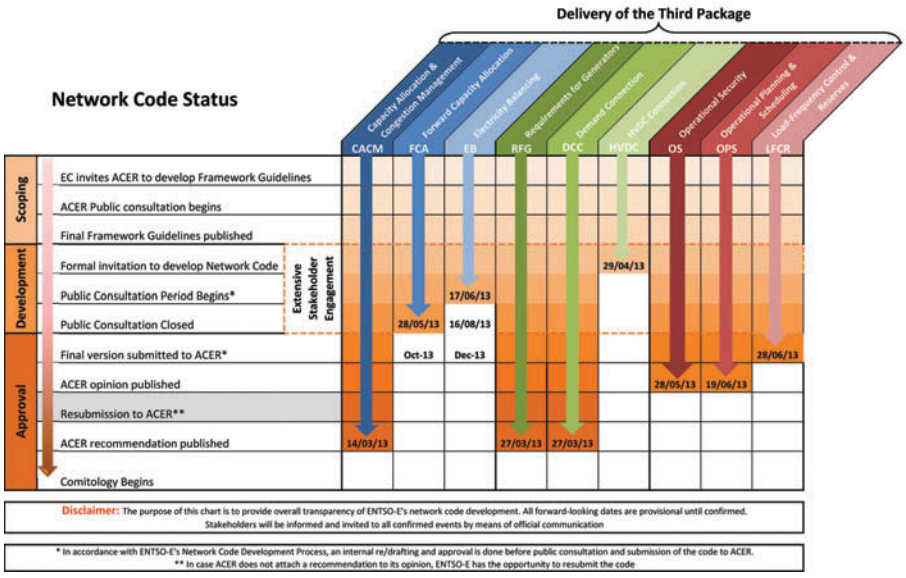

Figure 4 – Status of ENTSO-E's network codes on electricity (version 26 June 2013)

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The first network code that was initiated by the EC, based on a sense of urgency from the wider energy sector, covers Requirements for Generators (NC RfG). After an extensive debate across TSOs, DSOs, manufacturers, generation owners, industrial consumers, NRAs and policy makers, ENTSO-E finalized the NC RfG in July 2012. With a set of amendments in a limited number of areas, ACER recommended the code to the EC for urgent adoption as European legislation in March 2013, acknowledging its contribution in reaching the objectives of the Third package.

This code was soon followed by a dedicated network code on demand connections (Demand Connection Code, DCC). This code addresses three crucial demand pillars in the European electricity system:

- Large industrial loads
- Transmission/distribution interfaces, and
- Demand side response capabilities.

It is important to note that demand response in the context of European network codes, only covers services with a clear cross-border relevance, such as frequency management, wide area voltage support and transmission constraints. Other promising fields of demand response such as distribution congestion or supply portfolio managements are not in scope of the DCC.

The DCC is a connection code and as such sets clear functional capabilities on the installation of users who wish to provide demand response. These functionalities cover e.g. maximum time delays, communication interfaces, the need for adequate compliance testing, and a clear follow-up via registration of demand response providers with their network operator. The DCC does not impose specific technology dependent measures, nor does it refer to an explicit standard for communication protocols. The DCC provides a European legal framework that ensures that demand response services can be procured in a reliable and efficient manner.

For the practical implementation of demand response, the DCC explicitly allows for the role of aggregators to interact in the process. The procurement of demand response is also addressed in other network codes, notably the ones on operational security and electricity balancing, which provide a European level playing field for aggregation of demand and generation, and which bring both demand and generation on the same level in ancillary services markets.

ENTSO-E stresses that in future power systems with high penetrations of RES, demand response will be an indispensable part of the operational tools TSOs need to maintain the present security of supply performance. Therefore, the DCC has the ambition to lower the barrier as much as possible to empower all consumers (domestic to large scale) to deliver demand response. A specific procedure is prescribed in the DCC which enables specific appliances to made demand response-ready in the coming years. Several case studies have been discussed in the development of the DCC which all support the cost efficiencies for society when demand response opportunities are rolled out across all demand users. The specific procedure in the code to make this possible complements the present European Ecodesign legislative framework. Further work in standardization is needed in this process, e.g. in the domain of Mandate 490.

The DCC received a positive recommendation from ACER in March 2013 and is at present being prepared by the European Commission for a formal adoption process in comitology later this year.

CONCLUSION

The European electricity system is going through a period of unprecedented change. The generation mix is changing fundamentally, the potential for the demand side to become much more involved is vast and the market is becoming genuinely pan-European. Planning of the grid for the next decades requires detailed studies to define possible scenarios and processes to analyse grid reinforcements.

TYNDP processes, e-Highway2050 project and other regional or pan-European TSO initiatives are providing the cooperation framework to plan the future European grid. Reliable tools and data exchange mechanisms are a key aspect in enabling TSOs to perform network and market simulations in order to assess project proposals and plan the grid. The network codes which are being developed by ENTSO-E will help to ensure the long term security of energy supply, will promote the integration of large volumes of renewable energy generation and will play a central role in translating the vision of a pan-European market into a reality. However, network codes will impact on all parties active in the energy sector and will lead to considerable change in existing practices. MI

References

1. *TYNDP 2012, https://www.entsoe.eu/major-projects/ten-year-network-development-plan/tyndp-2012/ – July 2012 – ENTSO-E*
2. *Monitoring Update – Infrastructure Projects of European Relevance (TYNDP 2012, https://www.entsoe.eu/news-events/announcements/newssingleview/article/tyndp-2012-monitoring-update-projects-of-european-relevance/?tx_ttnews%25255BbackPid%25255D=28&cHash=334cdfc43a99b6b731f4437a8f485566 – July 2013 – ENTSO-E*
3. *SO&AF 2013, https://www.entsoe.eu/about-entso-e/system-development/system-adequacy-and-market-modeling/soaf-2013-2030/- April 2013 – ENTSO-E*
4. *CIM, https://www.entsoe.eu/major-projects/common-information-model-cim/ – ENTSO-E*
5. *e-Highway2050 methodologies, http://www.e-highway2050.eu/consultation/single/?tx_ttnews%5Btt_news%5D=14&cHash=860916fca132ee7767df546c5b82d14e – June 2013 – e-Highway 2050 Project*
6. *Network codes, https://www.entsoe.eu/major-projects/network-code-development/ – July 2013 – ENTSO-E*

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CLARION EVENTS

INSIGHTS FROM THE INVENTORY OF SMART GRID PROJECTS IN EUROPE

2012 UPDATE

By Gianluca Fulli, Catalin Covrig and Miguel Olariaga

The electricity sector is continuously evolving to meet new policy goals and to satisfy the increasing energy demand while integrating more environmentally aware energy resources. Renewable energy sources, demand response, energy savings, security of supply, consumer involvement and advanced services are all part of today's EU agenda in the sector. Smart grids, or intelligent electricity networks, are at the core of this revolution, playing a key role in shaping those changes.

By the end of 2010 the Joint Research Centre, the European Commission's in-house science service, launched the first comprehensive inventory of smart grid projects in Europe[1]. The final catalogue was published in July 2011 and included 219 smart grid and smart metering projects from the EU-28 member states, Switzerland and Norway. The participation of the project coordinators and the reception of the report by the smart grid community were extremely positive. A close insight from this report was published in Metering International in 2011 (Issue 3 2011, p 80).

Due to its success, the European Commission decided that the project inventory would be carried out on a regular basis so as to constantly update the picture of smart grid developments in Europe and keep track of lessons learnt and of challenges and opportunities. For this, a new on-line questionnaire was launched in March 2012 and information on projects collected up to September 2012. At the same time an extensive search of project information on the internet and through cooperation links with other European research organizations was conducted. The resulting final database is the most up to date and comprehensive inventory of smart grids and smart metering projects in Europe, including a total of 281 smart grid projects and 90 smart metering pilot projects and rollouts from the same 30 countries that were included in the 2011 inventory database. Projects surveyed were classified into three categories: R&D, demonstration (or pre-deployment) and deployment, and for the first time a distinction between smart grid and smart metering projects was made. The following is an insight into the 2012 report[2].

KEY MESSAGES

The analysis of the newly gathered data for the 2012 report has unveiled important key aspects that have been compared and correlated to the ones drawn from the 2011 analysis.

PROJECT INVESTMENTS AND SCALE

The 281 smart grid projects account for a total investment of €1.8 billion. The average project duration is 35 months. Over 50% of the projects surveyed were started after 2010.

The level of investments committed in 2011 was remarkable mainly due to some large publicly funded projects, in particular the first batch funded by the ambitious Low Carbon Network Fund (LCNF) in UK for a total of €120 million and a number of large scale demonstrators financed under FP7 or with European regional funding. The fact that the number and level of investments of the projects started in 2012 are well below that doesn't necessarily indicate a negative tendency but might only reflect the fact that the survey was closed by September 2012.

As important as the budget allocation is the size of the project. Smaller projects indicate more research and market exploratory work while larger projects might imply rollout or development of more consolidated and mature applications. Projects have been categorized into five different groups: 'very small scale' for projects under €2.5 million, 'small scale' for projects between €2.5 million and €7.5 million, 'medium scale' between €7.5 million and €20 million, 'large scale' between €20 million and €30 million, and 'very large scale' for projects over €30 milllion. Analyzing the available data from 2006, two tendencies can be noted: the 'small scale' cluster is increasing at the expense of the 'very small scale' cluster and the 'medium scale' cluster is shrinking in favour of the 'large' and 'very large scale' ones. In general, the size of projects is increasing, showing positive signs in terms of the scalability and maturity of related smart grid applications.

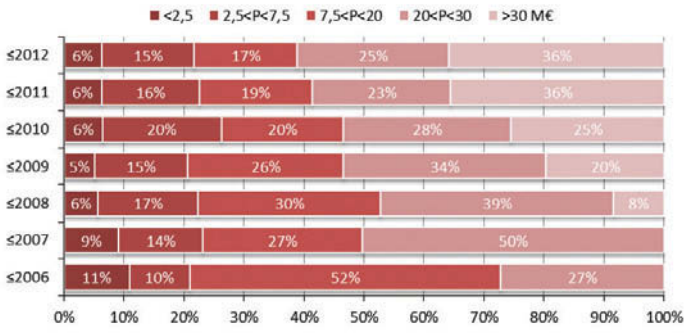

Figure 1 – Share of projects in each budget range across the years in terms of budget allocated

GEOGRAPHICAL DISTRIBUTION

70% of all projects are in only seven countries: Austria, Denmark, France, Germany, Italy, Spain and UK. Eastern European countries are significantly lagging behind.

In terms of spending, UK leads with 15% of the total, Germany and France around 12% each and Italy, Denmark and Spain around 10% each. The public sector has played a major role in starting new projects, especially in France through the Smart Grid program of the Agency for Environment and Energy Management (ADEME) and in Italy through the regulatory authority AEEG. Denmark is the leading country in R&D projects and also the country that invests most both per capita (over €30 per person) and per kWh (€0.5 per MWh) of consumed electricity.

Multinational collaborations are becoming an ever expanding opportunity to share knowledge, resources and costs. In 2012, up to 60 projects were being carried out by multinational consortia. Organizations involved ranged from energy operators to research centres, manufacturers and service providers.

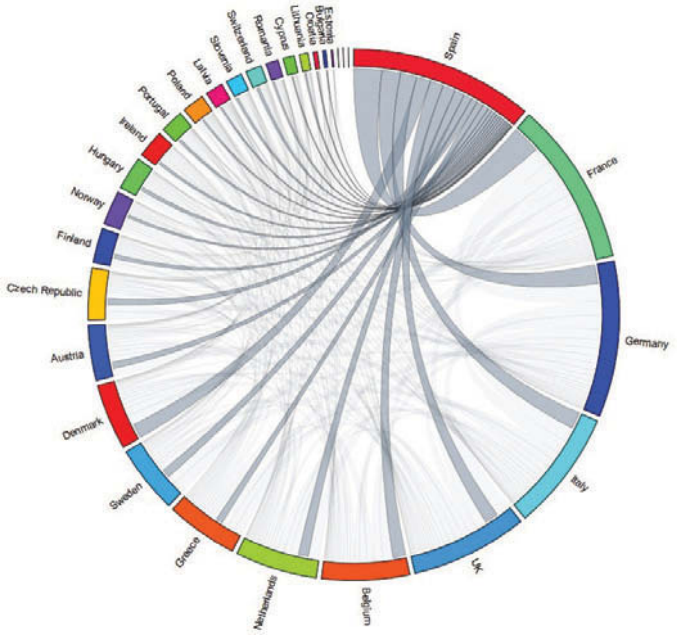

Figure 2 — Collaboration links in European multinational projects (weighted by project budget)

WHO IS INVESTING?

Distribution system operators (DSOs) continue to lead the participation in smart grid projects, participating in over 80% of them. However, there is a tendency change compared to the previous report where the participation of other types of organizations is increasing. That's especially the case of universities/research participating in over 70% of the projects and IT/telecoms, in over 35%. Cooperation agreements between actors are also increasing, having DSOs/utilities and universities/research acting as the main 'cooperation hubs' for other players like manufacturers and IT/telecom companies.

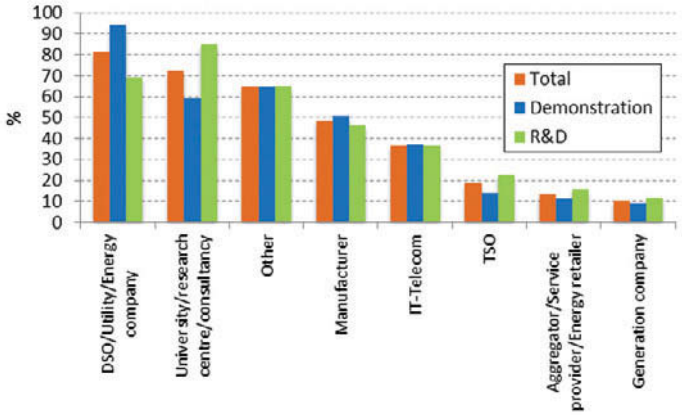

Figure 3 – Participation by type of organisation (percentage of projects with at least one representative of that type of organisation)

Regarding project leadership, DSOs are still ahead of other organizations, taking the lead in a total of 115 projects with an investment equal to 57% (over €1 billion), while universities/research centres/consultancies lead projects with an investment equal to 23%. This is mainly due to the fact that the current phase of smart grid development is primarily focussed on the technical aspects of the architecture where DSOs have a leading role and are required to actively participate in any projects affecting the operations of the grid. In addition, DSOs have direct access to regulatory funding. This might change in the near future, when the development of new smart grid applications gives way to other market players.

Transmission system operators (TSOs) lead 23 of all smart grid projects surveyed, equally split between R&D and demonstration, for a total of €160 million. Most of these TSO-led projects are funded by the European Commission and are focussed on strengthening the interface with DSOs, the integration of demand side management (DSM) in transmission system operations, the development of new tools for the coordinated management of the transmission grid and specific works on the integration of large scale renewable energy sources (RES).

Telecoms and ICT companies are the lead organizations in 17 projects, mostly R&D, with a total budget of around €55 million. The focus is on ICT technologies to foster flexible production (demand response and storage mainly) and consumption (home energy management and consumer involvement).

Of all the projects in the catalogue, 45% of funding comes from private capital and 55% from various sources, including regulatory, national and European funding. Since 2011 regulatory funding has been comparable to national and EC funding. National regulators have different funding programmes that differ widely among countries. In Denmark over 50% of the projects in the catalogue are funded by the Forskel programme, which is financed from tariffs. The UK regulator Ofgem, through its LCNF programme, budgets up to €370 million to support distribution network operators with the aim of providing security of supply at value for money. The European Commission, through the 6th and 7th Framework Programmes and the European Regional Development Plan, has contributed around 20% of the total funding of all projects in the catalogue. National funding differs substantially among countries but also amounts to around 20% of the total.

SMART GRID APPLICATIONS

A smart electricity grid enables the development of new applications that reach all domains, from transmission to distribution and consumers. There are several areas of interest that the majority of the projects surveyed are focussed on.

Smart network management

The objective is to improve monitoring and management of the networks, especially at medium and low voltage. Network monitoring requires real-time tools to identify and locate faults and smart meters to collect and store consumption data. Project results confirm that current tools are mature and reliable. Some areas of improvement are related to standardization and interoperability, in particular regarding the communication infrastructure. Network management is seen as a highly developed and efficient area. Some of the works are currently addressed to handle frequency control, reactive control, power flow control, auto-reconfigurable capabilities, smart relays or dynamic line rating. Areas for improvement include cyber security and scalability of applications.

Integration of large scale RES and distributed energy resources (DERs)

Both are very active areas of work mainly oriented at planning, control and forecasting. Technical solutions are available, but more flexibility is still required. However, significant progress is required in areas aside the technical aspects, including regulatory frameworks, coordination of physical and market requirements or standardisation of control and communication technologies.

Aggregation

Aggregation, including virtual power plants (VPPs) and demand response, is regarded as a key area and has concentrated intensive efforts over the past 5 years, involving different actors including

ICT companies. Several projects (Web2Energy, REFLEXE, Virtual PowerPlant, EU-DEEP, FENIX) have confirmed the technical feasibility of aggregation mechanisms while technical challenges that remain are scalability and standardisation. Demonstration projects (EcoGridEU, PowerMatchingcity, E-Energy) have been testing complex coordination mechanisms and have identified some non-technical challenges, like the viability of the business models and consumer involvement through market signals, the availability of simplified contract formulas (e.g. fixed monthly rate for flexibility) that might encourage small DERs and consumers to participate, or clear regulatory requirements to facilitate the participation of VPPs.

On the other side, a success story has been the RWE-led VPP project that has successfully tested trial operations with hydro power plants, combined heat and power units and emergency power systems. Since 2012 it has been able to trade electricity on the Energy Exchange (EEX) in Leipzig.

Regarding demand response, projects focussed on consumer involvement, like the EcoGrid EU project, are still testing small-scale aggregation of demand response, typically up to 2,000 residential consumers. At industrial level demand response is a much more consolidated application.

Smart customers and smart homes

The smart home will require intensive work in the future. Some projects show promising results with dynamic tariffs (based on variables such as exchange price, forecasts, residual load, grid conditions, etc.) indicating that this might be the best way of adapting demand to grid conditions. However, fixed grid charges prevent their full potential from being realised, indicating that regulations need to be updated to take full advantage of new opportunities. Agent-based technology is widely used and shows promising results in terms of scalability (e.g. Beywatch project).

Electric vehicles (EVs)

Not surprisingly, up to 10% of the projects in the catalogue have the integration of electric vehicles in the grid as the main objective for a total budget of €190 million. Over 60% of those projects were started after 2010. GreenEmotion is the most ambitious effort at European level to support electro-mobility and is also the largest demonstrator on EVs of all projects surveyed. It includes seven pilot regions in Europe with a current total of 2,000 EVs and 2,500 smart charging stations, which are expected to increase up to 70,000 EVs and 80,000 charging stations by 2015. The main focus of the project is interoperability and the optimization of the charging infrastructure (type, number, location, consumer acceptance, etc.) at European level. It's a very vast area including standards, IT architecture, analysis of user needs, charging times and patterns, load on the network, customer billing management or customer roaming.

Projects surveyed showed that the main concern is to ensure that the EV charging and communication infrastructure is fully operational before venturing into vehicle-to-grid (V2G) services. In fact, at the time of the survey, there were no demonstrators testing V2G services.

THE EUROPEAN ELECTRICITY GRID INITIATIVE (EEGI)

EEGI is a 9-year European research programme to develop a smart grid for Europe 2030. The EEGI roadmap estimates that €1.8 billion in investments will be needed in the period 2010-18 assuming coordination of projects. Projects are classified into one of two groups: 'core projects' with a budget over €15 million and 'support projects' with a budget between €2 million and €5 million. At present, core projects represent 14% of all projects and account for 66% of the total budget in catalogue. Support projects represent 35% of the projects and account for 29% of the total budget. The

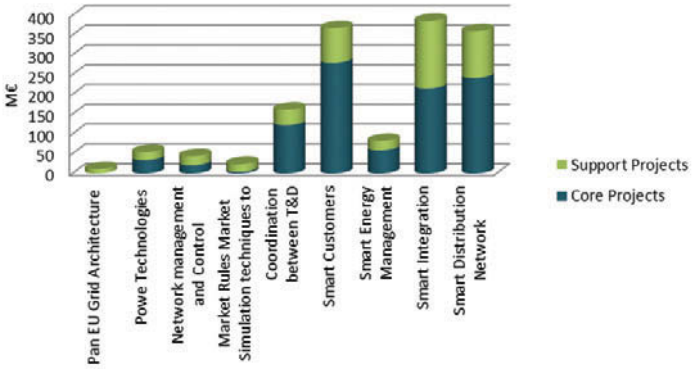

Figure 4 – Cumulative budget in EEGI functional areas for core (budget≥€15 million) and support (€2 million to €15 million) projects

main areas on which the projects focus are smart customers, smart integration and smart distribution networks.

DATA COLLECTION AND DISSEMINATION

Although widely seen as a key element to support the transition to smart grids, project data dissemination is still regarded as an issue to be solved. Many barriers exist: caution over sharing quantitative data and lessons learned; lack of a common framework for data sharing and analysis; fragmentation of initiatives to share project results; lack of dedicated websites for many projects, or when available, lack of multilingual pages, having only the version in the national language of the country hosting the project.

Improvements are needed in data collection/exchange, including a common structure for data collection (definitions, terminology and categories) and strengthening project repositories at the national and European level. The JRC smart grids project inventory has been created with this idea in mind.

SMART METERING PROJECTS

Smart metering projects have been analyzed separately in the 2012 report update. The main reason for this is that smart metering projects have achieved a greater level of maturity and most of them regard smart meter rollouts. In fact, the EC directive 2009/72/EC requires member states to achieve the rollout of at least 80% of smart meters in their territory by 2020, if the cost-benefit analysis is positive. Overall, 13 countries have decided to go ahead with the rollout, 3 have decided not to proceed after a negative CBA and the other 11 have not taken a decision yet.

Ninety projects dealing with smart meters have been included in the catalogue. In most cases those projects are led by DSOs/utilities except in UK (led by energy retailers) and Bulgaria (led by a telecom company). A conservative estimate is that €5 billion has been spent to date on smart metering pilots and rollouts and another €25 billion is expected to be invested until 2020. In Italy alone, 36 million units have been installed for a total investment of €2.1 billion. In 2009, Sweden completed a rollout, installing 5.2 million units and investing around €1.5 billion. Malta and Finland will complete the rollout by 2013.

The communication infrastructure relies on powerline communications (PLC), telecommunication lines (ADSL, telephone, etc.) or wireless technologies and strongly depends on the local conditions. The most widespread option is the combined use of PLC for the smart meter-concentrator connection in the secondary substation and the use of GSM/GPRS for the concentrator-meter data management system connection. Cost per smart meter again strongly depends on location but it ranges from less than €100 to as much as €400. The average lifetime of each unit is estimated at 15 years. Pilot testing of multi-utility meters (electricity, water and gas) is ongoing but technology and results are still lagging behind.

Consumers perceive smart meters as advantageous to enable energy savings using the in-home display that will allow consumption control and proactivity to reduce it. Consumers also agree that smart meters can provide innovative services that might improve competition in the retail market, allowing further reduction in tariffs, the possibility of choosing the most advantageous supplier depending on own consumption patterns and more transparent and accurate billing. However, scepticism about real savings and concerns regarding security and control of installed devices in their own household still exist. Trusted sources (consumer associations or independent institutes) can play an important role to increase consumers' awareness and willingness to take on new opportunities.

The European Commission Task Force for Smart Grids clearly acknowledges the need to improve consumers' involvement in sustainable consumption. It's for this reason that up to 65 projects dealing with 'consumer engagement' can be found in the catalogue. Those projects are normally led by DSOs, mostly concentrated in a few countries (Denmark, Germany and France) and focused mainly in the residential sector. Motivational factors used by these projects are environmental concerns (41%), control over electricity bill (40%) and better comfort (15%). Most projects combine more than one factor, indicating that electricity providers are not yet targeting specific consumer segments.

FUTURE WORK

With the 2012 update, the Joint Research Centre aims at establishing an open platform for the collection and dissemination of project information involving all member states, international organizations and energy operators. In addition, a visualization platform linked to the JRC database has been developed to map projects across Europe (http://ses.jrc.ec.europa.eu/smart-grids-observatory), along with an interactive smart grid map produced by the JRC and the European electricity industry association, Eurelectric (https://portal.smartgridsprojects.eu). Yearly updates of the project inventory will follow. MI

References

1. *Smart Grid projects in Europe: Lessons learned and current developments, Giordano, V., Gangale, F., Fulli, G., Sanchez Jimenez, M., et al. JRC Scientific and Policy Report, 2011, available at http://ses.jrc.ec.europa.eu*
2. *Smart Grid projects in Europe: Lessons learned and current developments (2012 update), Giordano, V., Meletiou, A., Covrig, C. F., Mengolini, A., Ardelean, M., Fulli, G; Jiménez, M. S., Filiou, C. JRC Scientific and Policy Report, 2013, available at http://ses.jrc.ec.europa.eu*

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ABOUT THE ORGANIZATION

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle. Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

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BEYOND SMART METERS

ACTIVE LV NETWORKS COME NEXT

By Txetxu Arzuaga

One important aspect of the deployment of an advanced metering infrastructure (AMI) is that utilities are beginning to think about how the low voltage grid can be improved thanks to the new technologies that it brings.

Everyone is familiar with existing 'algorithms', based on customer complaints, to detect problems in LV networks. Additionally, conservative and inflexible planning rules are considered when extending the grid. Also current LV grids will face more challenges than in the past. Distributed generation penetration, net metering and customer network quality expectations will require utilities to reconsider their LV grid operation strategies.

Current deployments of smart meters are bringing a lot of benefits to all stakeholders. First, customers are getting real time information on their energy consumption and their power demand. Second distribution companies' operation processes are being optimized, thanks to the information they can gather from the network supply nodes. Finally, technology providers have shown that complex technologies such as the ones involved in an AMI system (metering, control and telecoms) can be part of cost competitive intelligent electronic devices (so called smart meters).

Once AMI technologies are mature, utilities can go to the next step, i.e. to convert their current passive LV grid into an active future proof LV grid. By active LV grid we mean an LV grid that is:

- One where voltage levels are continuously monitored
- Aware of its assets, which implies that it knows its feeder and phase capacity usage, and where smart meters (phase and feeder) are installed
- Able to detect faults (fuse problems, neutral and phase faults)
- Able to help in the operation of the medium voltage grid.

This active LV grid is now possible due to the technology improvements of smart meters.

AMI systems are based on the continuous exchange of information between data concentrators installed in secondary substations and smart meters deployed at customer premises. Innovative and cost effective solutions, based on smart meters technologies, can be installed in secondary substations so that:

- Smart meter installation feeder and phase can be determined
- Power flow and system voltage are continuously monitored
- Line capacity is controlled
- Phase unbalances are identified, assuring that their loads are evenly distributed (phases and feeders)
- Non-technical losses can be reduced due to the availability of different energy registers at different grid locations.(in each transformer and feeder).

An example of such a system is shown in Figure 1.

Some utilities are even going beyond this. Not only have they installed LV grid systems such as that illustrated but they have also decided to install automation solutions so that the LV grid has become an active player in the smart grid arena. Smart switches, installed in certain network nodes, will be operated based on both, the node and its nearby nodes' status.

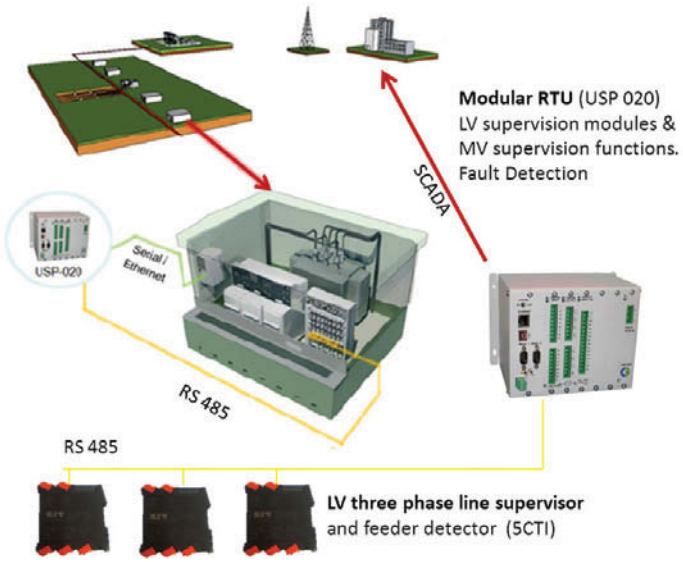

Figure 1 – LV grid automation

ZIV is ready to supply a new generation of smart electronic devices to control and monitor an active LV grid. These will help utilities to optimize the operation of their LV grids. We are ready to go for the next step. Let's make the LV grid a real smart grid. MI

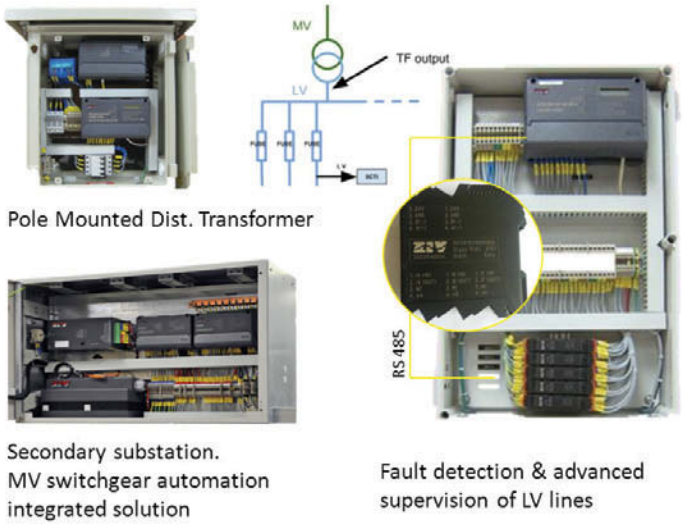

Figure 2 – ZIV grid automation cabinets

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ABOUT THE COMPANY

ZIV is a Crompton Greaves (CG) group company. ZIV leads the Automation division of CG and is the centre of excellence for the development of CG's smart grids worldwide (substation automation and distribution automation systems). ZIV DAS offer includes smart meters, data concentrators, AMI, communications and EV integration solutions.

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ERDF: LEADING SMART GRID RESEARCH IN FRANCE

INTERVIEW WITH MARC BOILLOT, SENIOR VICE PRESIDENT STRATEGY AND PROJECT DEVELOPMENT, ERDF

Marc Boillot

France's distribution network operator ERDF (Électricité Réseau Distribution France) is involved in no less than 15 smart grid pilot projects around France, which have been introduced over the past 3 years, with the latest launched in June, and is also leading the Europe-wide Grid4EU project. To find out more about these Metering International spoke to Marc Boillot, senior vice president in charge of strategy and project development at ERDF.

What is ERDF's strategy towards smart grid development?

We have 20 years of experience in making networks smarter. At the medium voltage level our networks are already smart as we have invested in 30 regional dispatch centres and more than 100, 000 remote control devices located on the network. This is demonstrated in the power quality and we have moved the average power outage time across France from around 300 minutes per annum 20 years ago to 75 minutes last year.

We see the distribution network as playing a central role in the electric system and DSOs having to play an increasingly important and more active role through the energy transition, with for example the growth in renewable energies and electric vehicles leading to multiple generation sources and reverse power flows, and the entry of new market players.

The current situation in France is that, by the end of 2012, 95% of the renewable production, i.e. from PV and wind, representing 10 GW is connected to the grid (out of a total capacity of 120,000 MW). Just in 2012, 1.5 GW of new installations were connected by ERDF. So for us smart grids are not an option but a necessity to ensure stability and security of supply. We cannot decide to put in extra investment to connect renewables and electric vehicles unless we have considered all other options, and that is what we are doing with our investment in smart grid research.

We have projects with energy storage, demand and generation forecasting, online diagnosis, supervision, EV charging station management, curtailment management, renewables integration – all these functionalities have to be considered. The objective is to evaluate the technical and economic adequacies of the new technologies, and the perspective is to deploy them on the networks when the technology is mature. The majority of the projects are financed mostly by ERDF. Grants or loans are provided and also by ADEME (the French Environment and Energy Management Agency) but also by the European Commission, and we work in cooperation with more than 100 partners including industrial partners, DSOs, universities, etc.

Regarding the low voltage network, we have developed the Linky smart metering system based on PLC technology. We have promoted interoperability and have different suppliers of meters and of data concentrators. This system has been successfully tested with 300,000 smart meters deployed in Touraine and Lyon since 2011. We see smart metering as the first step towards the modernization of the low voltage grid.

Which were the first projects to be launched?

The first projects were Greenlys in Lyon and Grenoble, Nice Grid in Nice and Venteea in eastern France. But in parallel we have two projects already in operation on the Houat and Hoëdic islands in Brittany and the Watt&Moi project, also in Lyon.

What results are emerging from these projects?

We have got some interesting results from the Houat and Hoëdic islands project. One cable supplies power to the two islands but it is frequently damaged by fishing activities, so we installed a genset there and Linky meters to the 500 customers. Then we can remotely reduce the capacity of the meters to 3 kW instead of the normal 9 or12 kW and in this way all the customers can benefit from the power from the genset when the cable is down.

Another project with interesting results is Watt&Moi. We selected 1,000 customers from those who already had the Linky smart meters in Lyon, since this area was one of the Linky experimentation locations. A secure internet website gave them access to information about their electricity consumption and personal energy coaching. We have observed that once customers join the program they are extremely motivated, particularly when their

electricity consumption is compared with neighbouring similar households. This is the first program of this type in France at this scale and the gains by several households have reached up to 10% of consumption.

What has been the general response of consumers to the projects?

With Linky we had very few complaints – less than 1%. Customers have realized the advantages, such as remote interventions, without the need to wait for a technician. For example, most of the interventions were to switch on the power as these activities can be done remotely.

In general customers have been interested to join, but our challenge is to maintain that interest in the longer term to save energy and to be a participant in the system. In some smart grid projects we needed to recruit customers to install PV systems on their roofs and this was difficult, because of the investment required. But concerning the Linky project it was obviously free and the majority of participants have appreciated the benefits. We are really still at the start of the analysis of the behavioural patterns and will have more information in the months ahead.

What is the background to the Sogrid project, given the availability of several PLC standards?

With Sogrid we want to test the use of PLC between the meter and primary substation. With Linky PLC is used today for transmitting data from the meter to data concentrator and then GPRS is used to the central system, but we feel using PLC to the primary substation may give us better control and be less costly.

Narrowband PLC is a very new technology and we have been a pioneer and see G3 as having a great future. It's not something that will bring more to the customer but for the DSO it should improve the speed and volume of data to transmit to control the system.

We started the G3-PLC Alliance with 10 partners and it has grown to more than 40 member companies in Europe, the US and Asia with the objective to standardize and promote G3 PLC worldwide.

What is the background to the newest project, Smart Grid Vendée?

Smart Grid Vendée was launched at the end of June with a €28 million budget – the majority financed by ERDF – focused on the integration of renewable energy. It is our most geographically widespread project to date and includes six wind farms and 30 PV generation sites; and on the consumption side more than a hundred public buildings, 10,000 public lighting devices, and 350 EV recharge stations. On the distribution side it includes six primary substations, several hundreds of secondary substations and 500 Linky smart meters.

Overview of ERDF's smart grid pilot projects

We aim to monitor the state of the network on a second by second basis and the objective is to develop innovative forecasting and decision making tools to balance production and consumption.

It's very specific because of its size and the level of innovation.

Do you see products coming out of the pilots that could be utilized in other countries?

Sure, the software for forecasting production and demand could be used abroad, and the sensors for online diagnosis and observability are readily available. In fact most products could be used, most likely with some evolution to adapt them to a specific local environment.

Do you anticipate starting any more pilots?

We have covered a lot of the concerns in the pilots we have launched but it may happen that certain aspects may need to be addressed in new projects. But for now we have a lot of knowledge to gain and then make our smart grid investment decisions from this. MI

'SMARTNESS' FROM THE BOTTOM UP

A FEW INSIGHTS INTO THE AMSTERDAM SMART CITY PROGRAMME

By Ger Baron

This article discusses the impact of the current internet and energy revolutions on the ecosystem of energy suppliers, distributors and generators. The effects are tremendous, influencing the whole network as well as raising questions about efficiency and IT. But the opportunities are bigger still, with possibilities to create cleaner, cheaper energy and to generate more efficient usage.

It also means that roles within the market will change and that there will be casualties – namely, companies that fail to change quickly enough – along the journey to a new ecosystem. The role of the government is extremely important: incentives need to be in place to engender change at the speed that is possible and even needed. We are in the middle of an industrial revolution where energy and internet providers are bundling forces to create a whole new platform for products and services. This means the energy market can finally become a consumer-driven market. This new industrial revolution – the digital revolution – will create the opportunity for users to really choose. The multi-trillion dollar energy market will change very rapidly – but not everybody seems to be ready.

AMSTERDAM: A SMART CITY?

You could argue that Amsterdam was the first real smart city in the world – not with the start of the Smart City programme in 2009, but way back at the end of the 16th century. At that time, Amsterdam's importance as a trading city began to grow. One of the most important reasons that Amsterdam became one of the richest cities of that time – with over 50% of all sea-going vessels in the world departing and arriving from its harbour – was the availability of data relating to trade and cargo. In a physical space of 400 by 400 metres, all the information on the cargo, destination and ownership of all these vessels was gathered. This enabled merchants to trade cargo that was still on a vessel or to compare products.

This rich data seam engendered the world's first stock exchange and the opportunity for everybody to invest in trade, generating investments on a scale never seen before, while financial newspapers shared the information with everybody who wanted to access it.1 Basically, it was open data avant la lettre.

AMSTERDAM SMART CITY: 2013

Amsterdam Smart City (ASC) is a programme that facilitates business, governments and academics. The programme bureau consists of a dedicated team who believe that by combining knowledge, competences and partners, the city will develop and precipitate a higher quality of life and more business opportunities. ASC does not just believe in a top-down approach; there is a strong belief at ASC that bottom-up ideas can contribute greatly to our city, especially when it comes to the development of new products and services.

1. *De Vries, Jan; Van der Woude, Ad (1997).* The First Modern Economy: Success, Failure, and Perseverance of the Dutch Economy, 1500-1815. Cambridge University Press.

There are several definitions of a smart city. Caragliu & Nijkamp's is perhaps the most compelling:
"A city can be defined as 'smart' when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory action and engagement." [2]

For Amsterdam Smart City all of the above is true – as are probably several other definitions. In essence, we see smart city development in Amsterdam as creating open infrastructures where companies and users have access to and can deploy new products and services. The model of Google Market is perhaps the best comparison, where the city is the platform.

To develop Amsterdam as a smart city there are two lines of action:

1. Stimulate the development of new products and services that improve the quality of life of the people who live and work in the city and contribute to solving societal challenges
2. Ensure infrastructures are open and state-of-the-art to enable the requested services and products.

Stimulate the development of new products and services that improve the quality of life of the people who live and work in the city and contribute to solving societal challenges

During the first three years of the Amsterdam Smart City programme, the focus was primarily on two things: collaborative models and creating insight/access to data for users. In the second phase, which began in 2012, the focus moved towards creating scalable models and possibilities for users to act. The projects that are executed in Amsterdam (sometimes directly managed by ASC, but most of the time by other parties in Amsterdam) can generally be divided into three categories, all relying on energy, connectivity and data. And although the same principles apply to all industries (including health, education and tourism), we will focus on the energy sector in this article.

1. Creating products and services for (end) users

As stated above, the first three years of the ASC programme focused on giving insight and creating collaborative models.

2. *Caragliu, A; Del Bo, C & Nijkamp, P (2009). 'Smart cities in Europe.'*

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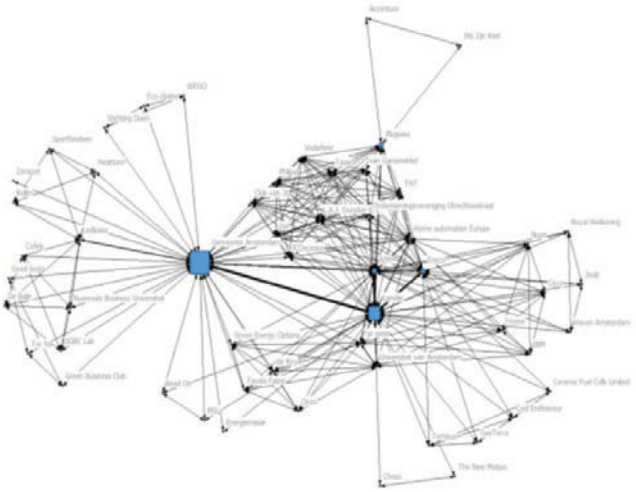
With regards to giving insight, several projects were executed that gave insight to energy users (for example, West Orange, Buurzaam Geuzenveld, Klimaatstraat, ITO Tower and Smart Plugs in Haarlem). This necessitated gathering data on energy that was then disclosed to users. Amongst the most important lessons learned was that most users do not greatly care about energy in general – most probably because it is intangible. By giving insight into the use of energy and making it more tangible, usage reductions of around 12-13%[3] appeared to be the average, just by saving energy and becoming more efficient. It also created a greater demand for energy companies to do more amongst users. Since the low hanging fruit possibilities to save energy weren't that high, users lost interest pretty quickly. Having gained insight, we needed to develop collaborative models. The following questions needed to be answered: How can a housing agency work together with a global IT company? How can an innovative SME in energy efficiency collaborate with a more traditional water company? Different company cultures aren't always that easy to align. Simple issues can make them incompatible – like the fact that tech start-ups have a scope of 40 days and infrastructural parties a scope of 40 years – or more complicated issues that relate to legal structures applying to grid operators or housing agencies, which limits them from making certain investments necessary for solution providers to implement their products.

Research being executed by PhD student Fatemeh Nikayin and Dr Mark de Reuver[4] has given an insight into how several organizations collaborate together and who collaborates with whom in the Amsterdam Smart City projects. Unlike most presentations about smart cities, this is not an organized chart but an organic ecosystem, as can be seen in the figure.



Taking these lessons into account, Amsterdam Smart City was ready for its next phase: scaling and creating the opportunity to act.
The second phase of Amsterdam Smart City is obviously still about collaboration, but it is no longer about getting to know each other any more. Rather, it is about finding new business models that facilitate in-demand products and services. Solutions should also be scalable. The most important mechanism is market waking. This requires infrastructure owners who have a vision of the long term and are willing to facilitate. What we have seen is that successful SMEs that tested new products within the Smart City context – such as Quby or Plugwise – achieved their success based not only on their technology, but also – and especially – on the basis of their own entrepreneurial skills. Larger companies that collaborate with these successful SMEs to create scale provide help with market entry. Creating these combinations is very important, and within the new wave of projects there is a strong focus on making the right combinations, with business models that are scalable and potential clients being part of the development.

3. Demonstrated in 'West Orange' and 'Buurzaam Geuzenveld' for consumer market; potential for businesses is higher.
4. Nikayin, F, & De Reuver, M, in press.

This has led most providers to help their users to act, and several companies have started a business that helps users to save energy, based on the insights reached using the new products. These solutions vary from customized solar panels or LED-lease constructions to neighbourhood energy company initiatives. The result is a whole new market with hundreds of active companies.

2. Use of data for consumers, businesses and government: analytics

Data is valuable, and there is a lot of it out there. As stated in the introduction of this article, in the 16th century, all the data on Amsterdam trade was contained in a square of 400 by 400 metres. Nowadays we would probably need a 400 by 400 by 400 metre data centre. And since more and more devices (in Amsterdam, probably more than double the number of inhabitants) are IP-enabled nowadays, there is more data being accumulated every day. This data comes from energy grids, housing agencies, mobile devices or from the government. Some of it is real time and updated every second; some of it is static and will never be updated.

In the first phase of Amsterdam Smart City, the focus was on gathering knowledge, making it comparable and making sure data was available. In close collaboration with the city of San Francisco, in the context of the highly successful Cisco-endorsed Connected Urban Development programme, a first start was made via the Urban Eco Map in 2008. A map of the two cities where energy, waste and mobility use per neighbourhood (or borough) was visualized. The most important findings during this phase were threefold:

- It is very hard to make data comparable internationally owing to different methodology but also, for example, different sizes of boroughs
- Data is not always correct and the 'cleansing' process takes time
- Data only becomes interesting when you start to combine or compare it.

Not rocket science, perhaps, but for all people involved it's very good to see this in practice. For the first time we could do some (real time) analytics on CO_2 usage per neighbourhood and household in a very transparent way. Based on these, and other, insights, an open data programme was launched in Amsterdam. The approach was a parallel start to both disclose more data and to show this via a catalogue (www.amsterdamopendata.nl), and to organize the use of it via competitions such as AppsforAmsterdam and Hackathons.

The next wave, happening right now, is that the data is getting bigger and the possibilities for the analytics are growing rapidly. Currently (due for completion at the beginning of 2014), a 'city dashboard' is being developed that gives dynamic information

Who owns the data?
A smart city is filled with data streams. Smart meters read how much energy people use; cameras follow cars on the highway; mobile operators can follow their users constantly; and banks know exactly who buys what, where and when. There are more and more discussions about who owns the data and who has access to it.

Within the Amsterdam Smart City programme we strongly believe that the data is, in principle, owned by the person who generates it. Companies (and governments) should never share the data of a single or group of person(s) without explicit approval from the user. Users should also be able to get insight into the data that is being gathered wherever it is reasonably possible.

The issues around this topic need to be discussed further, and the role of the government/regulations will be very important. Together with our partners, we will keep joining these discussions, following the principle as stated above.

Cyber security
With ongoing digitalization, topics around cyber security are becoming more and more pertinent. With cities that are totally IP enabled and energy systems that rely on connectivity (as connectivity infrastructures rely on energy) it is more and more important to make sure systems are safe and resilient. Cyber security is relevant on a local level, but issues are global as well. Initiatives such as the European Network for Cyber Security and strong national focus on this topic are therefore key in ensuring that users experience the quality of service they expect and deserve.

on almost all the things that are currently relevant, but which also gives the opportunity to combine (real time) data and create new insights. In the design of this dashboard, open principles are key: the platform is open source and the source of the data transparent. This next wave of innovation also includes measurement by consumers: think of using smartphones as sensors (for example, as was done in the national ISPEX project) or the use of a Smart Citizen Kit, which has been developed by the FabLab in Barcelona and is already in use in Amsterdam as well.

3. Development of new city infrastructures
Having a city with smart infrastructures revolving around energy and connectivity provides a whole list of new opportunities. Once you realize that almost everything can be done as long there is energy and connectivity, you can start to think about IP-enabled infrastructures throughout the city – and about having several infrastructures link to one another. During the past few years, experiments with almost every infrastructure have been conducted by the City of Amsterdam or its partners: traffic installations, cameras, street lights, EV charging infrastructure, signage systems and so on. The new possibilities are tremendous: when you leave the house it could be switched to standby; streetlights could function as your alarm system; ambulances could be guided through traffic with ease. Or when you have a party, the lights in your house could turn red, and the safety camera stream the action immediately to your YouTube channel.

At this moment, it's time for the next wave: connecting the several networks that are already in place to create an architecture that makes it possible to operate the systems in a safe and smart manner. This seems to be something that needs to be developed in a broader context. Initiatives started by the European Commission and the City Protocol initiative are supported by Amsterdam Smart City, especially when it comes to standardization of technologies. But in the end, most solutions will be very localized and the most important thing is that the quality of services gets better and higher while the costs become lower.

Ensure infrastructures are open and state-of-the-art to enable the requested services and products
With new requirements from infrastructures (due to new demands and expected resilience), infrastructures need to be more modern and flexible. Throughout the 20th century, cities have focused on traditional infrastructures such as roads, metro/tram systems and buildings; energy and water have not often been under discussion, and data and connectivity meant nothing more than landline telephones and television. In the 21st century, cities still have departments for roads, housing and public transport, while water and energy infrastructure is managed by a regulated body. Investing in broadband connectivity, smart energy grids and creating proper data infrastructures is in most cities just a minor priority. But the development of energy infrastructures cannot be viewed independently of the digitalization of society.

We do not need to do much research to understand the importance of data. Imagine the difference between a one-hour traffic jam and an hour without internet or energy. In terms of the economy, the

impact of an hour without internet will absolutely have a greater impact (no financial transactions, trading, email, online support, online sales, etc.).

This is why there are several public-private partnerships in Amsterdam that focus on making the city resilient and future-proof. In the Amsterdam Smart City consortium they work together to enable innovation, both incremental and disruptive. The total investments in energy and connectivity infrastructure will exceed €1 billion within the next few years, but in an unusual way.
From an infrastructural perspective, Amsterdam Smart City is a collaboration between the grid operator, the fibre-to-the-home company, the City of Amsterdam, the water company and a district heating company. Visions on infrastructure are not viewed separately any more, but from a more integrated perspective.
This is why Amsterdam Smart City has organized three large scale test beds where the aforementioned parties are jointly upgrading infrastructures to on the one hand create a test bed for state-of-the-art products and services, but on the other to learn from each other and how to collaborate together more extensively.

On a practical level, this means that in Amsterdam there is not only a deployment of smart metres, fibre to the home, district heating, smart energy grids or G4/LTE, but also that there is a focus on the 'why' of doing this: nobody wants a technology push without users. So yes: our internet is amongst the fastest in the world; there are smart meters being deployed at this moment; there is a 50 Mb/s LTE network – but in the end, it is about quality of life, and that mostly relates to new products and services enabled by Smart City.

CONCLUSION
Amsterdam Smart City is not just about energy. Or health. Or data. Nor it is about infrastructures. The Amsterdam Smart City programme enables citizens to use the information that is available to make the choices they want to make. This means that implementation is sometimes a bit slower than with a top-down strategy; it also means that some lessons need to be learned. But it seems, based on what has been learned over the last few years, that the more than 100 partners that combine to make Amsterdam Smart City are fully committed to providing the products and services that consumers want, so they can, for example, not only know how much energy they use, but also take measures to reduce that number. MI

ABOUT THE AUTHOR
Ger Baron is Cluster Manager IT for the Amsterdam Economic Board. He is one of the founders of the Amsterdam Smart City program. Before this he worked for the Dutch Social Democratic Party and Accenture Consulting.

ABOUT THE INITIATIVE
Amsterdam Smart City is a platform where consumers, companies, knowledge institutions or governments can develop, test and launch new products and services. Amsterdam Smart City has supported over 40 initiatives within the last 4 years and works together with over 100 different organizations. Its founding partners are grid company Liander, Telco KPN, water company Waternet, the City of Amsterdam and the Amsterdam Economic Board.
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THE EERA JOINT PROGRAMME ON SMART CITIES

By Reinhard Schütz

Global warming and dwindling fossil fuel resources are forcing a radical energy policy rethink worldwide. This is manifesting itself in numerous political and research strategy measures aimed to combat climate change and secure energy supply at the European and global level. The European Commission, for example, has committed itself to cutting greenhouse gas emissions by 80% of 1990 levels by 2050 (European Energy Roadmap 2050) and initiated a Strategic Energy Technology Plan (SET Plan) to accelerate the development and deployment of cost efficient low carbon technologies.

One of the key instruments introduced to support achievement of the SET Plan priorities was the founding of the European Energy Research Alliance (EERA). This joint effort of leading European research institutes is designed to streamline and coordinate energy research activities and to pool expertise and infrastructure at the European level. Several EERA Joint Programmes have been launched, which constitute strategic, permanent collaborations between major European research organisations and act as virtual centres of excellence addressing the key topics of our energy future.

"The key aim of the Joint Programme is to develop new scientific methods, concepts and tools designed to support European cities in their transformation"

Cities play a significant role in this context, given the growing trend towards urbanization and the fact that cities already now account for almost two-thirds of global energy consumption. The EERA Joint Programme on Smart Cities was launched in November 2011 to provide scientific answers to these challenges. The scientific coordination and management of the Joint Programme, involving 64 research partners from 16 European countries, was entrusted to the Austrian Institute of Technology (AIT), which has successfully positioned itself as an expert in smart cities research at the European level.

The key aim of the Joint Programme is to develop new scientific methods, concepts and tools designed to support European cities in their transformation into energy efficient and sustainable smart cities. This is to be achieved by substantial increases in energy efficiency, the extensive integration of renewable energy sources and smart energy management at urban level based on an integrated, interdisciplinary and multi-technology approach. The clear long term research strategy of the Joint Programme is designed to secure the future leadership of European R&D in urban energy technologies and will enable European cities to act as role models for others to emulate.

KEY TOPICS FOR URBAN ENERGY SYSTEMS

The Joint Programme on Smart Cities is divided into four sub-programmes addressing the key topics of urban energy systems: energy in cities, energy-efficient interactive buildings, urban energy networks and urban city-related supply technologies.

Energy in cities

The sub-programme Energy in Cities takes an integrated approach to merge urban and energy planning and aims to provide a detailed understanding of the energy performance characteristics and energy flows in urban areas. The scientific tools to be developed will support cities throughout the transition process towards a low carbon energy system, from systems analysis, vision development and pathway exploration through to experimenting, assessment and implementation. A strong focus will also be placed on examining best practice examples of smart city visions, setting up a guideline for the implementation of the living lab concept, developing key performance indicators and methods of progress monitoring as well as investigating interactions with other sustainability aspects such as mobility, waste or water.

Urban energy networks

Smart cities also require smart energy grids, which are able to communicate with each other to balance thermal and electrical loads depending on supply and demand. Urban Energy Networks concentrates on the intelligent planning, design and operation of such grids. The integrated approach taken in this sub-programme includes the generation, storage and consumption of both power and heat in urban environments. The final aim is to optimize these interconnected networks, integrating all accessible sources of renewable energy and providing flexible balancing potentials using comprehensive sensor networks and sophisticated ICT solutions.

Energy-efficient interactive buildings

In today's cities, buildings account for around 40% of primary energy demand. The sub-programme Energy-efficient Interactive Buildings takes account of the fact that the buildings of tomorrow's smart cities will no longer be "stand alone objects" but will actively interact with their environment. They will make use of energy conservation measures and on-site renewables to reduce their energy demand, enable coordinated exchange of energy with thermal and electrical grids while providing a comfortable healthy indoor environment for their users.

Research in this sub-programme will range from novel design concepts and envelope solutions for resource-efficient buildings to the integration of renewable energy systems and innovative building-to-grid approaches through to issues of user interaction with a focus on how to link human factors and behaviour with energy data.

Urban city-related supply technologies

The development of smart integrated energy networks will require both new components and systems, as well as a better

understanding of how to integrate renewable sources of energy into urban infrastructure in an efficient and cost effective manner. Distributed energy technologies such as heat pumps, solar thermal, photovoltaics, energy storage units, etc. play a key role in this context. The sub-programme Urban City-related Supply Technologies addresses the efficient integration of these on-site renewable energy sources into buildings and grids. It aims to develop a methodology capable of dealing with complex integration of thermal and electrical energy technologies, and enabling the design and evaluation of renewable technologies integrated at district or city level.

In addition, a Taskforce on Simulation Platform Development has been established to deal with cross-cutting topics concerning the modelling and simulation of complex urban energy systems. The Taskforce aims to maximize synergies and complementarities between the individual sub-programmes and to coordinate the development of a new integrated comprehensive urban energy simulation platform to support stakeholder decision making.

The EERA Joint Programme on Smart Cities has got off to a good start. The first official review carried out by international experts in April 2013 provided a very positive feedback, attesting that the researchers, laboratories and capabilities are world-class and bring in a high level of expertise on energy system integration, especially in the areas of electrical and thermal systems. The Joint Programme plans to leverage this expertise by expanding its international activities beyond European borders. A major focus in this context is placed on entering into official dialogue with China, whose rapidly growing megacities are faced with enormous challenges in terms of energy supply and environmental problems. The Joint Programme is intended to act as a bridgehead for the European Commission, providing a platform to identify common thematic interests and priorities between the EU and China and trigger the initiation of joint flagship projects in the field of sustainable urban development. It is thus expected to act as a European "one-stop shop" enabling a well-coordinated framework for collaboration with China, but also with other key markets such as India or the US in the long term. MI

ABOUT THE AUTHOR
Dr. Reinhard Schütz is currently working as Business Developer for Smart Cities and Regions within the Energy Department at the Austrian Institute of Technology (AIT), with responsibility for strategic project development in Europe and Asia with regards to urban infrastructure. Following undergraduate studies at Graz University of Technology, he graduated with a PhD degree in Civil Engineering from Imperial College London.

www.eera-set.eu/index.php?index=30 / www.ait.ac.at

USING PROVEN NFC AND AUTHENTICATION TECHNOLOGIES TO SECURELY INTERCONNECT AND MANAGE SMART METERS

By Cristina Ardila

The management of energy resources has become a major global challenge. The increase in energy demand, the limited capacity to generate and transport electricity and the increasing cost of energy are all economic drivers to the deployment of smart grid networks that aim to balance today's energy demands. The traditional grid is transforming into a network of interconnected devices that are able to exchange metering data, dynamic pricing information or control commands in order to optimize the grid operations.

In particular, the smart meter is becoming a pivotal element in the 'Internet of Things' along with other consumer devices like smart phones, in-home energy displays, contactless prepaid cards, smart refrigerators and electrical vehicles. This 'interconnectivity' drives the need for a communication technology that allows devices to interact with each other directly and seamlessly. As well as providing this simple communication, a technology such as near field communication (NFC) is able to provide an additional interface for convenient device management and transactions.

Unfortunately, these additional features and connectivity increase the possible attack surface and make the smart meters vulnerable to new forms of manipulation which did not exist in traditional meters. Therefore upgrades should only be deployed together with strong authentication technologies, based on tamper resistant hardware-based security components.

NFC BRINGS ADDED VALUE TO METERING

Traditionally, NFC has been used for conventional secure payment activities, such as mobile payment and transportation, but now, as smart phones are more and more a part of our lives, new use cases have appeared. ABI Research estimates that the number of NFC-enabled devices in use will exceed 500 million in 2014 with 285 million shipped in 2013. In addition to payment options, NFC can be used in a variety of different ways in metering applications and systems.

Payment solution to reduce costs

Prepayment meters working with contactless cards such as MIFARE can be conveniently upgraded to NFC and work in parallel as well. MIFARE, a technology turning 20 next year, has revolutionized the efficiency of public transport and other applications but is also the support technology of contactless prepayment schemes in metering. With contactless cards, a bi-directional communication can be built up and key statistics can be transmitted to the utility at the next top-up of the card. NXP's comprehensive contactless reader portfolio (150 million sold to date) is best suited to support MIFARE cards and NFC devices and also supports established prepayment standards such as STS.

Increased flexibility and traceability in the supply chain

NFC makes it possible to track and ensure that the right parts are being used in the manufacturing process. It can be used to upload firmware at a very late stage in the supply chain thus improving planning efficiency and flexibility to adjust to regional or country specific requirements. NFC's fast data transfer rate also allows manufacturing data to be dynamically updated along the entire supply chain, leading to major improvements in the traceability and supply chain efficiencies compared to static technologies such as barcode.

Intuitive interaction for augmented user experience

NFC can significantly reduce the pairing time between meter and gateway at large buildings. In the long term, it can replace not only the infrared port but also the complete meter display, thus reducing the overall power consumption. The end-user can securely access the data in the meter which can be then displayed on the NFC device's screen.

Customized data access

NFC can also limit or grant access to certain operators in a customized way. Using a NFC-enabled device, the end customer can access to the smart meter and perform the consumption reading and send it to the utility. A third party company could manage the reading and communicate the data back to the utility and end customer via email.

After sales service and maintenance

The meter can communicate directly with the NFC device, letting it know maintenance due dates, send a service phone number, send maintenance registers or share usage tips. A software upload or firmware upgrade can be performed via NFC. Error logs can

Itron EM512 supporting MIFARE, NFC and STS standard

Itron EM512 side view

also be conveniently transferred to the utility company via phone even if the meter is offline. Consumption data (both actual and historical) can be displayed graphically on the displays of authorized smart phones or tablets.

NFC SOLUTIONS

Infrastructure solutions such as NXP's PN512 transceiver or NXP's NTAG I²C can be used in many industrial applications and ensure a robust link between the meter and the NFC device. They work at 13.56 MHz with all major contactless standards (ISO/IEC 14443A/ MIFARE, FeliCa and ISO/IEC 14443B) and are fully NFC forum compliant enabling maximum interoperability across all NFC devices in the market. Choosing the best device for the application will depend on a number of factors including passive or active solution requirements, data transfers requirements, data encryption requirements etc.

The NFC-enabled demonstrator is based on PN512's transceiver with the E350 module from Landis+Gyr

Security to protect sensitive data and critical infrastructures

A smart metering system is typically a nationwide critical infrastructure that must be properly protected against cyber-attacks, manipulations and privacy breaches. Ensuring that the network is secure is a huge step in gaining acceptance and trust from the various stakeholders (consumers, energy and service providers, governments).

Securing connected remote devices is a challenge!

One of the main issues to address is the long lifetime of these smart metering devices. Typically, meters and communication gateways will remain in the field for 20 years without any hardware upgrade possibility. Unfortunately recent exploits show that the level of sophistication of attacks is increasing with time, with hacking tools and knowledge to tamper with devices becoming increasingly accessible to a large number of people. Today it has already been demonstrated that (cryptographic) key extraction on embedded systems, even those as complex as smartphones, can be performed without any invasive techniques (meaning casing closed) by analyzing power consumption on the supply cables for example. Software upgradeability makes smart meters very flexible but also vulnerable to malware. Malware has the potential to transform any communication gateway or connected meter into another device type performing a functionality it is not intended to do, for example acting as a Trojan horse to compromise the whole communication network.

Security is essentially an implementation matter. Nowadays systems are no longer broken because they fail using the right communication link protection and cryptographic algorithms like AES encryption. They are compromised because the implementation of these cryptographic algorithms has weaknesses; because the integrity protection and/or secrecy of keys is weak; because security holes are constantly discovered in particular in SW communication stacks; because the HW platforms are easy to tamper with, fail to deliver the right access control to data, code and keys, or fail to deliver required performance like true random number generation, a key component in the foundation for secure systems.

Smart meters will be manufactured by different OEMs supplying the different utilities or infrastructure owners from a diversified and global supply chain, which raises the issue of compliance to minimum implementation quality standards (security insurance) and identification of device origin. Counterfeit devices look like genuine ones but are more prone to vulnerabilities and may also contain backdoors intentionally designed-in to penetrate the infrastructure remotely. In addition metering data will only get legal or trustworthy value if signed with well protected keys. Meters and gateways also play the role of gatekeeper to prevent exposure of valuable data about the consumer and therefore to protect his / her privacy.

Remote devices can't fully rely on back-end support for the security. Since the network could potentially be down for a certain period of time, devices should be able to take local decisions securely on their own, for example regarding prepaid/postpaid configuration or on/off switching. This means they need to have built-in tamper resistance.

Considering this threat landscape, it is essential to implement state-of-the-art security in smart meters out in the field ensuring infrastructure integrity, protection of revenues for utilities and secure access to consumer data.

Authentication with a strong protection of the cryptographic keys is a fundamental and common requirement to meet the above security needs. As a matter of fact, no software only solution has been proven secure. It is therefore important to isolate the keys and associated cryptographic processing from the (meter or gateway) application software, and to apply state-of-the-art tamper resistant techniques to guarantee their integrity and confidentiality when at rest (storage) or in use. This functionality is typically fulfilled by hardware security modules, like NXP's A-series security ICs.

The A-series builds upon NXP's long-time expertise in security technology, as well as its leading positions in the overall identification market, including eGovernment, banking, public transport and mobile transactions. It leverages the advanced IntegralSecurity™ architecture of NXP's SmartMX™ high security microcontrollers which have more than 100 security features to protect the cryptographic keys and computations. Particularly suited to smart grid and smart metering applications, NXP's A-series security ICs provide turnkey solutions with the flexibility needed to meet different key management schemes, smart meter late stage personalization, easy pairing and secure commissioning.

CONCLUSION

Ease of use and secure connectivity is essential for the success of smart metering rollouts. The integration of proven hardware secure modules as trust anchors in devices and the use of the widely deployed NFC technology lead to a practical and cost effective approach to ensure an effective and trusted integration of smart meters on a global scale. MI

ABOUT THE AUTHOR

Cristina Ardila is Senior Marketing Manager Infrastructure and specialist for different segments including eGovernment, access management and metering, among others. She holds an MBA from Instituto de Empresa/UniAndes and specialized in International Marketing and Innovation. She has lived in several countries and speaks fluently German, English, French, Spanish and Italian.

ABOUT THE COMPANY

NXP Semiconductors N.V. provides high performance mixed signal and standard product solutions that leverage its leading RF, analog, power management, interface, security and digital processing expertise. These innovations are used in a wide range of automotive, identification, wireless infrastructure, lighting, industrial, mobile, consumer and computing applications. A global semiconductor company with operations in more than 25 countries, NXP posted revenue of $4.36 billion in 2012.
www.nxp.com

POWER HUB: AN ADVANCED VIRTUAL POWER PLANT

HELPING DENMARK AND THE FAROE ISLANDS INTEGRATE WIND POWER

By Jonathan Spencer Jones

The virtual power plant (VPP) is not a new technology but one whose time has now come, with the moves worldwide to increase renewable energy generation and to smarten the transmission and distribution grids.

In concept the VPP is very simple, and basically comprises a central IT hub managing a cluster of distributed generation, storage and flexible consumption resources to deliver services to the various power markets, in much the same way as any traditional power plant and with the same reliability, but with a higher degree of flexibility.

The challenge is that the renewable sources, particularly wind, are very variable. For example with wind – the main renewable generation source currently in countries in Europe – the variations can be both on a minutes to hours scale as the winds shifts or a storm stops the wind turbines for a few hours, or it can be days or weeks, as periods of either windy or calm weather can last.

This VPP concept underlies the Power Hub, which has been developed by DONG Energy, a European energy group headquartered in Denmark, and is currently being demonstrated in Denmark and the Faroe Islands under the EU's Twenties initiative.

BACKGROUND TO POWER HUB

What is the background to Power Hub? Anders Birke, Lead IT Architect at DONG Energy, explains that Denmark is the country with the largest share of wind power – in 2012 wind power covered 30% of the Danish consumption – and consequently is particularly challenged by this. For example, wind power can reach 100% of the consumption and on occasion has even reached

Anders Birke

140-150% in the western part of Denmark, and the country needs to be able to manage this.

Currently the excess power is exported through strong interconnectors to neighbouring countries Germany, Sweden and Norway. Particularly in Sweden and Norway a lot of the capacity is hydropower, which can be switched off to absorb this excess. Thus, effectively Scandinavian hydro power is able to help balance the Danish power system, keeping the lights on for the 5 million Danes. But if larger countries like Germany or UK installed the same percentage of wind power as Denmark has today, the European power system would be far more challenged, as the hydro capacity would not be sufficient for balancing.

On windy days in Denmark the power price can drop to zero due to the excess wind power. Then one might expect the thermal power plants are closed down, but that is not the case, partly because they are delivering stabilizing services to the power system including inertia, reactive power, reserves, etc. This is a costly way to operate the system, as the power price is so low that it would not be able to cover even the fuel costs of the thermal power plants.

On top of this Denmark's policy is to almost double the current wind power capacity to 50% by 2020, so wind power will effectively become the base load of the system and the volatility will be greatly increased.

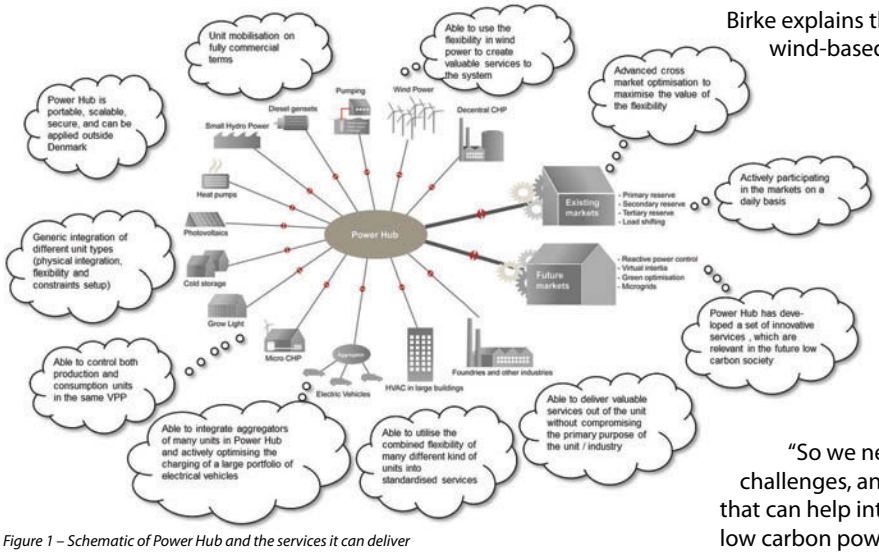


Figure 1 – Schematic of Power Hub and the services it can deliver

Birke explains the four primary challenges to balancing a future wind-based power system:

- Manage the surplus wind and be able to consume the excess power in a valuable way
- When there is no wind, to have some back-up capacity or be able to move part of the consumption to other hours
- Manage the extreme ramping needs, like when a storm stops a complete wind farm
- For the grid – congestion handling, as society becomes more electrified, and voltage control, as wind power can't deliver as much reactive power and nor can it easily be transported over long distances.

"So we needed to find new ways to manage these challenges, and we see the VPP as a way of delivering services that can help integrate large amounts of wind power in the future low carbon power system."

POWER HUB

Power Hub controls both small power producers like small hydro plants or gas turbines and flexible power consumption units from different industries. An example of the flexibility in power consumption is pumping water out of an area below sea-level, where it is normally possible to wait up to a few weeks with pumping the water. The flexibility is transformed into reliable services that can be used by the grid operator (TSO) to balance the power system.

The challenge with building a VPP is in understanding all the different industrial units in the system and their flexibilities. Power Hub is able to create valuable power system services from industrial units while still fulfilling the primary purpose of the industrial process. Power Hub is also able to optimize across the different markets and to evaluate whether the flexibility is most valuable today or tomorrow. The IT system has to be sufficiently powerful to analyze and optimize all the many different parameters.

Birke says that Power Hub, although small in scale, is notable for the number of different features and the number of different kinds of units that it is able to control. Power Hub was developed in-house in DONG Energy based on a Microsoft platform.

The IT system was inspired by an older system to optimize the company's fleet of combined heat and power (CHP) plants. The CHPs have different fuel costs, ramping capabilities and local heat needs among other characteristics. The system was optimizing the power market bids and the running schedule of the CHPs, so that the cheapest plant is always delivering the power while still fulfilling the local heat need. This optimization technology is reproduced in the VPP, adapting it to control smaller units of many types, representing both consumption and generation units.

Power Hub has now been operating, actively delivering services on a daily basis in the Danish market for about 2 years. In September 2011 it was involved in a frequency restoration event with a hydropower plant where it delivered primary reserve.

Power Hub has been used to demonstrate delivery of reactive power with a VPP, controlling an emergency gen-set. Power Hub has also been used to demonstrate how a VPP can optimize the load profiles of the Better Place electric vehicle (EV) fleet of a few hundred vehicles in Denmark.

TO THE FAROE ISLANDS

The latest project for Power Hub is to demonstrate the substitution of spinning reserve via very fast demand response with the utility SEV on the Faroe Islands – a group of 18 islands with a 50,000 strong population situated in the North Atlantic Ocean between Scotland, Norway and Iceland.

60% of the Faroese power supply was based on heavy fuel oil generation in 2012, with most of the remaining from hydropower and a small percentage from wind power. However, new wind turbines being installed will increase wind power to 25% of the islands' power production in 2014. The power system is a true island power system, with no interconnectors to other power systems, along with the operability challenges of a small power system and harsh weather conditions. Outages are common with very fast frequency drops, averaging around 30 per year, including one or more total blackouts, and the increased wind power will further challenge the security of supply on the islands.

"The Faroe Islands have some of the best wind resources in the world. An onshore wind turbine at the Faroe Islands produces twice as much power as one in Denmark, making it a cheap generation source (the wind power costs less than 1/3 of the costs to produce the same power based on heavy fuel oil) and as the wind capacity increases, so does the need for Power Hub."

Birke explains that since last November, Power Hub has been controlling three units in the fishing industry to offer fast frequency demand response to help stabilize the system. Together these units represents up to 10% of the islands' peak consumption (around 45 MW). The industrial units can be decoupled from the grid with a reaction time of less than one second. This is necessary because of the small size of the Faroese power system, which can go down within a few seconds, unlike in Europe where the rare blackouts happen more slowly.

The three industries, a salmon farm, a cold storage in a mountain cave and a factory freezing down fresh fish, all have units that can be without power for at least 15 minutes. The 15 minutes is more than sufficient for SEV to restabilize the power system. Losing power at other parts of the same industries does have a significant impact on their operation. All of the companies are pleased that they can help the Faroe Islands to get a more stable power supply.

Getting experience in operating the system, SEV is requesting a further expansion, with the incorporation of two emergency gen-sets, which with a reaction time of 20-30 seconds, will be able to deliver secondary reserve.

"Taking control of these units also has great value," notes Birke. "Then we anticipate some battery systems could also be added which would help absorb the wind volatility that exists throughout the day. They would have limited capacity but could give a large amount of power in a short period. In an emergency situation the batteries could supply the first 30 seconds until the gen-sets come online."

LOOKING AHEAD

DONG Energy hopes in the future with an appropriate partner to commercialize the Power Hub, perhaps as a cloud-based service that could be applied all over the world.

"The future transformation into a low carbon power system introduces a lot of new challenges for those responsible for delivering a stable power supply. For parts of the energy sector the transformation is a huge challenge, but some actors will be able to innovate and build new business models to deliver the needed services in new ways – they will see the future challenges as new business opportunities." concludes Birke. MI

Twenties participants involved in Power Hub include Energinet.DK, Fraunhofer IWES and the Spanish TSO Red Eléctrica.

INDIA'S ENERGY STORAGE MARKET

POTENTIAL GROWTH TO 15-20 GW BY 2020

By Dr. Rahul Walawalkar, Executive Director, India Energy Storage Alliance & VP, Emerging Technologies & Markets, Customized Energy Solutions

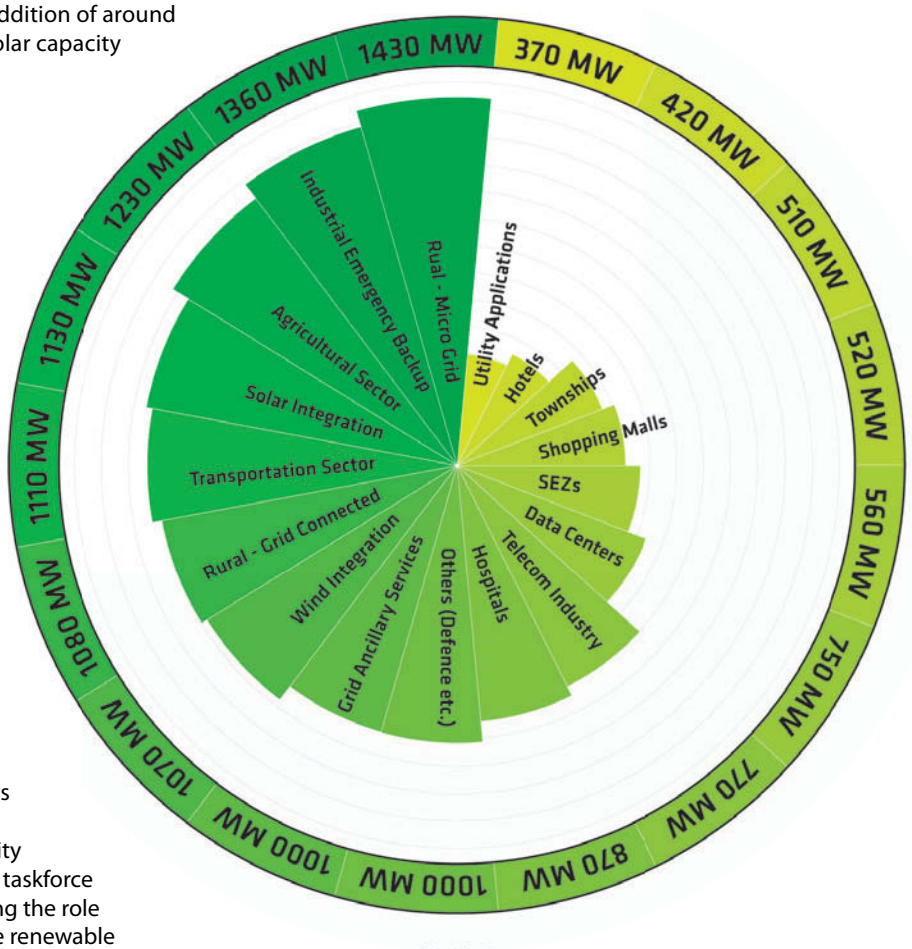
India is one of the fastest growing economies in the world, with current electricity generation capacity of around 200 GW to meet the needs of its over 1.2 billion population. India's per capita annual consumption of energy at an average 600 kWh is one of the lowest in the world, even when compared to developing countries like Brazil and China. Even after considerable growth in the power sector and the supply of electricity, many parts of the country continue to face severe power shortages as consumption has been increasing at a much faster rate than electricity supply.

Those who have access to power also suffer from shortages and poor quality of power. Consumers bear a large burden due to poor quality of the power supply. Industries maintain diesel powered generators and households have inverters with batteries as backup for unscheduled power cuts, low voltages or variable frequency. According to expert judgment, India needs to add at least 250-400 GW of new generation capacity within the next two decades to keep up with the demand growth. There is significant policy push for the adoption of renewable energy sources. These policies are expected to result in the addition of around 30 GW of new wind capacity and 20 GW of solar capacity by 2020.

DRIVERS FOR ENERGY STORAGE AND MICROGRIDS

Below is a summary of some of the drivers that could lead to the rapid adoption of energy storage and microgrid technologies in India:

- **Optimizing the supply and demand imbalance:** India's peak power shortages result in reliance on very expensive diesel power as backup for industries, commercial establishments as well as residential complexes. Although the average cost of grid electricity is low (below Rs5/kWh, i.e. about US$0.10/kWh), the operating cost of diesel generators could vary from Rs20-30/kWh (US$0.40-0.60/kWh).
- **Supporting the growth of intermittent renewable energy sources:** The Central Electricity Regulatory Authority (CERC) has mandated forecasting and scheduling of solar and wind farms, thus generating interest amongst the renewable developers on integration of storage technologies to manage financial risks. The Central Electricity Authority (CEA) has also created a national taskforce on renewable integration that is considering the role of energy storage for facilitating large scale renewable integration.
- **Introduction of ancillary service markets:** CERC is currently working on a policy framework to introduce ancillary markets in India with an initial focus on frequency regulation. Based on the supply-demand mismatch and the anticipated share of variable renewable resources in the supply mix, various experts at the Regional Load Dispatch Centres (system operators) anticipate that India needs to allocate 2-3% of the generation as frequency regulation resource to improve the grid frequency. Based on the current installed capacity of 212 GW, this could result in a frequency regulation market size of 4-5 GW to open up within next 12-18 months once CERC finalizes the regulations.
- **Transmission and distribution (T&D) upgrade deferral:** The Power Grid Corporation of India Ltd (PGCIL) has planned to invest Rs1,30,000 crores (US$26 billion) in the expansion of the transmission program for the next five to six years in India. According to the Green Corridors report developed by PGCIL, approximately 5 GW of energy storage and flexible capacity would be needed to manage the integration of the 30 GW wind anticipated by 2020.



Market opportunities in India for energy storage

- **Microgrid opportunities for special economic zones (SEZs):** Microgrid concepts by integrating various locally available distributed resources for ensuring power availability for the occupants are of interest to SEZs/townships that are drivers of economic growth in India.
- **Rural electrification:** Despite massive rural electrification plans, India has nearly 54,000 un-electrified villages. In most of the electrified villages not only are the connected households a fraction of the total but for many villages power is available for less than 8 hours per day. Off-grid power generation augmented by local renewable energy (wind, solar, bio, hydro) in a microgrid mode is therefore an attractive option to energize nearly 125,000 villages. India has set an ambitious goal of providing access to basic electricity to every household by 2017, which would require providing access to energy to almost 400 million additional people.
- **Energy efficiency improvement opportunities in large energy intensive industries:** The Bureau of Energy Efficiency has launched the Perform, Achieve and Trade (PAT) mechanism for improving efficiency of energy intensive industries. It can be feasible to integrate appropriate ESS technology along with other possible energy efficiency measures for the reduction in peak demand and specific energy consumption.
- **Telecom sector:** India has one of the largest telecom markets in the world with over 300,000 telecom towers, the majority of which need back up power using renewables. Also there is growing need for backup solutions for data centres in the India to replace diesel generators. Recently Reliance Jo has selected 3-4 vendors for supplying Li-ion batteries for new 4G telecom towers. This order (anticipated at $200 million) is expected to be the largest order for distributed energy storage technologies in recent times. Apart from this there are other telecom operators with over 600,000 existing telecom towers that are also evaluating similar solutions.

- **Electrifying the transportation sector:** The Indian government has allocated Rs20,000 crores (US$4 billion) over the next eight years to promote hybrid and pure electric vehicles, through research and development, infrastructure and subsidies under the National Electric Mobility Mission Plan (NEMMP) 2020 with a goal of adoption of 6 million hybrid (HEVs) and electric vehicles (EVs) across various customer segments.

These drivers have resulted in tremendous opportunities for the integration of energy storage technologies for a variety of applications. The advanced energy storage market in India is in its infancy; however it carries significant market potential. A recent market assessment by the India Energy Storage Alliance suggests

a potential of 15-20 GW by 2020 in India for various applications ranging from telecom tower backups to grid ancillary services and renewable integration. The chart provides an overview of the various market opportunities.

MOVING FORWARD

The India Energy Storage Alliance (IESA) was launched in 2012 by Customized Energy Solutions to promote energy storage and microgrid technologies and their applications in India. IESA does this by creating awareness among various stakeholders to make the Indian industry and power sector more competitive and efficient, and by promoting information exchange with the end users to assist with more informed decision making. IESA also provides insights to technology developers and system integrators on the policy landscape and business opportunities in India through frequent interaction with key stakeholders. IESA is proud to have key strategic alliances for bringing together the leaders of global trade organizations.

With response received from the storage industry across the globe, the IESA is quickly gaining a strong foothold across various stakeholders and technology providers. To further the growth of awareness about storage and the application of storage to solve electricity system problems, the IESA has also launched the Knowledge Partner Network (IESA KPN) for an open and transparent information exchange that will assist with decision making. The following figure lists current members of IESA-KPN.

IESA is hosting India's first international conference & exhibition dedicated to energy storage and microgrids in Mumbai from December 4–6. Energy Storage India (www.esiexpo.in) is poised to provide a first-class networking event to drive energy storage

market expansion in profitable applications – highlighting the synergies, inter-relationships and new business opportunities for transmission, distribution, customer-sited, microgrids/campuses and mobility (electric vehicle charging) applications. Metering International subscribers can get a special 10% discount for participating in the ESI expo by using the code "ESI2013MPPX". MI

ABOUT THE AUTHOR

Dr. Rahul Walawalkar leads the Emerging Technologies & Markets practice for Customized Energy Solutions. He currently serves on the Board of Directors of Electricity Storage Association and is also Executive Director for India Energy Storage Alliance. He holds a Ph.D. in Engineering and Public Policy from Carnegie Mellon University. He is chairperson of Maharashtra Electricity Regulatory Commission's working group on Integrating Renewable Energy Sources, Microgrids and Energy Storage and a member of the national taskforce for integration of renewable energy sources in the grid.

ABOUT THE COMPANY

Customized Energy Solutions is one of the fastest growing US energy consulting and services companies operating throughout the Unites States for the past 15 years. CES actively manages approximately 3,000 MW of generation and demand side response throughout the United States and India. Customized has also launched India's first demand response program for Tata Power in Mumbai in 2011.
www.indiaesa.info

THE PULSESPLUS BATTERY BY TADIRAN

20 YEARS OF SERVICE LIFE AND MORE

By Dr. Thomas Dittrich

The PulsesPlus battery series eliminates the voltage drop, increases pulse current capability and minimizes the impedance loss of the battery. With its very long service life, it is perfectly suited for smart metering applications.

The most expensive thing about a battery is having to replace it. The **PulsesPlus** battery by Tadiran puts an end to that. 20 years of continuous power supply to a display and GSM module where currents range from microamps to 2 Amps – that is the challenge.

THE PULSESPLUS BATTERY

The **PulsesPlus** series has been developed by Tadiran to expand the application range for lithium/thionyl-chloride (LTC) batteries. This is done by elimination of the voltage drop, increase of the pulse current capability and minimization of the battery's impedance loss.

The hybrid layer capacitor

For this purpose, a dedicated hybrid layer capacitor (HLC) was developed. A **PulsesPlus** battery is made up of one or several non-rechargeable LTC batteries connected in parallel to one or several HLCs. This HLC is rechargeable. Its electrodes contain lithium intercalation compounds and are spiral-coiled. The HLC has been optimized for self-discharge, temperature range and longevity. Additionally, the material properties of the electrodes have been chosen carefully and a glass-to-metal feed-through is used for sealing.

Performance

As a result, the **PulsesPlus** battery exceeds conventional lithium batteries such as the 3 V batteries of the $LiMnO_2$ system and even coiled LTC batteries: **PulsesPlus** batteries supply a higher voltage and capacity and offer an unparalleled operating duration.

Minimum self-discharge

The **PulsesPlus** battery is suitable for a mains independent power supply of 20 years as required for applications in GSM or radio modules. The reason for this is the stability of the LTC battery and the HLC regarding the sealing system and the internal resistance, and particularly the extremely low self-discharge.

No impedance loss

Figure 1 shows a D-cell being discharged with a continuous load of ~50 µA and short pulses of 150 mA. Adding an HLC makes it a **PulsesPlus** battery and the impedance loss causing severe voltage drop after only 5 years disappears.

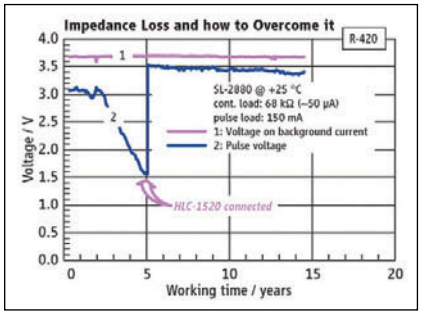


Figure 1

Application in GSM modules

Figure 2 shows the behaviour of a **PulsesPlus** under typical conditions of a GSM-communication module. For each temperature level, the upper curve shows the voltage under peak load and the lower one that under continuous load.

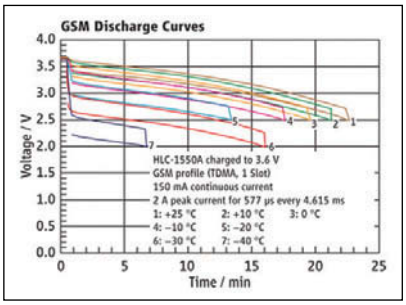


Figure 2

Predictable service life

Figure 3 shows the average current that a **PulsesPlus** battery can deliver in order to reach a certain service life. The typical battery life is between 5 and 10 years; even 20 to 30 years are possible, longer than the life of the powered device itself.

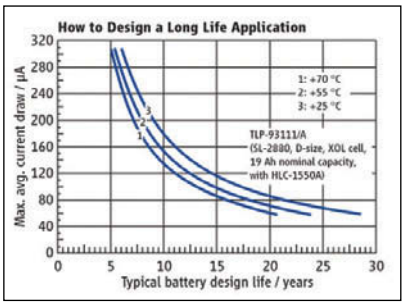


Figure 3

APPLICATION IN SMART METERING SYSTEMS

The **PulsesPlus** battery meets all requirements for a power supply for smart metering applications. This makes it perfect for use in this area. Early cooperation between the battery manufacturer and user, however, is recommended in any case to adjust the power supply to the specific circuit – if possible in the planning phase, while changes are still possible. MI

Overview: Benefits of PulsesPlus batteries

- High and stable voltage of 3.6 V (optionally 3.9 V)
- Higher capacity (up to 19 Ah per D-cell)
- Wide operating temperature range (–40 °C to +85 °C)
- High reliability (hermetically tight laser welding, glass-to-metal feed-through)
- Outstanding storage capacity (up to 10 years)
- Recognized safety (UL)
- Very low self-discharge (less than 2% per year)

ABOUT THE AUTHOR

Thomas Dittrich studied physics and physical chemistry at Bonn University in Germany. He joined Sonnenschein in 1980. As manager of Quality Assurance, he led Sonnenschein Lithium GmbH to ISO 9001 certification in 1993. Since 2002, he has been Manager of Applications Engineering. In 2006, Sonnenschein Lithium changed its name to Tadiran Batteries.

ABOUT THE COMPANY

Tadiran Batteries is a leader in the development of lithium batteries for industrial use. Its technology has been well established for more than 30 years. Tadiran Batteries are suitable where utility meters require a single long term stand alone power source, even if it has to supply high pulse currents for a GSM module.

www.tadiranbatteries.de

THE WIRELESS DATA TRANSCEIVER MODULE IN INTELLIGENT PROCESSING

By Jeffery Liu

The development of technology brings innovation and efficiency to our society, especially in the 21st century. Fast growth and wide application of communication technology, automation and IT are having a deep effect on lifestyle and industrial production, and bring both opportunities and challenges to smart production and smart living.

The increasing intelligence of the network environment is not only related to intelligent hardware design and installation in production and lifestyles, but is also summarized and improved as a new type of intelligent society management mode, and then it becomes an important part of social transformation. In other words a working model of collaborative distributed computers combining modern communication technology and computer technology. Fully taking advantage of "human intelligence" and "machine intelligence" is the basic structure and initial research purpose of advancing intelligence. In a working model of collaborative distributed computers, low power wireless data transceiver modules play an important bridging and urging role and enable the realization of increased intelligence.

WIRELESS DATA TRANSCEIVER MODULE

The wireless module mainly transmits a wireless signal such as infrared, ultrasonic wave or radio frequency signal to replace traditional data transmission by cable. The wireless module becomes the important R&D achievement and breakthrough in current technical innovation.

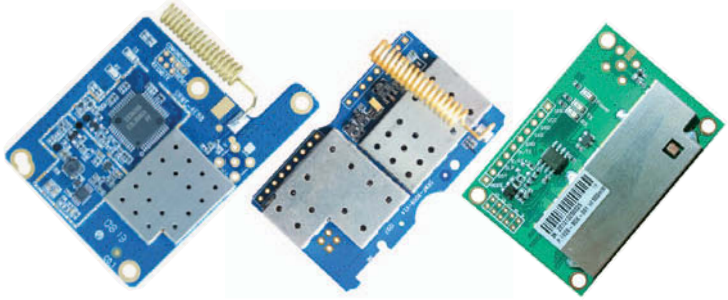
Wireless data transmission can be based on special data transmission systems or public network platforms such as CDPD, GSM or CDMA.

The wireless module has many advantages including:

1. Without a cable, it reduces the installation cost and the installation project schedule
2. It is easy to maintain with good adaptability and expandibility.

At the same time, wireless data transmission improves reliability and avoids effects from the environment.

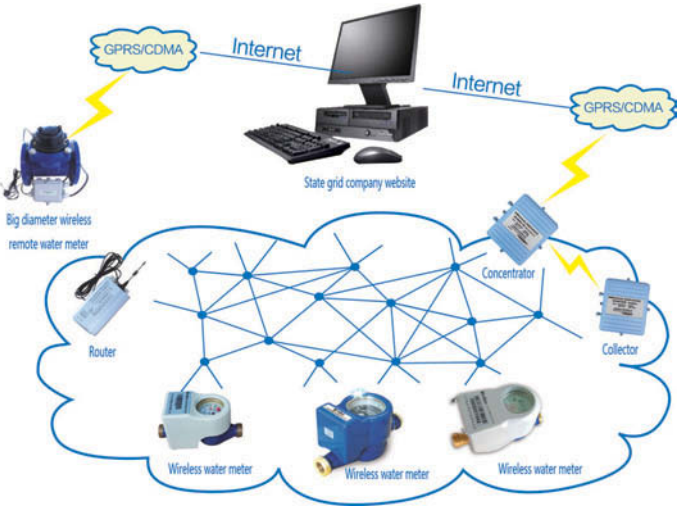
The micro-power wireless data transceiver module from Shanghai Sunray Technology Co., Ltd supports the function of low power and sleep mode. Sunray modules have high anti-interference and low bit error rate, and they are available with data transmission distances ranging from tens of metres to several thousand metres to meet customers' different requirements. The module interface and baud rate can meet the requirements of different products and furthermore, Sunray modules have good stability. With a Sunray module, the customer simply needs to set the parameters and the module automatically realizes their required operation – in turn realizing increased intelligence of work and lifestyle.



APPLICATION FIELDS

Benefiting from automatic wake-up, automatic frequency hopping and automatic routing, Sunray wireless modules are widely used in many fields, including:

- Water/gas/electricity/heat meter reading and billing systems
- Industrial remote control
- Data collection systems
- Data communication of railways, oil wells, wharves, etc.
- Medical and electronic equipment automation control
- Intelligent wireless lighting control
- Car anti-theft, tyre pressure monitoring and four-wheel positioning systems
- Wireless weighing scales
- Banking queue systems
- Wireless alarm and security systems
- Wireless smart POS systems
- Wireless dish ordering systems
- LED display screen of buoys or wild fields
- No-parking automatic charging system projects on highways.



ABOUT THE AUTHOR

Jeffery Liu is overseas sales director of Sunray. He has worked in communication and the semiconductor industry for over ten years serving overseas customers. He joined Sunray in 2010 and promotes Sunray modules to markets such as Europe and North America.

ABOUT THE COMPANY

Shanghai Sunray Technology Co., Ltd is the largest manufacturer of wireless data transceiver modules in China. Its modules support 433/470/868/915 Mhz and transmission power ranges from 10-500 mw to meet different customer applications, especially AMR. Some modules are CE and FCC certified and are widely sold around the world.

sunray_sale1@163.com / www.sunrayrf.com

Shanghai Sunray Technology Co., Ltd

SUNRAY

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Micro-power Wireless Communication Expert

Largest wireless RF module manufacturer in China

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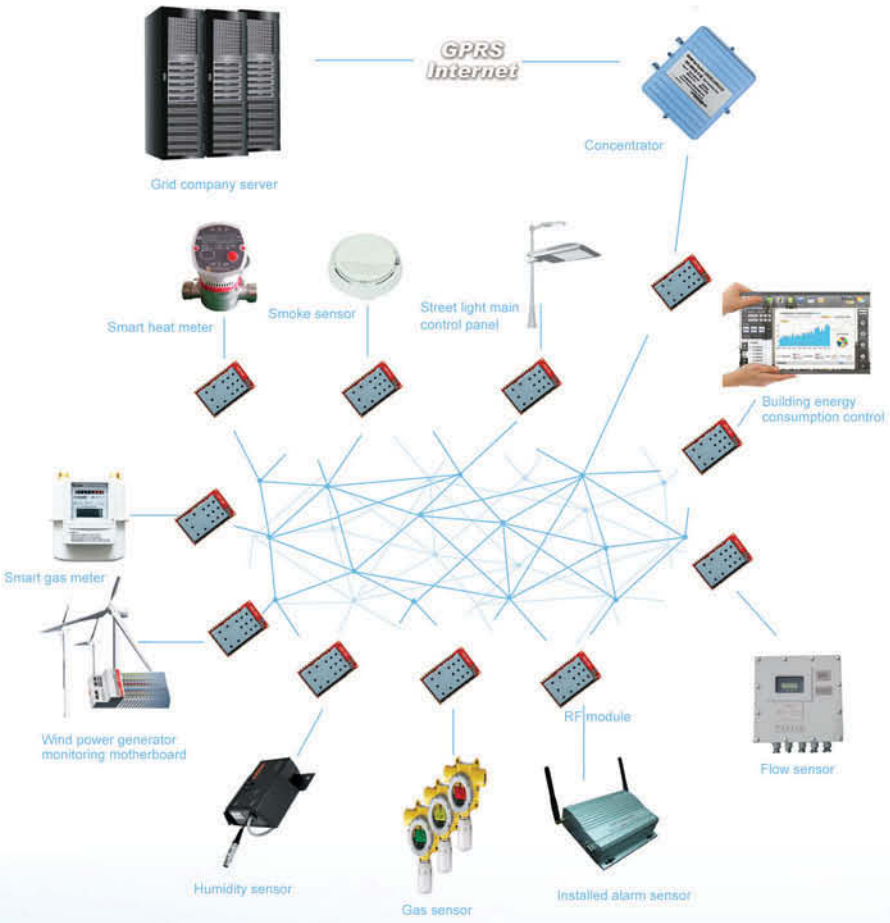
- Two million pieces deployment for water/gas meter
- Five million pieces deployment for electricity meter
- Over 100 type of products for your options
- CE certified
- Frequency: 433/470/868/915/other(adjustable)
- Power:0-500mW (adjustable)
- Interface: pulse / TTL / Uart / RS232 / RS485



SRWF-8009D for water meter

SRWF-8009A for gas meter

SRWF-7009 for gas meter

SRWF-4E88 for Single phase electricity meter

SRWF-4E18 for Three phase electricity meter

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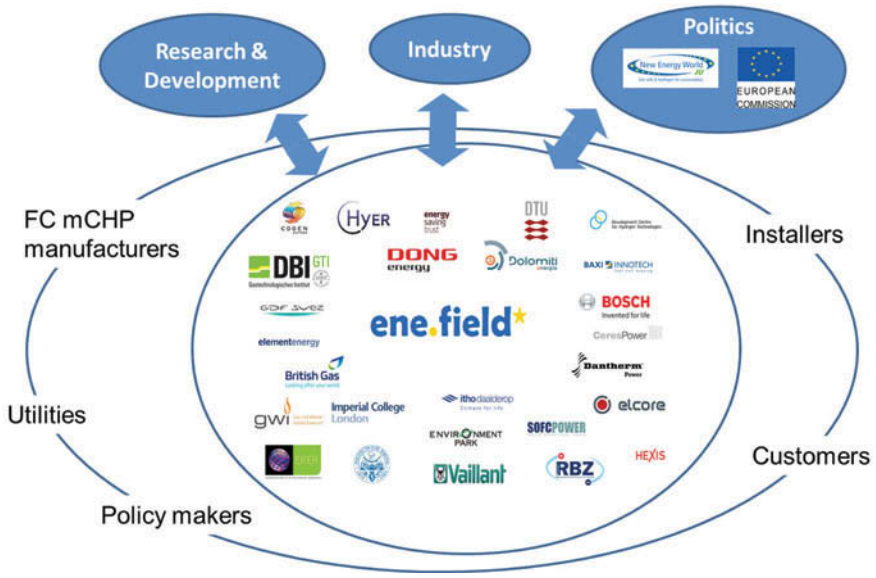
ENE.FIELD: DEMONSTRATING MICRO-CHP IN EUROPE

By Fiona Riddoch, Managing Director, COGEN Europe

The ene.field project is the largest European demonstration of the latest fuel cell-based smart energy solution for private homes. The project features micro-CHP, providing both heat and electricity in the home and will allow up to 1,000 households across Europe to experience the benefits of this new energy solution.



ene.field overview

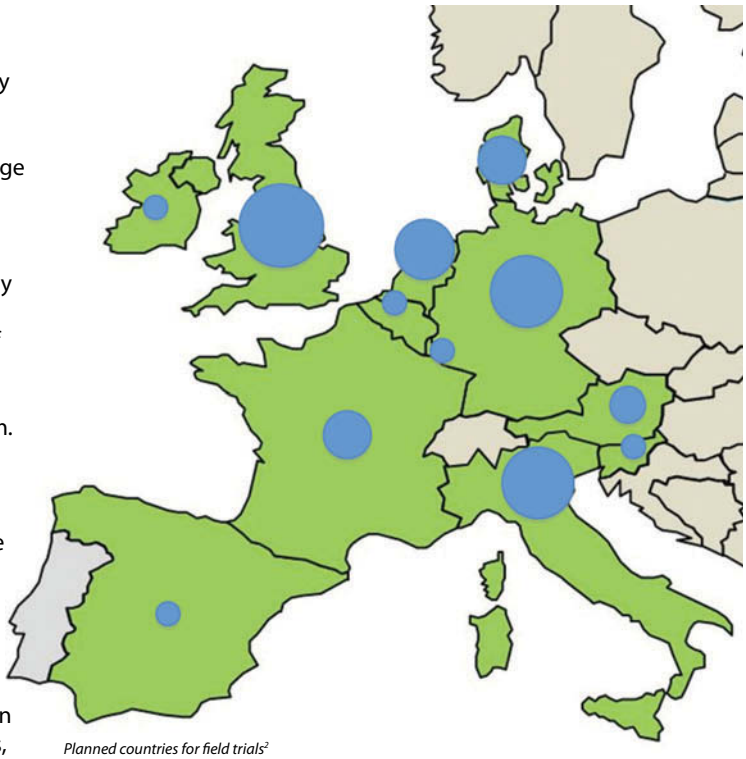
Micro-CHP is a home size version of integrated energy supply through combined heat and power (CHP) which until very recently was reserved for much larger installation in refineries, district heating networks, universities or food processing plants. CHP is a highly efficient way to use fuel which minimizes the energy wastage in the generation of electricity and heat. The key to its application is that the electricity must be generated locally to the site where the heat can be used. In homes the demand for electricity and heat broadly coincide as people wish to be comfortable when they eat, watch TV or use a computer. Large seasonal changes in heat demand mean that some balancing storage and export/import of electricity is needed periodically.

Ene.field is introducing the latest in fuel cell technology in its program. Fuel cells generate proportionally more electricity to heat than traditional CHP which is the trend of integrated energy consumption in the home. Fuel cells are now at the critical stage of first market penetration and European manufacturers face a significant challenge from Japanese suppliers who have a head start from a nationally led implementation program on a substantial scale. By comparison ene.field is modest, but the manufacturer and utility partners involved in the project have serious deployment plans for this technology.

Co-funded by the European Commission's Fuel Cells and Hydrogen Joint Undertaking[1] (FCH-JU), ene.field brings together 26 partners, among whom are the nine European manufacturers which will make the products available across 12 EU member states. At the moment Austria, Belgium, Denmark, France, Germany, Luxembourg, Ireland, Italy, The Netherlands, Slovenia, Spain and the United Kingdom are targeted.

Within ene.field 1,000 European households will become part of the new world of smart integrated energy supply, in some cases taking part as a supplier in the electricity network. Europe's new Energy Efficiency Directive[3] and the European legislation[4] around energy market liberalization is creating a framework to encourage new participants to join the energy market, particularly the electricity market. Some of these new participants will be households, probably working through third parties (aggregators) to pull resources and jointly create benefits of scale.

In the new smarter energy world a range of new services is required to maintain the traditional high level of availability of supply. Simple electricity supply will be augmented by services offering flexibility to better match supply and demand. Demand response, where the electricity user can decide to reduce



Planned countries for field trials[2]

1. The research leading to these results has received funding from the European Union`s Seventh Framework Programme (FP7/2007-2013) for the Fuel Cells and Hydrogen Joint Technology Initiative under grant agreement n 303462

2. These are the countries where units are currently expected to be installed. This may change as ene.field partners will also look to identify opportunities to deploy units in other European countries.
3. Energy Efficiency Directive 2012/27/EU
4. European Union Third Energy Package including Energising Europe IP/07/1361

demand at particular times in response to market signals is one such flexible service, or equally flexibility of supply to supply more electricity to the grid than foreseen for a period. Micro-CHP, which is controllable on-demand generation, has a strong role to play in this new world of services. The European rollout of smart meters[5] is one of the enabling factors in developing these new markets and there is currently significant activity around defining how these markets will develop and hence what the characteristics of the smart meters should be, to be effective. Correctly specifying the meter requirements will have a significant impact on how services in the new electricity network will develop and what role the citizens can ultimately play in that market.

The ene.field project runs for five years from 2012-2017. The project aims to create a framework for manufacturers of the new fuel cell micro-CHP products to better understand their customer needs and supply chain capabilities. The project will generate a body of data which in itself will help both project partners and the Joint Undertaking for fuel cells and hydrogen to assess the real environmental and energy benefits of these products and evaluate the market opportunity in action.

The project aims specifically to create real world learning through monitoring of an extended product demonstration effort. The project explores questions of market potential, segmentation, cost and environmental benefits of micro-CHP. It will provide an evidence base on the cost and environmental performance of all units from customer homes that can be used to accelerate learning on product design and specification. CHP is explicitly supported in EU legislation as one element, along with better building insulation and product efficiency standards, of the EU's push for higher energy efficiency in the economy. Ene.field will provide valuable information to guide future policy on micro-CHP and improve the industry's own understanding of the required harmonized codes and standards for a truly European market. By implementing the demonstration projects the industry as a whole can ready itself for wider deployment, building understanding and capacity in the supply chain and exploring the interaction of this new technology with the electricity network.

At the heart of the ene.field project is the customer. The integrated supply of heat and power at this domestic level is an altogether new concept which has considerable potential advantages for overall EU energy and climate objectives and represents a unique interaction between citizens and the energy market. Households have become familiar with solar panels on the roof, better building standards, geothermal heating supplies, and are better prepared than ever for the idea of generating both their own electricity and heat. This local generation is part of an overall more integrated approach to energy supply with controllable micro-CHP feeding locally and flexibly into an integrated concept of energy supply, and balancing intermittent renewables. It is a concept which has the potential to seize the popular imagination. MI

5. European Union Third Energy Package including Energising Europe IP/07/1361

ABOUT THE AUTHOR
Fiona Riddoch is the Managing Director of COGEN Europe, the European Association for cogeneration, since 2007. She has worked in a range of engineering and management roles involving sectors from consumer goods to building controls and components.

ABOUT THE ORGANIZATION
COGEN Europe is the European association for the promotion of cogeneration. We represent 70 organizations, including national COGEN associations, manufacturers, users, utilities and service companies. Currently around 100,000 Europeans are employed in the cogeneration sector.
www.cogeneurope.eu / www.enefield.eu

SOAKING UP THE SUN:
ADVANCED DMS AND WEATHER FORECASTING MAKE RENEWABLES MORE VIABLE

By Jeff Meyers, Smart Grid Strategy and Development, and Ron Sznaider, Vice President of Weather Services, Schneider Electric

Electric utilities are at a crossroads. New regulatory requirements and energy demands are placing an increased pressure on utilities to aggressively incorporate renewable sources into generation portfolios. A new law in California sets a target for 33% of energy to be sourced from renewables in less than seven years, and other states in the US, as well as governments around the globe, are following suit.

In light of these pressures, utilities are increasingly turning to distributed energy resources (DER), an up and coming source of power. DERs are becoming a key focus in the smart grid world today, aiding utilities in generating and distributing renewable energy without needing to spend hundreds of millions of dollars to build large scale centralized generation facilities and associated transmission systems.

However, renewable resources, specifically those operating at the medium and low voltage levels within a utility's distribution system, pose operating challenges for the smart grid that leave system operators and regulators alike wary of their dependability and practicality.

To safely and effectively integrate renewable DERs, utilities need new, advanced tools capable of managing the complex operating issues they present. This article will detail the challenges utilities face when integrating DERs and why advanced distribution management systems (ADMS) are the go-to tool chosen by utilities to manage these intricate challenges, specifically distribution at the low and medium voltage levels. It will also discuss the importance of combining ADMS with advanced weather forecasting technology in order to help utilities effectively manage energy demand.

THE RENEWABLE CHALLENGE: INTERMITTENCY AND THE LEGACY DISTRIBUTION GRID

DERs represent small scale power generation technology that typically supplies less than 10 MW at each location throughout the distribution network. DERs can be divided into two categories:

Active and passive. Active DERs include energy generation sources like wind, solar, combined heating and power (CHP) and micro-hydro energy. Passive DERs consist of storage technologies like batteries and compressed air or gas storage systems.

A common challenge for active DERs is the intermittency of renewable energy – people need power regardless of whether the sun is shining or the wind is blowing. Although intermittency is a characteristic of renewable generation plants of all sizes, it is particularly difficult for low and medium voltage systems to predict and manage DER installations. While passive DER technology in conjunction with active DERs can help solve some intermittency issues by storing excess generated energy, unfortunately, that technology has not yet gained broad adoption and is still undergoing development and commercialization.

Furthermore, the intermittency of renewables is additionally complicated by another primary challenge for local renewable integration: The legacy distribution grid.

The legacy infrastructure carrying energy to most of the world's customers was never designed for bidirectional energy feed. Distribution systems were designed to operate radially from one centralized source, distributing power in a single direction down the grid. To integrate DERs as a power source distribution systems need to both radiate power down from that same centralized source and manage power coming in from additional DER sources. This bidirectional system completely changes the philosophy of traditional distribution network operations, and especially the protective scheme of the distribution grid.

These two challenges can combine to cause operational and safety issues, particularly when DERs are clustered together in a concentrated area.

Here's a theoretical example of how a scenario could play out. Suppose there is a residential area that requires 5 MW of power at peak load and contains homes with solar panels capable of generating 2 MW. During normal operations with the sun shining, the solar panels supply 2 MW from solar DERs and the neighborhood draws the remaining 3 MW needed from the grid through local transformers to meet its full demand.

Now imagine it's a partly cloudy day. Suddenly, clouds pass over and cover the sun shining on each home's solar panels. The entire subdivision loses its local power generation source and needs to pull all its power from the distribution grid. The 2 MW of power that disappeared create a system imbalance, shifting the load demand by 40% in a matter of seconds. The distribution system needs to restore that 2 MW to rebalance itself, and needs to do it quickly in order to prevent sagging voltage and potential loss of service.

A few hours later, the clouds go away and the solar panels again start generating 2 MW of power. Now 7 MW of power is flowing into a system that can only consume 5 MW, creating a system

oversupply. The result is higher voltage seen at each home. Both overloads and high voltage conditions are dangerous to the system's assets. Because the system has to adjust quickly to major fluctuations in voltage and power, severe stability problems are possible. In addition, the protective scheme designed for one-way radial flow could fail to protect both equipment and personnel when DERs connected to the system result in looped or bi-directional feeds.

Despite these challenges, integrating renewable DERs can be plausible and safe, but only in conjunction with advanced technology that controls when and how much load will be transferred throughout the distribution grid. An advanced distribution management system (ADMS) is one such technology option.

An ADMS provides a host of analytical tools that recommend the most optimal system operations, or even control automated device operations. This maximizes a utility's network efficiently and reliably while mitigating the risk of renewable energy resources. An ADMS supports DER management as well as overall grid operations optimization and planning, with a real time network model.

WHAT IS THE "ADVANCED" IN ADMS?

Operating the modern grid requires a brain with the capacity and functionality to digest and analyze volumes of data at both scope and scale beyond the current state of the basic DMS. With thousands or even millions more data points in the network, along with the need to integrate a variety of DERs, requirements to automate switching, and bringing OMS functions into a seamless user experience, existing DMS technology falls far short. That is where ADMS comes in.

Just what makes a DMS advanced? In the often-hyped environment of the smart grid, the term 'advanced' gets thrown around plenty, but in the world of operational grid control an ADMS has some very specific characteristics:

- Convergence of SCADA, DMS, and OMS functionality – in addition to real time network analysis, an ADMS allows the user to operate all SCADA monitoring and control functions, as well as provides complete OMS functionality for managing outages and dispatching crews. The right user experience is critical; ADMS presents an integrated flow of information in a single, straightforward user experience, simplifying the operations and analysis of the distribution grid for the operator.
- Scale of data management and analysis – to manage the smarter grid, an ADMS must account for hundreds of thousands, or even millions of real time data points. Accounting for a variety of new devices and end-point types, ADMS must be able to adapt as new kinds of distribution and customer devices come on line, sometimes in vast quantities.
- Scope of feature function – an ADMS must be able to provide functions that drive critical business value for the smarter grid. It effectively does this with features such as closed loop control in a self-optimizing and/or self-healing manner, and the ability to analyze, execute commands, and then re-analyze the network to determine impact. Optimizing volts/VARs to increase efficiency and reduce peak load, enabling distributed generation and other forms of DERs, supporting demand response analysis and execution, and enabling a faster distribution switching process through automation are a few of the many important groups of functions that support smart grid processes and value.

Each of these three key capabilities adds value to make an ADMS the chosen operating platform for integrating DERs. The real

time network model supports operations management, network optimization and comprehensive planning to ensure the ability to add DER devices while minimizing losses and maximizing reliability and safety.

An ADMS provides an accurate, near-real time model of the current distribution network state, including DERs. This allows utilities to determine if operating problems like high/low voltages, excessive and reverse active and reactive power flows, and system harmonics are caused by DERs verses normal loading conditions. Utilities can then take steps to mitigate impacts before customers or equipment are affected. Where DERs are controllable, for example through energy storage systems or CHPs, an ADMS allows utilities to analyze, operate and control DERs to solve power flow and voltage problems.

Planning tools within an ADMS allow utilities to model DER sources before they are deployed, to prepare for and avoid problems caused by DERs. Planning tools can also allow utilities to select the optimal location for connecting large DER resources to the network.

With an ADMS, utilities can rapidly and safely solve the numerous advanced equations that are crucial to determine how much power is needed so that it is available at all times. By calculating the amount of distributed generation that is powering different loads at different locations, including the current voltage and power flow in the system, an ADMS presents a clear, real time picture of the grid. Utilities can safely perform monitoring, control and analysis of their distribution networks. However, the ability to accurately predict renewable generation is realized via ADMS integration to advanced weather forecasting systems.

HELPING TO SOLVE INTERMITTENCY THROUGH WEATHER FORECASTING

While an ADMS helps in the real time management of renewable DERs, utilities still need to be able to effectively plan on reliable generation and load. Advanced weather integration yields more accurate network load forecasts, equipment operating capacity determination, and forecasted contribution of renewables, based on integrated weather feeds, essential for effective renewables integration.

As a utility integrates DERs it first needs to determine the DER generation contribution. This is not an easy task since renewable energy sources are intermittent and vary in generation capacity based on the weather. If a utility is able to predict when intermittency will occur and prepare for the resulting changes to maintain grid stability as shifting clouds and varying winds cause variable solar and wind generation power production, it will be well positioned to accurately rely on renewable sources.

Let's revisit our residential neighbourhood with the solar panels. In order for the utility to not only rely on, but actually plan for, the use of the solar generated energy, it must be aware of the differences in generation contribution from the solar panels throughout the span of the day. This allows utilities to place a greater emphasis on solar power when the sun is shining and seamlessly transition to other sources when the clouds roll in. Advanced weather forecasting technology gives the utility the ability to calculate and predict the contribution of renewable generation, allowing the grid to be scaled back or scaled up if operators know the solar panels will not be generating enough energy or excess energy at a given time.

Both solar and wind power forecasts help utilities anticipate the variations in generation. Highly specialized weather forecasts predict the power output from solar arrays and wind turbines. Solar power forecasts predict the direct or indirect solar irradiance and the resulting power generated by the solar panels at a given time. Wind power forecasts predict the power generated by the forecasted wind speed, direction and more at a given location throughout the day at different heights above the ground. Both forecasts help a utility to understand how much energy it will generate from these renewable sources at each point in time.

With solar, imagery from satellites is used to track cloud movement and predict the resulting irradiance a few hours ahead. Machine learning techniques that include both statistical and artificial intelligence methods are also used to enhance the power forecast accuracy beyond what is provided by traditional weather modelling alone. Ground-based weather stations, including sensors measuring the levels of actual solar radiation, can be used to provide accurate current conditions and help "tune" and optimize the forecasts. The load or demand is also predicted, using historical information, accurate weather forecasts and artificial intelligence methods. This enables one to predict the balance between load and DER generation. Predictive weather intelligence allows an ADMS to anticipate weather conditions and proactively adjust the network, creating new levels of efficiency and network reliability.

A FUTURE OF RENEWABLE ENERGY RELIANCE

Utilities are experiencing a greater requirement to incorporate renewable energy sources. DERs provide localized, increasingly cost efficient power while cutting carbon emissions via renewables. DERs will only become more prevalent due to regulatory drivers and customer demand, but high penetration rates can pose stability and operating issues for the grid.

An ADMS helps to solve the problem of integrating renewable resources through analytical tools that provide planning for and recommend optimal device operations to maximize network efficiency and reliability, mitigating the risk of renewable energy resources. ADMS and weather system integration allows accurate prediction of the contribution of renewables, allowing utilities to optimize DERs and provide power reliably and safely. Overall, ADMS technology enables DER integration while minimizing the negative operational impacts, making distributed renewable energy more viable and ensuring a brighter future for all. MI

ABOUT THE AUTHORS

Jeff Meyers is a second generation electrical engineer, and former president of Telvent Miner & Miner. In his 30-year utility career, he has designed electric substations and transmission lines, and developed system planning and protection studies. Most recently, he has been helping Schneider Electric users understand the smart grid and how the use of integrated technology can bring energy efficiencies to the industry.

Ron Sznaider is the executive vice president and general manager of Schneider Electric Weather, where he leads the company's global software as a service (SaaS) offerings designed to mitigate weather risk, increase efficiencies, and improve safety. He has more than 30 years of professional industry experience. Education background includes University of Wisconsin-Madison and Naval Postgraduate School in California in atmospheric sciences, and the University of St. Thomas Graduate School in Minnesota in computer sciences.

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Gateway (DOT)

The GSM/GPRS Gateway is a data gateway that provides remote access to data stored in smart energy Meters. It communicates with Meter(s) through RS485, RS232 or Euridis. The data can be acquired remotely via GSM/GPRS Network. In addition to data storage, the Transparent Mode feature provides live access to Meter on demand. Easy integration with AMR Systems makes the Gateway an ideal solution for utilities upgrading to the next generation of Metering Infrastructures.

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UTILITIES SHOULD EVALUATE THE REAL TIME DATA PLATFORM FOR UTILITIES

By Markus Bechmann

There are lots of global trends in the utilities industry challenging current business models and operational capabilities of utilities companies. Decentralized generation, renewable energy, prosumers, virtual power plants, demand side integration, etc. – the number of new requirements for business processes and IT systems seems to be endless. To deal with these challenges utilities should start to consolidate all relevant data and applications on a solid and modern IT platform which we call the "Real Time Data Platform for Utilities".

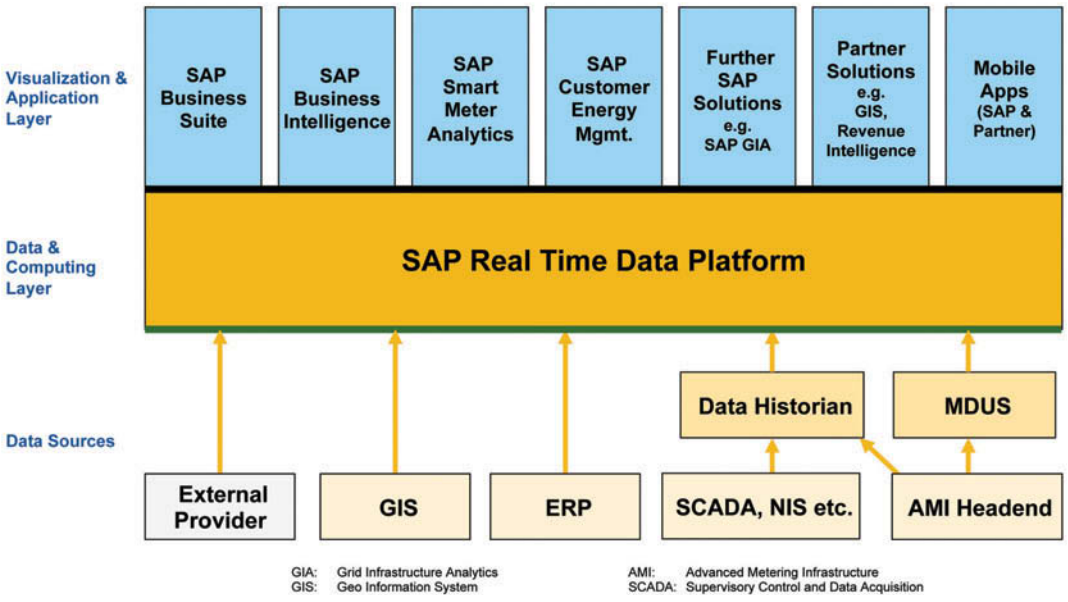
REQUIREMENTS FOR A REAL TIME DATA PLATFORM FOR UTILITIES

In order to enable new business models and optimized business processes the real time data platform needs to fulfill several key requirements:

- **Combine data from various sources:** Generally, we need to combine data from various data sources to generate value for a business scenario. For demand response management for example, we need asset data, consumption data, geographical data, generation data, weather data, etc. Usually, the data is split over several internal and external information systems that are not integrated.
- **Handle big data:** The amount of relevant data is virtually "exploding". The installation of one smart meter with 15-minute interval data compared to a classic Ferraris meter with one meter read per year multiplies the amount of data 35,000-fold. This happens for millions of meters and some utilities are already thinking about new services based on one-minute intervals! If we are going to reflect the physical energy flows in the transportation and distribution networks in IT systems it is really justified to speak about the "internet of energy" as many authors already do.
- **Support (near) real time processes:** The third requirement for the platform is to enable processing of (near) real time data and event streams as required by the business scenarios. For billing and tariff design real time processing is not necessary whereas for balancing supply and demand, e.g. in a demand side management scenario, real time processing is required. Other scenarios like sending out the workforce after a local black-out in the distribution system requires very fast reaction which can be referred to as "near" real time.
- **Manage integration:** Combining data from various sources has one general problem: Data comes in different formats and is often not consistent. The platform must provide a general data model to enable mapping of the different sources and combining redundant data. Having each data element only once in the platform is the ultimate goal and vision of the platform. However, due to historic development of data sources and possible slightly different data structures for different business scenarios some redundancy of data will probably stay in every platform. This redundancy needs to be properly managed to keep the data consistent.
- **Hide complexity:** The ultimate objective of the platform is to enable utilities to quickly respond to new market requirements. In order to do so, utilities and specialized independent software vendors need to be able to quickly create new applications and change existing ones. The speed and flexibility of application development can be increased by providing a solid infrastructure which gives easy access to the necessary data and functions. The complexity where the data is stored and how it needs to be accessed can be hidden by the platform if one consistent data model is provided. Basic functions like time series handling should be directly implemented in the platform so that applications can directly use them.

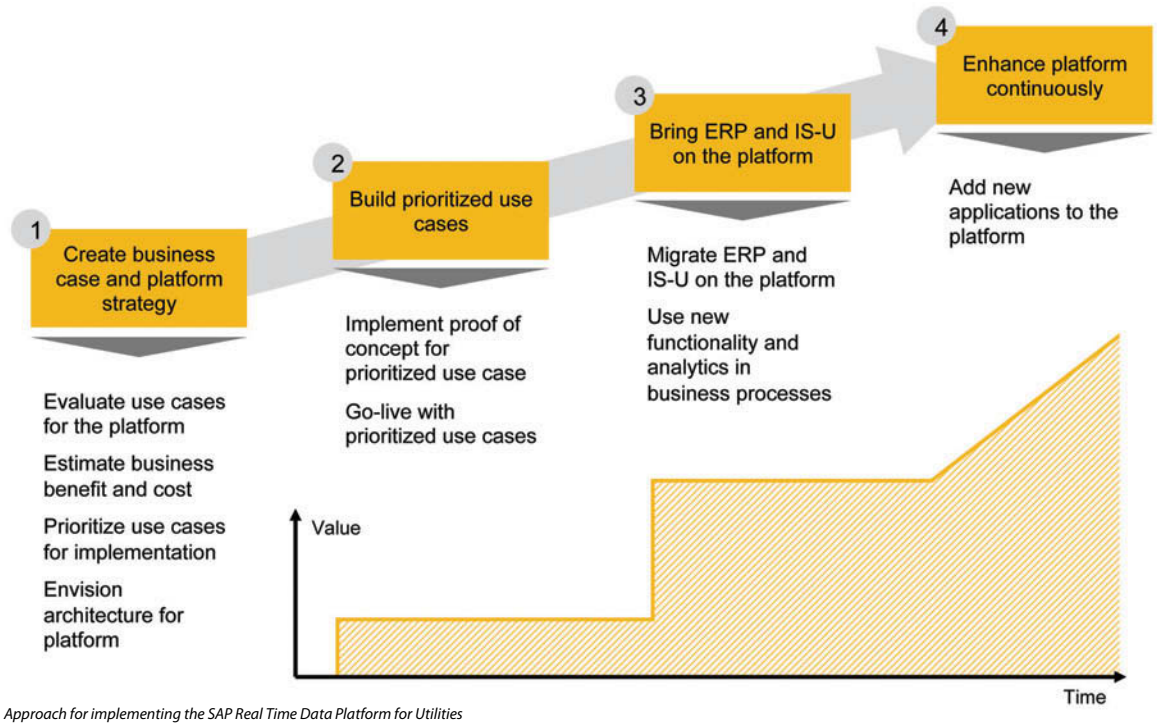
ARCHITECTURE OF THE SAP REAL TIME DATA PLATFORM FOR UTILITIES

As the market leader in the utilities industry, SAP is enhancing its solution portfolio to address the above mentioned requirements and provide the Real Time Data Platform for Utilities.



High level structure of the SAP Real Time Data Platform for Utilities

The SAP Real Time Data Platform for Utilities is organized in three layers. The Data & Computing layer in the middle can be designated as the engine of the platform. It provides the database components HANA and Sybase which are enriched by utilities specific data models and functions and connects to the data sources like SCADA data, metering data or geographical information. On top of the Data & Computing layer sits the Visualization & Application layer. This layer hosts new SAP solutions like SAP Smart Meter Analytics and SAP Customer Energy Management which provide specific functionality to analyze interval metering data and provide insight into consumption data and energy services to end customers. Central components in this layer are also the existing SAP solutions Business Suite and Business Warehouse, which are already available on HANA, and IS-U which is planned to be available on HANA in the fourth quarter of 2013.



Approach for implementing the SAP Real Time Data Platform for Utilities

The platform is also open for third party applications and customer specific developments. As an example, Choice, a Brazilian software company, brought its application for revenue intelligence on the SAP platform. The application looks for consumption patterns indicating energy theft using various data sources like consumption data, weather data, socio-economic data and property records. The needed time for pattern detection for 4 million customers with 5 years of data could be cut down by the factor 1,000 reducing it from one hour and nineteen minutes to just 4 seconds. With this acceleration, it is possible to run analyses which are more detailed and take more factors into account and are therefore more accurate.

Another example of performance improvement is the acceleration of the settlement process at a European network operator. The runtime of market settlement for interval and classical meters could be reduced from nearly four hours to two minutes. Given the fierce time constraints for settlement processes this also enables more optimized settlement runs and helps to stay compliant with market regulations.

IMPLEMENTATION OF THE SAP REAL TIME DATA PLATFORM FOR UTILITIES

In order to develop an implementation strategy for the SAP Real Time Data Platform for Utilities, we need to have several requirements in mind.

First, the platform must leverage the installed SAP customer base. Utilities using SAP for Utilities solutions need to be able to continue to do so and integrate them into the new platform. Second, SAP's groundbreaking innovations like the in-memory database SAP HANA need to be leveraged to fulfill the above mentioned requirements. And finally, utilities need to be able to split the implementation of the platform into several steps providing value from the first step on. Therefore, an individual roadmap needs to be set up to guide the way to the envisioned platform.

Four fundamental steps need to be taken to implement the Real Time Data Platform. Step 1 is the creation of the business case and platform strategy. The platform can provide value to all areas in the utilities value chain reaching from asset management for power plants and grids to customer management for retailers. Utilities can evaluate the possible use cases in workshops together with SAP. Depending on the business priorities and existing IT landscape, the future architecture for the platform can be envisioned. This vision will then serve as a guideline for each future implementation step to make sure that they are in line with the platform strategy. In step 2 the prioritized use cases will be implemented. This helps to derive value from the platform from the very beginning. To leverage the existing SAP solutions the SAP for Utilities suite should be transferred to the platform as well. This third step will enable additional value from Suite on HANA and the integration to other applications on the platform. Finally, additional applications, data and functionality can be added to continuously enhance the platform.

The Real Time Data Platform for Utilities is designed to cover the above mentioned requirements and will be SAP's next generation utilities platform. It can be flexibly deployed to derive value from the very beginning and leverages the installed base of SAP solutions. In order to be well prepared for the current and upcoming challenges in the utilities industry, utilities should start now to develop the platform strategy and evaluate the potential business value. MI

ABOUT THE AUTHOR:
Markus Bechmann is Chief Strategist for Energy Management Solutions at SAP AG. With over 15 years of relevant consulting experience with leading strategic consulting firms, he combines strategic management expertise in the utilities industry with extensive know-how in operational implementation. Through several publications and work in various research projects he is a recognised expert on future-oriented topics such as "smart energy".

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THE SHAPE OF THINGS TO COME

A VISION AND ROADMAP FOR THE GRID OF 2050

By Georges Simard, IEEE PES Grid Vision 2050 editor-in-chief, and President, SIMARD SG

In the year 2050, the centralized grid we know today is likely to be closer to an interactive fabric woven of many elements. The ubiquity of distributed generation and distributed intelligence, in tandem with advances in computing, data networks, sensors and controls, power electronics and energy storage, is likely to transform the grid as we know it.

Some drivers are already apparent. The world's population is projected to grow by one-third, to 9.6 billion. Climate change could increase ambient global temperatures by 2° to 6°C, depending on what actions we take. Fossil fuels will give way to renewable energy sources. Demand for electricity could nearly double over 2009 levels as electrons, the most efficient conveyor of energy, become more essential in an increasingly digital world.

The grid of 2050 is likely to accommodate very high penetrations of renewable energy – perhaps as high as 50 to 100% – and be much less reliant on fossil fuel generation. The line between transmission and distribution systems will be blurred by distributed intelligence. "End users" will have become "prosumers," who both produce and consume power and, perhaps, participate in transactive energy markets via automation. Unexpected developments – variables inherent in any futuristic scenario – may skew this picture one way or another.

Sound familiar? Many of these elements and their place in our future have become conventional wisdom in some sense. But the IEEE put five teams together to cover five major technology areas of smart grid to piece together the most plausible future scenarios based on data, tangible trends and professional judgment.

Of course, no brief generalizations can capture the future grid in all its permutations. Its resources and strengths may be regional in nature. In developed countries and cities where legacy grids are likely to be upgraded incrementally, prior infrastructure investments will guide progress. In vast swaths of the world, where current residents have little or no access to electricity, the future is likely to look quite different. The latest, standalone energy systems will dot the land, creating technological oases that provide enough power for lights, sanitation, food production, education and, of course, access to news of the outside world, computing power, the Internet and applications in the cloud.

The transformative effects of these changes on the societies they impact may alter the course of global culture, commerce and competitiveness. Powerful variables such as policy could accelerate, slow or change the mix of these technology implementations. Conversely, advancements in technology might well shape policy. Acknowledging the variables and uncertainties is part of the exercise.

It is incumbent upon those of us with a role in meeting society's fundamental needs to chart a rational course to meet the known and unknown challenges of the future, despite the vagaries of the task.

To do so, the IEEE Standards Association (IEEE-SA) and five of IEEE's technical societies considered the past, assessed the present and – employing use cases, application scenarios and known technologies – created iterations of the future in increments of decades. One result: a multi-layered resource that charts the development of technology and standards for each society across the decades reaching to 2050.

The IEEE-SA engaged the IEEE's Power & Energy Society, Computer Society, Communications Society, Control Systems Society and Intelligent Transportation Society. For these five teams experts were selected in their respective fields who have also exhibited visionary traits. We recognized the need for these formerly disparate fields to work together in an integrated manner to meet the increasing need for a cross-disciplinary approach to innovation. The integration of these fields underscored that the challenge ahead is as much a human and social challenge as it is technical.

Stakeholders will find abundant insights that may well influence their R&D investments, product development cycles and market expectations.

This article will focus on the expected impacts, both for the IEEE's processes as well as for power industry stakeholders, including those who drive the investments that will make the future a reality for the power grid of 2050.

THE FUTURE: HOW DISTANT?

Forecasting how the power grid will look in distant 2050 might seem a quixotic quest. While many power utilities typically develop 3-5 year plans for the challenges before them – and resource planning might even dare a 15-year horizon – the development of related technology and standards takes place on a much longer timeframe. The task of forecasting technological progress across multiple decades should be daunting.

But wait. How distant is 2050, really? One way to consider that question is to note that traditional utility investments in the 20th century typically spanned about 40 years – a little longer than our time machine needs to travel. So that murky future is really only one full generation of "big iron" away.

Of course, we need to qualify that once monolithic generation of useful life for "big iron" by noting that the shift from electromechanical devices to digital and power electronics driven sensors and controls will lead us to a more rapidly changing world of software, computing and data. The timeframes for research and development and product lifecycles in the fields of computing, software, data networks and analytics are generally projected to shorten. The rapidly evolving nature of computing and communications technology, applied to power infrastructure, will indeed introduce new, radically shorter lifecycles to the once tradition bound grid.

Certainly the juxtaposition of traditional infrastructure lifecycles with the increasingly rapid evolution in computing and related fields only underscores the vagaries of creating useful future

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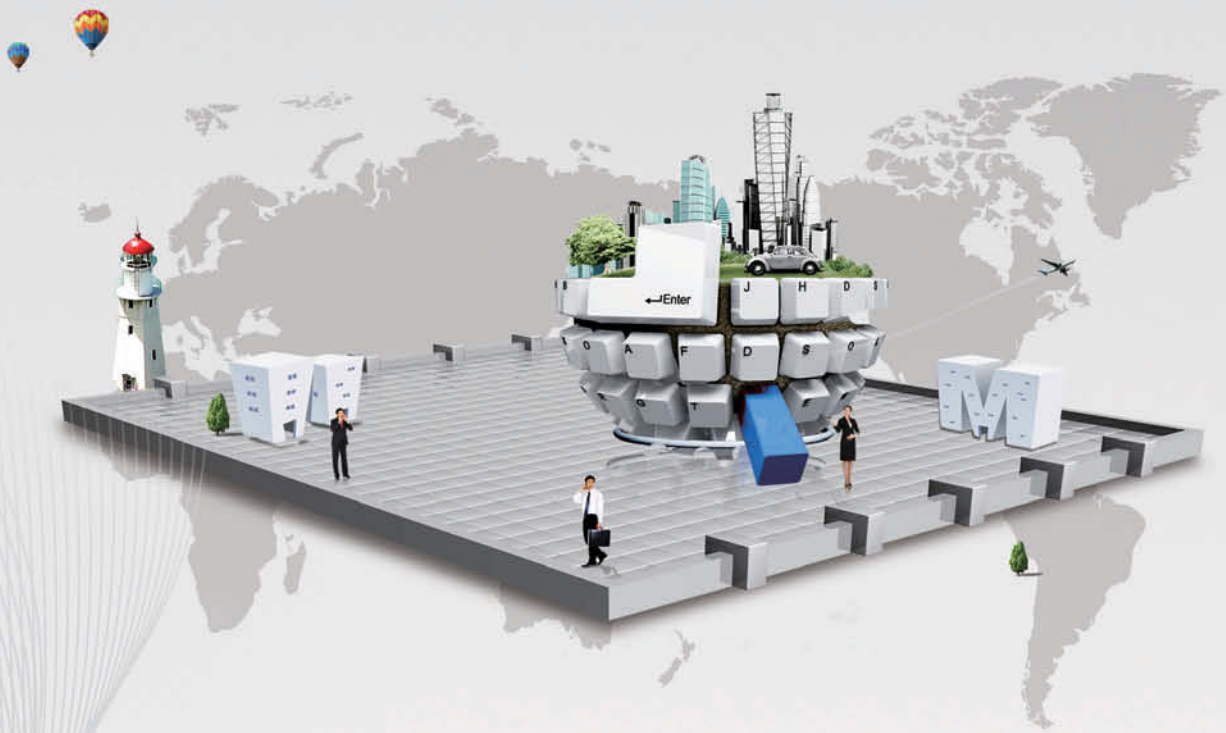

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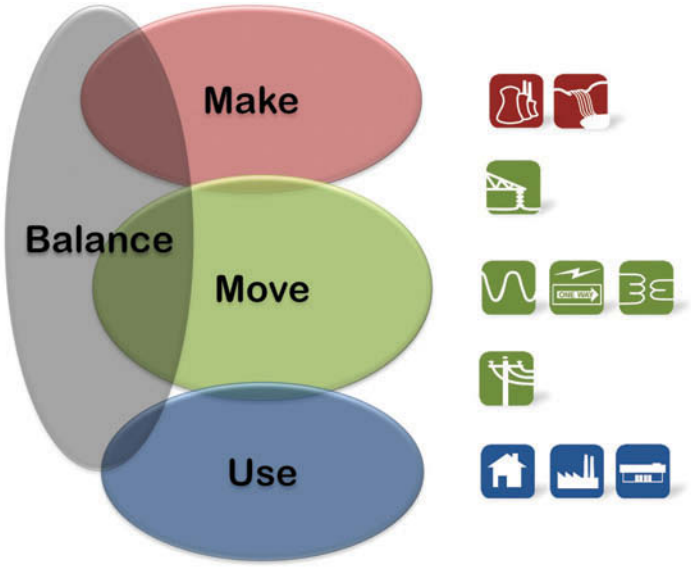
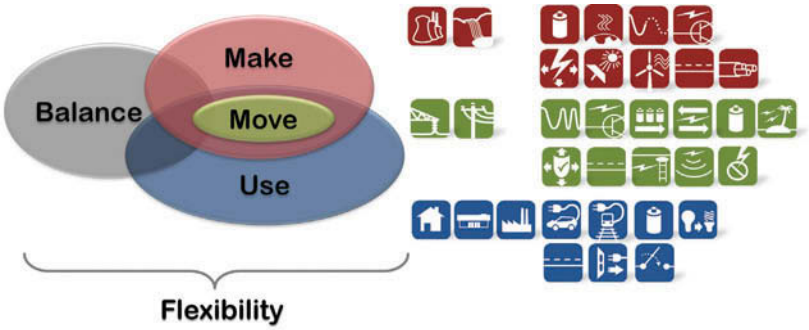


In this conceptual graphic of the present day grid, generation (Make), transmission (Move) and load (Use) are essentially discrete functions, related predominantly by the need to balance the system. The icons on the right reflect the simple functions of a centralized grid with one-way power flows.



In a more decentralized grid of the not-too-distant future, Make, Move and Use are inextricably linked functions that may be performed by any single entity on the system. The system enables two-way power flows, perhaps aiding transactive energy markets. Such a system will require a fundamental flexibility to balance itself and manage the relationships between myriad nodes, a functionality likely to be aided by automation. The numerous icons on the right reflect the proliferation of means by which electricity will be made, moved and used in decades to come.

scenarios. But by working forwards in increments of a decade at a time from current technology and identifiable gaps, and working backwards from a 37-year projection of major trends, we can at least describe the contours of the future landscape. We approached the future with pragmatism, by applying a deep familiarity with the timeframes governing technology and standards development, commercialization and implementation.

To quote my colleague, Bill Ash, strategic program manager for the IEEE Standards Association (IEEE-SA), we are exploring "the full lifecycle of standards-related activities by adopting a proactive, forward looking approach from pre-standard activities to real world adoption and implementation … to help key stakeholders advance their own work [and] create a pipeline for [the] incubation of innovative technologies to standards development and market acceptance."

The intended result is a future oriented view of an anticipated, robust, global market that addresses our collective future needs, driven by targeted investments and focused research and development.

ONE THEME: FLEXIBILITY

In light of the uncertainties, which include climate change, the evolution of technology and policy (to name just three), the notion of flexibility emerges as an important tool for adaptability. At the device and software level, flexibility means interoperability based on standards. (That aspect of the process of technology development will only grow in importance.) Operational flexibility will be needed to orchestrate the interaction of myriad technologies on the future grid. We'll need to be more nimble with investments in research and development as we discover shorter paths from A to B. We'll need a more diverse toolkit to gain flexibility in approaching different regional and cultural differences in the provision of power.

THE APPROACH

To establish a baseline for reaching across the decades, in the case of the Power Grid Vision we based our work on scenarios for electricity demand developed by the International Energy Agency (IEA), which recently defined future energy availability, production and usage into the year 2050.

The IEA produced three basic scenarios, based in part on anticipated levels of climate change and our responses to it. These are the so-called "two-degree," "four-degree" and "six-degree" scenarios, whose names refer to projected increases in average global temperature in degrees Celsius. The six-degree scenario is based on minimal, global mitigation efforts. The four-degree scenario is based on guidance on greenhouse gas emissions embodied in the Kyoto Protocol, established way back in 1997. And the two-degree scenario comes into play if we do everything we can to adopt sustainable energy practices in the face of climate change and a doubling in demand for electricity by 2050.

The latter outlook obviously presents the greatest challenge, but based on the precautionary principle we selected it as the basis for our vision. Should we bring the world's best minds to bear on the challenges associated with rising temperatures, changing climate and soaring electricity demand, we may succeed in meeting the future's demands. Conversely, if electricity demand does not double and global temperatures do not rise as anticipated, we'll have positioned ourselves well for a more sustainable future. To accept a lesser challenge and half-heartedly attempt to meet it would simply be irresponsible.

THE OUTPUTS

Our work recognized past technology trends, assessed current and nascent technologies – including gaps and challenges – and for the power technology study topics, we made forecasts for technology development and deployment for the years 2015, 2020, 2030, 2040 and, finally, 2050. For each of the five chosen technology areas IEEE developed a vision statement, a roadmap and a reference model.

To ensure the vision documents are anchored in reality, we created them in tandem with potential use cases and application scenarios, supported by enabling technologies. To promote flexible thinking in the face of future variables, our efforts relied on translating current terms into more future-oriented ones. Centralized power even today is being augmented by distributed generation. The lines between transmission and distribution are blurring. In a more decentralized grid, "end use" may not be the right term. Thus, the Power Grid Vision team adopted the more flexible terms "make," "move" and "use."

The Power Grid Vision document is accompanied by a roadmap and a reference model. These documents are crafted to stimulate discussion and articulate the challenges in actual deployment of future-oriented power technologies. The roadmap forecast when emerging technologies may reach the market and, just as importantly, define research and standards development needs that can aid technology innovation. The reference models, in turn, summarize the fundamental technical concepts defined in the vision.

At the end of the technical discussions in the Grid Vision are stated challenges – that is, where do technology gaps or inadequacies currently exist? These statements are intended to give direction to

academics, researchers and investors on where work is needed and where innovation is likely to be rewarded.

Prior to publication, we requested peer review of our work from experts around the globe. Although the general response was positive, some reviewers considered our vision too futuristic; others thought it did not go far enough. Perhaps we managed a "Goldilocks moment": just right.

IMPACTS ON STAKEHOLDERS

It's tempting to offer simple, declarative statements on how the myriad stakeholders in the power industry will be impacted by our project. But with the emphasis on flexibility – of approach, process and outcomes – and a wariness of prescription, that's simply not possible.

Though we've noted the need for improvements to our collective processes – such as cross-disciplinary, holistic thinking and collaboration – we also found that current processes continue to serve us all well. Existing methods for collaboration in technology and standards development might need a tweak, but there's no need to reinvent the wheel.

As for this project's internal impacts on IEEE processes, I can offer an example that might inspire readers. One of the opportunities revealed by this work is the notion of creating small scale DC power systems driven by solar photovoltaics (PV) and/or micro-turbines that could power DC loads in homes and small businesses.

Today, AC power from the socket is rectified to DC for consumption by a range of electronics, LED lighting and other in-home appliances. DC power produced by solar PV is converted to AC, then rectified to DC for consumption with significant losses at each conversion. Why not create a direct, efficient DC-to-DC circuit that could provide every home with a degree of independence from the grid? This would provide another degree of reliability for critical loads in the event of outages and might well serve as a cost-effective resource for the grid. Thus the IEEE-SA has formed a working group to study "DC in the Home," under its "Industry Connections Program."

FLEXIBILITY, REDUX

It's worth revisiting the notion of flexibility, because it has many implications. The most obvious implication, of course, is that technological flexibility will rely on interoperability. For physical components, that means "plug and play" functionality. For software, that means using architecture and language that translates easily from network to network, component to component, system to system. Although interoperability is emphasized today, product testing in the lab and implementations in the field reveal that this challenge has not yet been fully met.

The notion of flexibility also describes the desired dynamism around supply and demand on the grid. Today, for instance, power utilities are seeking flexibility with end user loads through demand side management. In the future, flexibility will need to extend to the entire system, whose components will dynamically interact. Optimization for energy efficiency and to reduce losses on the system will also require operational flexibility.

The notion of flexibility cuts another way. Not only must we achieve operational flexibility, but facing the future itself means maintaining flexibility in our approach. While we can identify the component technologies of an operationally flexible grid, we cannot foresee which components – or which technologies comprising those components – will become dominant. (If, indeed, any of them will.) Thus we must remain nimble in research, technology development, standards efforts and financial investments to account for shifts in innovation.

ASSUMPTIONS, CAVEATS AND VARIABLES

Our work rested on a variety of assumptions, of course, and recognized the inherent uncertainties of a range of variables.

One obvious assumption we made is that fossil fuel supplies are finite by definition and their use results in high environmental impacts. Sustainable energy practices therefore must play a major role in meeting the needs of forthcoming decades. Another assumption: nuclear fusion technology will not be available by 2050. Of course, this latter assumption carries a greater degree of uncertainty and could turn out to be incorrect.

Among the obvious variables, advancements in fundamental aspects of the grid could have ripple effects across the entire ecosystem, sending our collective efforts in new, unanticipated directions. For instance, we anticipate advancements (the term "breakthrough" should remain suspect) in computing. Given the current focus on data driven decision making, such advancements could have far reaching consequences. We've also anticipated progress in areas such as power electronics, telecommunications and energy storage, to cite just three examples. We have energy storage today in several forms, but innovation in storage seeks an energy density akin to oil. That'll take time, but such a development could be highly disruptive if and when we achieve it.

Another, somewhat audacious advancement we anticipate is worth remarking upon: wireless power transfer, initially in the low to medium voltage range. It's just getting traction in the laboratory, so we see commercial implementation still decades away. Think of the pervasive influence such a development would have across homes, businesses and industry.

One important caveat – another variable – relates to policy. We've seen how powerful policy can be in shaping markets. This is, perhaps, as it should be. Societies and their policy making processes should determine and articulate their collective values and priorities, which technology serves. Yet that also subjects long-range technology developments to shorter term political and policy machinations. One of our forthcoming papers touches on this variable as it relates to technology innovation, but for the most part, policy per se falls outside the IEEE's purview.

NEXT STEPS

In practical terms, the IEEE's Grid Vision 2050 effort has yielded the structure and substance of one of the power industry's most comprehensive portfolios of smart grid related intelligence, which provides a framework for further work. We now have a set of long term visions, roadmaps and reference models for each of five fundamental technology sectors. Discussions continue on whether and how we might make periodic revisions to these resources as the path ahead becomes clearer. We do anticipate coordinating the work of the IEEE's various technical societies as the technologies themselves require.

For the first time, however, we have created a plausible picture of where we stand, where we need to be and how we might get there. We may never know the future, but we have a responsibility to plan on meeting its demands. MI

ABOUT THE AUTHOR

Georges Simard served as editor-in-chief of the IEEE-Standards Association's Grid Vision 2050 project. He is the past chair of the IEEE Power and Energy Society's Smart Distribution Working Group, participates in the Power and Energy Society's Intelligent Grid Coordinating Committee and has been elected an IEEE senior member. After a successful career at Hydro-Quebec Distribution, he currently leads his own firm, SIMARD Smart Grid.

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KINETIS M-SERIES AS A SINGLE SOLUTION FOR 1-PHASE, 2-PHASE AND 3-PHASE POWER METERS

By Luděk Šlosarčík and Lukáš Vaculík

Freescale® Semiconductor, Inc. introduces three types of metering reference designs based on the new Kinetis® M-Series microcontrollers (MCUs). These MCUs address high accuracy and low cost needs by providing a high performance 24-bit analog front-end combined with an embedded programmable gain amplifier (PGA) to increase the accuracy of energy measurement.

These power meter reference designs were developed to demonstrate the key strengths of the Kinetis M-Series MCUs in typical automated meter reading (AMR) applications. The reference designs are very suitable for real customer metering applications, thanks to their integrated human-machine interfaces (HMI) and communication interfaces for remote data collection and AMR. For a faster time to market, the designs provide both the hardware and the software sources for customer applications.

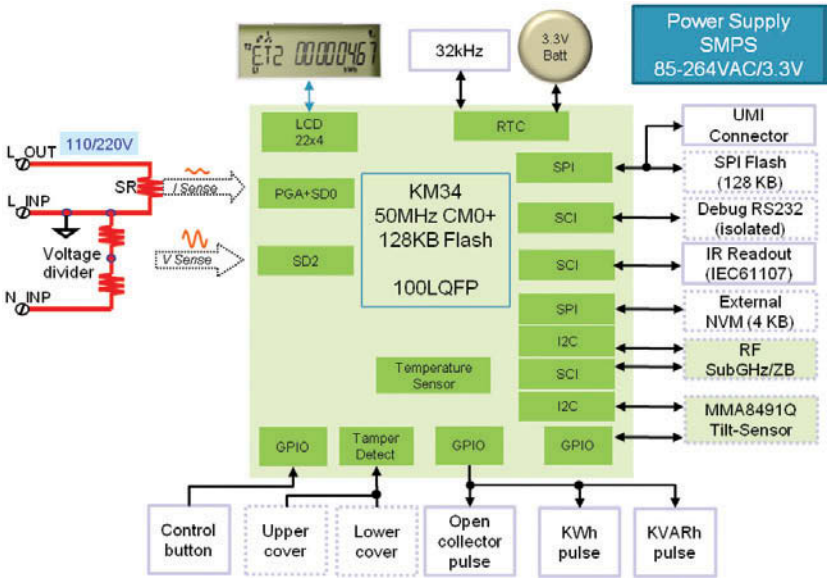

Figure 1 – Kinetis M-Series single-phase power meter block diagram

The metering engine of each particular reference design contains the majority of the components for metering, communications, and backup storage together with the switch mode power supply (SMPS) which is used for supplying the meter itself. At the heart of the metering engine lies an ARM® Cortex™-M0+ core with a high performance analog front-end. The reference designs also contain a built-in optical read-out port (infrared) for a handheld terminal reader, and an expansion header for an RF communication daughter card supporting an IEEE 802.15.4 compliant radio with ZigBee® and/or 6LowPAN stacks (due to HAN/NAN communication). The backup battery in the meter is used to power the meter electronics in the case of power loss. Some reference designs also support electronic tamper detection circuits. The first tamper event may be generated by the Xtrinsic™ 3-axis low power tilt sensor which may be used for cover opening detection. The second tamper event may be generated by the Xtrinsic 3-axis low power magnetometer. This sensor can measure magnetic fields in three dimensions and is primarily used for tamper detection of the current transformers by an external strong magnet. These power meters are used for the measurement and registration of active and reactive energy with direct connections for residential metering. The metering engine of each particular meter is housed in a professional power meter enclosure according to the relevant standard.

METERING REFERENCE DESIGNS

The single-phase power meter reference design is used for measurement in single-phase two-wire installations. The design is targeted specifically at the EMEA region (EN50470-3, class C). There is a cost effective shunt resistor sensing circuit implementation used for current measurement up to 120 A. A standard system functional block diagram of this reference design is shown in Figure 1.

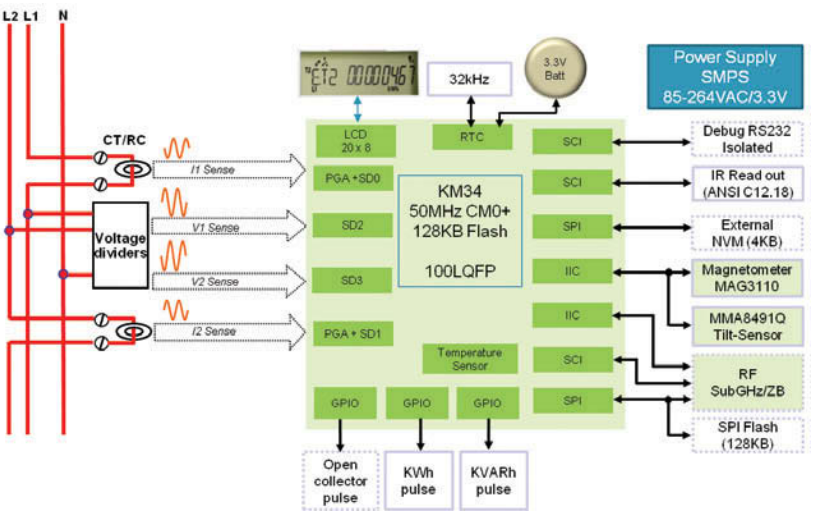

Figure 2 – Kinetis M-Series two-phase power meter block diagram

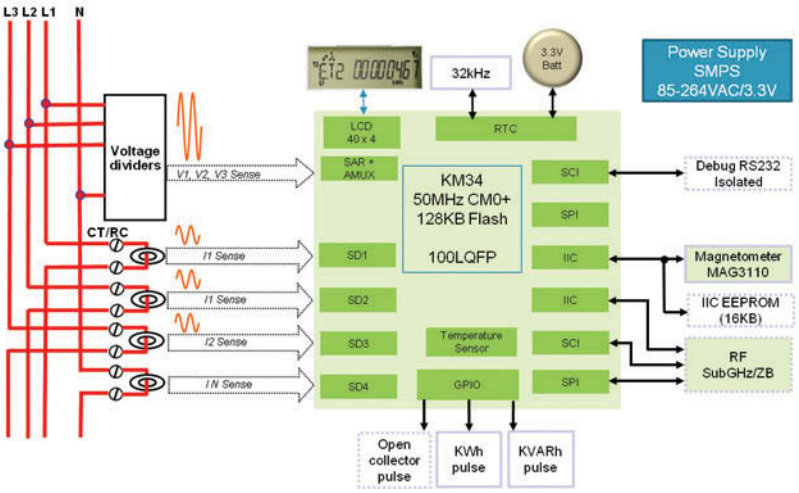

Figure 3 – Kinetis M-Series three-phase power meter block diagram

The two-phase power meter reference design is used for measurement in single-phase three-wire (two-phase) installations. The design is targeted specifically at the US (ANSI C12.20, class 0.2) and Japan regions. A standard system functional block diagram of this reference design is shown in Figure 2. The meter is housed in a round plastic enclosure according to the ANSI standard, with integrated power connectors for a 12S configuration and with two in-built current transformers for current measurement up to 200 A.

A standard system functional block diagram of the Kinetis M-Series three-phase power meter reference design (EN50470-3, class C) with current transformers or a Rogowski coils sensing circuit implementation is shown in Figure 3. The commonly used three-phase meter topology is based on the six or seven channels of the sigma-delta (SD) AD converters. The Kinetis M-Series family uses a different topology because it offers four channels of 24-bit (SD) AD converters and 16-bit successive approximation (SAR) AD converters with an input analog multiplexer. The current range in the three-phase power meter is typically from 50 mA to 120 A, thus the current must be digitalized by the ADC with a wide dynamic range. The sigma-delta ADC is an ideal solution to meet this requirement. On the other hand, the voltage signal is typically in the range from 80 V to 280 V. The voltage dynamic range is approximately 60 times smaller than the current dynamic range, therefore the voltage requirement could be easily resolved a high resolution SAR converter. The common reason for using six or seven independent ADC channels is for easier converter synchronization, where all could be simply started at a precisely defined time. The Kinetis M-Series family resolves this problem by the periphery called XBAR (internal connection matrix among the periphery). Internal signals such as conversion complete from the SD converter could be used for starting the SAR conversion. So, the complete signal sampling process based on the combination of three or four SD ADCs and one SAR ADC with an input multiplexer is fully supported by the device H/W and only the conversion result must be read by the MCU core or by the DMA.

ADVANCED METERING ALGORITHMS

The described reference designs support two different types of advanced metering algorithms. Both these algorithms calculate all the billing (energies) and non-billing (U_{rms}, I_{rms}, etc.) metering quantities, one in the time domain and the second in the frequency domain. For a time domain signal analysis we use a Filter-Based Metering Algorithm. This algorithm requires only instantaneous voltage and current samples to be provided at constant sampling intervals. These samples must be phase aligned using digital FIR filters and also removed from the offset using digital IIR filters.

The positives of the Filter-Based Metering Algorithm are:

- Adjustable precision of the reactive energy calculation
- Adjustable computational load at the expense of non-billing quantities precision
- High resolution of the pulse output generation.

For signal analysis in the frequency domain, we use a computing technique based on the Fast Fourier Transform (FFT). The principle is to collect the power of two voltage and current samples during the signal period and to translate these signals into the frequency domain at the end of each period. Therefore, the main calculation process is performed only once per one signal period in comparison to the filter-based metering algorithm.

The positives of the FFT-Based Metering Algorithm are:

- The same precision for both active and reactive energies
- Four quadrant active and reactive energy measurement
- Frequency analysis of the mains, ability to compute total harmonic distortion (THD)
- Automatic offset removal due to missing out the zero harmonic in the power computing formula.

Thanks to an efficient processor core with support for 32-bit math, this enables fast execution of both metering algorithms for these reference designs. A typical active energy error of the described reference designs is shown in Figure 4. The error curves are very low with good margins to the specification thanks to the MCU with a high performance integrated AFE. MI

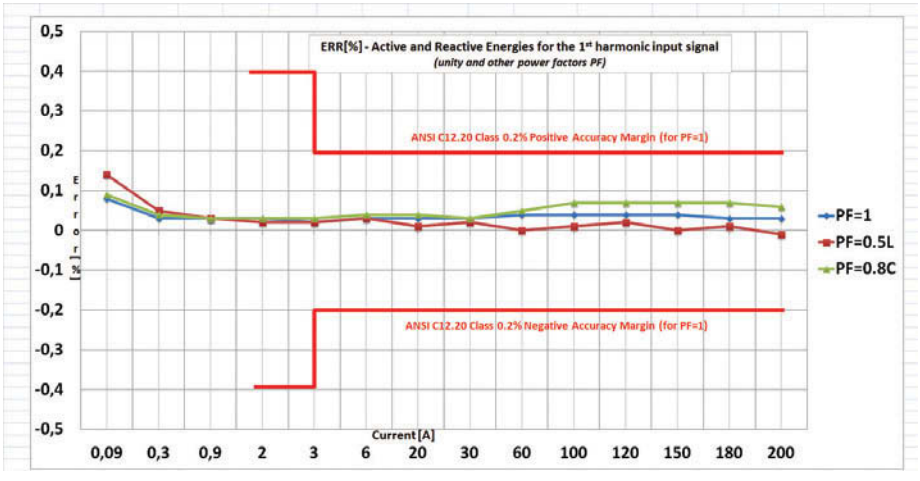

Figure 4 – Typical active energy error of the Kinetis M-Series power meter

ABOUT THE AUTHORS

Luděk Šlosarčík received his M.Sc. degree in electrical engineering from the VSB-Technical University of Ostrava in 1992 and 1997. His early career experience includes two different R&D companies focused on designing of equipment for measurement and control and power engineering. Since 2008, he has been employed by Freescale Semiconductor, Czech System Centre (Roznov pR), as a Systems Application Engineer with a focus on sensor and metering applications.

Lukáš Vaculik graduated with an M.Sc. degree in electrical engineering. He has been employed by Freescale Semiconductors, Czech System Center (Roznov pR), as an Application Engineer with a focus on metering application especially on the three phase meters.

ABOUT THE COMPANY

Freescale is the global leader in embedded processing solutions, advancing the automotive, consumer, industrial and networking markets.

GRID-FRIENDLY CHARGING

HOW ELECTRIC VEHICLES CAN BENEFIT EVERYBODY

By Kristian Handberg, Dr. Julian de Hoog and Raman Jegatheesan

For utilities and society generally, the case for fully grid-integrated electric vehicle (EV) charging has been established through in-field demonstration, electricity network modelling and financial assessment.

As part of the Victorian government (Australia) Electric Vehicle Trial, DiUS Computing demonstrated EV charging demand management using United Energy's smart meter network. Modelling of the United Energy network by the University of Melbourne found that uncontrolled charging would require network augmentation once EVs are adopted by 10% of households. In contrast, managed charging would allow the network to support in excess of 50% uptake using existing capacity. Furthermore, the end-to-end EV charging demand management solution demonstrated by DiUS could be implemented for one-tenth the cost of the network augmentation. Although success factors were identified during the demonstration that may serve as an input for demand management program design, electricity market arrangements may be the strongest determinant of adoption generally.

EVs AREN'T COMING – THEY'VE ARRIVED

While gradual and not without a few hiccups, the electric vehicle market has achieved some major milestones in 2013:

- In January, the US Department of Energy reported that plug-ins had reached double the amount of sales of hybrid vehicles at a similar point following their introduction to the market[1]
- In May, the 100,000th plug-in vehicle was sold in the United States[2]
- Also in May, EV start-up Tesla (Figure 1) paid back its US government loan 9 years ahead of schedule[3], and shareholders drove the company value to equal 25% of General Motors[4]
- In June, the LA Times reported that EVs had crossed the point at which they were cheaper than their gasoline (petrol) powered counterparts[5]
- In July, Nissan was meeting with dealers to help manage sales that were outstripping production volumes.[6]

With around 19 new plug-in models from 15 different manufacturers forecast for introduction to the market in the period through to 2015[7], it finally seems likely that electric vehicles are here to stay.

Figure 1 – Tesla Model S, described as the best car ever tested by Consumer Reports, widely regarded as the most influential magazine among US car buyers[8, 9]

WHAT ARE THE NETWORK ISSUES AND OPPORTUNITIES?

With the slow but steady rise in market share of EVs, utilities are starting to take their impact on the electricity grid very seriously. A variety of recent studies suggest that EVs can contribute to increased peak load, voltage instability, harmonics, and thermal overload[10-13]. However, if controlled properly, EVs can also be used as tools for demand management, allowing for more efficient use of existing assets and reducing the need for further infrastructure or generation investment.

EV charging may impact on the electricity grid in a number of different ways:

- **Peak and total demand:** Each EV under uncontrolled charging conditions is likely to contribute roughly the same to total and peak demand as a full household (Figure 2).

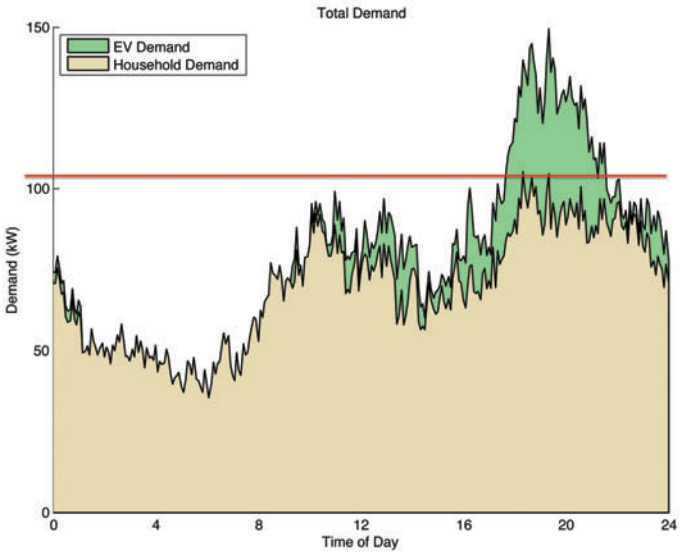

Figure 2 – Impact of EV charging on peak demand. If vehicle charging is left uncontrolled, the impact on peak demand will be significant and asset lifetimes will be reduced. In this case an EV penetration of 40% leads to a 40% increase in peak demand

- **Component overload:** If the current ratings for the distribution transformers and the utility lines connecting houses to the grid are exceeded due to additional current required by EVs, there will be an adverse impact on the lifetimes of these assets.
- **Voltage drop:** As more current is drawn through the lines due to charging of EVs, the decrease in voltage that occurs with increasing distance from the distribution transformer is exacerbated (Figure 3); at houses receiving a voltage below regulated limits, appliances may fail or suffer.

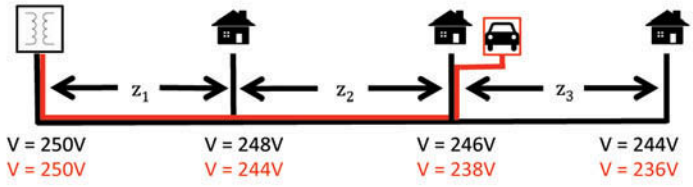

Figure 3 – Impact of EV charging on voltages throughout the network. Without an EV present, voltages are as specified in the top row (black). With an EV present, voltages are as specified in the bottom row (red)

- **Phase unbalance:** Large loads like EVs, particularly if they are distributed in an unbalanced manner, can have a large contribution to phase unbalance, exacerbating problems of voltage stability.

If left to charge uncontrolled, the impact of EVs on each of these factors will be significant. The general consensus among a variety of studies in several countries is that at present, distribution networks can only handle EV penetration rates of between 5-15% before networks begin to fail according to one of the above criteria[13-15]. In general, voltage falling below required levels seems to be the first point of failure in many networks.

While EV charging is likely to be a relatively large contribution to a household's electricity demand, it may be transferred to off-peak periods without overly affecting use of the vehicle. In contrast, there is little opportunity for time-shift in the use of household air-conditioning – the recognized cause for much of the increases in Australian electricity costs[16].

In addition, EVs can also be used as tools to solve both the problems they themselves cause and those originating from other causes. If charging rates may be controlled, EVs would allow network operators to gain a high degree of control over their networks:

- To prevent excessive peaks, charging could be delayed until there is available capacity in the network, for example during the demand trough that generally exists after midnight.
- To prevent thermal overload, charging could be delayed or scheduled in such a way that asset limits are not exceeded and life extended.
- To prevent excessive voltage drop, charging rates could be adjusted in such a way that voltage stability is maintained within required limits, while still providing fair charging times to all EV owners.
- To prevent phase unbalance, vehicle charging could be scheduled in a way that excessive unbalance is prevented. In fact, the charging of vehicles could be used as a tool to rebalance the existing unbalance in the network arising from uncontrollable loads, thereby improving voltage stability as well.
- Finally, there is widespread speculation on the potential of using EVs as distributed storage units that draw from the grid at times of low demand and supply to the grid at times of high demand.

In short, the ability to control vehicle charging rates and timing would allow network operators to use existing networks at much higher levels of efficiency, without having to install excessive additional infrastructure. A more efficient network is cheaper to run, requiring less generation and providing longer asset lifetimes. These savings could be shared with end-users as part of a system approach to achieving optimum outcomes for all.

HOW DOES GRID-FRIENDLY CHARGING WORK?

In 2012 DiUS Computing delivered a demand management demonstration project using United Energy's smart meter network[17]. The project formed part of the Victorian Government Electric Vehicle Trial[18], and was delivered in partnership with the Victorian Department of Transport, United Energy and the University of Melbourne.

The technical solution devised for implementing demand management through the United Energy network is presented in Figure 4 and operates as follows:

- At times of high demand or during emergency situations, United Energy sends a signal via the utility wide area network to the smart meter installed at the customer premises.
- The home charging terminal that the EVs plug into – designed and operated by DiUS Computing – connects to the smart meter via the consumer home area network using the Zigbee Smart Energy communications protocol.

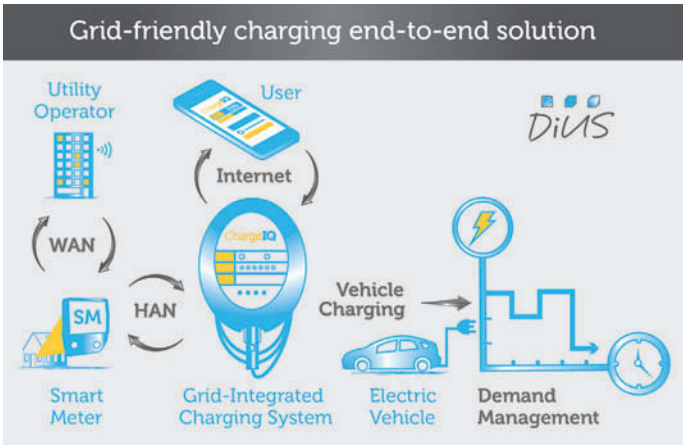

Figure 4 – End-to-end demand management system as implemented by DiUS Computing and United Energy

- If a Demand Response/Load Control (DRLC) event message is received, charging of the EV may be reduced or deferred.
- The charging terminal is also connected to the internet, allowing network operators to alert vehicle owners of DRLC event notifications via an online portal, their smartphones, via email and SMS, or directly on the charging terminal's user interface.
- EV drivers may respond to the DRLC events in a range of ways, including opting out by initiating charging on-demand via the terminal interface, their smartphone, or the online portal.

Figure 5 – A DiUS Computing grid-integrated charging terminal at a participant household[17]

Charge management scenarios for the project were designed as a reflection of real-world operating conditions:

1. **Peak charge management**: On days when parts of the distribution network might be at risk of exceeding plant ratings (e.g. particularly hot summer weekdays), a utility load control event could be triggered; consumers are notified 24 hours in advance, the duration of the event would cover the peak demand period of around 3-4 hours, vehicle charging rates would be reduced by 50%, and consumers would be permitted to opt out with some accompanying cost impact.
2. **Emergency charge management**: In rare situations under extreme weather conditions such as heat waves or lightning strikes causing unplanned or forced outage of plant, the network may require significant load reduction to avoid failure of remaining plants; consumers are notified at short notice (10-15 minutes), events would take 3 hours, EV charging would be reduced by 100%, and although participation would likely be mandatory, for the demonstration an 'opt-out' option was provided in recognition of some broader sensitivities arising from the smart meter rollout.
3. **Smart charging**: In line with time-of-use tariffs that incentivize drivers to charge during off-peak periods, this management scenario schedules charging to occur between 11 pm and 7 am; this is the default charging mode.
4. **Demand charging**: also called "uncontrolled charging", in this scenario users have the opportunity to opt in to charge 'on demand' by overriding the other charge management options above.

Charging activities	No.	%
Smart charging events	365	56
'On-demand' charging events	291	44
Total vehicle charging events	656	100

Table 2 – Aggregated charging events for ten households over their three month EV 'ownership' experience[17]

The breakdown in the charging event selection made by the participants is provided in Table 2. The bias towards smart charging was felt to be due to the default setting of the charging terminal to this mode.

Charging activities	No.
Total charge management events issued by utility demand manager during demonstration period	64
Total charging events undertaken by participants during charge management demonstration period	128
Smart charging events undertaken by participants during demonstration period	29 of 64
Vehicle charging activities impacted by charge management events during demonstration period	6 of 64
Incidence of vehicle not charging during charge management events	28 of 64
Incidence of charge management event messages not received by charging terminal	3 of 64

Table 3 – Aggregated charging events for eight households over the demonstration period[17]

A total of 64 load control events, split 50/50 between peak and emergency charge management, were delivered to eight household participants over four weeks – refer to Table 3 for results. To gain insights into the household participants' opinions and experiences, a qualitative survey was delivered to those who took part in the charging demand management events[17].

Although the limited number of responses (seven) entails that the results be treated as anecdotal, some observations can be made as follows – participants:

- received the peak charge management event notifications, and where affected took steps to manage their charging/vehicle use;
- were only occasionally aware that the emergency charge management events were taking place, and were largely unaffected;
- were mostly accepting of load control by the utility, even if there were no financial benefit;
- were less likely to accept mandatory load control, but could be influenced by a financial benefit;
- mostly felt that the DiUS charging system was a key enabler for charge management; and
- found the SMS notifications to be the most useful of the user-facing applications.

WHAT WOULD HAPPEN WITH LOTS OF EVs?

Post-trial modelling and analysis conducted at the University of Melbourne using data gathered during this trial made it possible to examine some alternate scenarios that could not be tested in the real trial, such as exploring what the impact of higher penetration rates of EVs might be. Using information gained during the trial, we developed a model of the network in which the DRLC events took place:

- The network in question is a typical suburban neighbourhood having 114 houses connected to a single 300 kVA distribution transformer
- To simulate EV demand, Victorian Department of Transport data[19] was refined to 24-hour vehicle travel profiles consistent with an EV range (less than 160 km), and to travel profiles originating from the local government area that our network is located in
- To estimate typical daily household demand profiles, distribution transformer data collected from our trial network was used to establish average household profiles separately for each phase
- To understand the effect of different rates of vehicle adoption, increasing EV uptake scenarios were modelled, where vehicles and travel profiles were distributed randomly to households
- To ensure that this was a realistic way of simulating household demand, a validation cycle was undertaken; voltages were within 1-2 V (<1% difference), and currents were within 4-6 A (5-7% difference) – in other words, a fairly close correlation between simulation and reality.

In our uncontrolled charging approach, our first failures occurred at 10% EV penetration due to voltage falling below 216 V at one house for two or more 30-minute intervals. In other words, if only 10% of households were to buy EVs, some networks would already be at risk of failure without additional upgrades or changes to the network.

In our controlled charging approach, vehicles were assumed to connect as soon as they arrived at home as for the uncontrolled charging scenario. However, each vehicle's charging rate was decided by a central solver with access to key network state parameters, such as demand at each house (available via metering data), and impedance in the lines between houses.

Using the optimal charging method, the solver's effectiveness was measured as: Are vehicles being charged enough? In the majority of runs, our 7 am charging completion target was met without any negative impacts on the grid. Only in very rare cases did a vehicle not receive a 100% charge by 7 am.

WHAT DOES THIS MEAN FOR THE FUTURE?

The case for grid-friendly EV charging will reflect the underlying business case, market arrangements and program design.

In order to understand the business case for demand management of EV charging, an understanding of the costs associated with both this and the non-demand management option is required.

Once EV penetration reaches 10% of households, the modelling above indicates that network augmentation will be required under the non-demand management scenario. High level costings for this augmentation can be understood in terms of the following options:

1. Transformer upgrade/new transformer – estimated costs may be AU$50,000-60,000 (US$46,000-55,000) for a pole-mounted unit, or AU$100,000-120,000 for a ground-mounted kiosk. Note: This option is applicable in a location where there is HV infrastructure available; if not, estimated costs are AU$150,000-200,000.
2. Low voltage regulator (LVR) installation – estimated cost AU$150,000. This option should be applicable in a location where there is no HV network available to install a new transformer. United Energy is currently trialling this new LVR technology on its network.

For a cost comparison, the demand management solution for the 10% of households that would require a network augmentation solution as identified previously would equate to around AU$7,000. Note also that this estimate captures the entire cost of the dedicated EV charging units, not simply the utility load control functionality.

Despite the clear business case in favour of the grid-friendly charging approach, existing market arrangements for Victoria suggest that significant barriers may exist for implementation[16]. The benefits associated with investment in demand management technology are spread across the electricity market – generators, transmission and distribution businesses, retailers and end-users. As a result, no one market participant can realize all the benefits from such investment, a problem known as 'split incentives'.

In addition, due to the emphasis on network solutions based on capital expenditure, the Australian market rules currently disincentivize distribution businesses from investing in demand management[20].

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Despite these challenges, opportunities for grid-integrated demand management of EV charging exist within the current market arrangements:

- EV charging loads are both significant and transferrable within the large windows of opportunity that exist when the vehicles are parked/plugged in, making them well-suited to demand management
- Victorian EV drivers may be obligated to work with their distributor on integration of EV charging loads into the system[21]
- As part of the rate review process, Australian distributors may be obliged to consider demand management alternatives to network augmentation in support of EV charging demand[16, 22]
- Electricity utilities may promote EV uptake as a means of promoting electricity demand/revenue[23]
- The Australian market rules allow distribution businesses to propose innovative tariff arrangements as a means of promoting EV uptake[22].

While rule-makers offer a demand management incentive scheme in Victoria, distributors sought approval of AU$550,000 of expenditures in 2011 – equivalent to only around 5% of the allowance[24]. In a contrast that has been explained in terms of the disaggregated character of the Victorian electricity market[20], the three main Californian network operators had US$1 billion in (analogous) demand response program expenditure approved for the 2012-14 period[25].

This disparity in uptake suggests that the market settings associated with demand management (response) may be the strongest influence on adoption of fully grid-integrated EV charging.

A key challenge for adoption of grid-integrated EV charging lay in program design effectiveness, particularly from the perspective of both utilities and regulators.

Anecdotal results from this project indicate that EV drivers may accept load control, even without a financial incentive. However, they may be less likely to accept mandatory load control – an observation also made elsewhere[26].

For distribution businesses, peak load management must be sufficiently reliable to justify this approach over network augmentation. Regulators are unlikely to compel utilities to adopt demand management in the absence of a compelling argument in favour of this approach.

Although these observations suggest a fine balance between the needs of EV drivers and distribution businesses, other insights promote confidence in the demand management approach:

- Peak demand periods are typically infrequent and short-lived[16]
- Price signals that clearly disincentivize charging during peak demand periods are likely to be effective at promoting cooperation by most EV drivers, while still providing an 'opt-in' option
- Timely, relevant and reliable information about demand management events is likely to promote acceptance and cooperation by EV drivers
- Real time, remote monitoring and control capabilities for EV charging allow drivers to easily and conveniently respond to demand management events
- The modelling above indicates that up to 10% of drivers may choose to 'opt-out' of a utility demand management event before network capacity becomes an issue.

Noting the wide range of direct load control programs already being offered by US utilities[27], these insights should inform design for successful EV charging demand management programs.

Furthermore, EV uptake is likely to be gradual, such that refinement and validation of the program design can occur over time. This is consistent with recommendations on demand response program design more generally[28].

Although these conclusions may be specific to the Victorian context, it is clear that the insights may inform decision-making elsewhere as markets strive towards a more-efficient, less-costly energy future. MI

References

1. *U.S. Department of Energy, "EV Everywhere Grand Challenge Blueprint", 31 January 2013, http://goo.gl/aOK2fB, accessed 23 July 2013.*
2. *J.Upton, "More than 100,000 electric vehicles now on the road in the U.S.", Grist, 21 May 2013, http://goo.gl/yRYrd2, accessed 23 July 2013.*
3. *S.Gustin, "Loser no more: Tesla repays $465 million U.S. loan", Time, 23 May 2013, http://goo.gl/0zFz6F, accessed 23 July 2013.*
4. *J.Koetsier, "Tesla now worth 25% of General Motors as CEO Elon Musk teases $30k electric vehicle", Reuters, 28 May 2013, http://goo.gl/RWufFs, accessed 23 July 2013.*
5. *B.Thevenot, "Electric cars getting as cheap as gasoline rivals", Los Angeles Times, 1 June 2013, http://goo.gl/9d3Rd, accessed 23 July 2013.*
6. *L.Chappell, "Nissan's new problem: Not enough Leafs", Autonews, 15 July 2013, http://goo.gl/cP6y2S, accessed 23 July 2013.*
7. *J.O'Dell, "What's coming: Alternative fuel vehicles for 2013-15", Edmunds, 23 January 2013, http://goo.gl/qplKG, accessed 23 July 2013.*
8. *P.Valdes-Dapena, "Tesla: Consumer Reports' best car ever tested", CNN Money, 9 May 2013, http://goo.gl/GyUY0, accessed 23 July 2013.*
9. *Image from Tesla Automotive, http://www.teslamotors.com/en_AU/models/gallery*
10. *S.Schey, D.Scoffield, and J.Smart, "A First Look at the Impact of Electric Vehicle Charging on the Electric Grid in The EV Project," in Electric Vehicle Symposium 26, May 2012.*
11. *M.Masoum, P.Moses, and S.Hajforoosh, "Distribution transformer stress in smart grid with coordinated charging of Plug-In Electric Vehicles," in Proc. IEEE Power and Energy Society Conference on Innovative Smart Grid Technologies (ISGT), Jan. 2012.*
12. *R.Carter, A.Cruden, A.Roscoe, D.Densley, and T. Nicklin, "Impacts of harmonic distortion from charging electric vehicles on low voltage networks," in Electric Vehicle Symposium 26, May 2012.*
13. *J.Lopes, F.Soares, and P.Almeida, "Integration of electric vehicles in the electric power system," Proc. of the IEEE, vol. 99, no. 1, pp. 168-183, Jan. 2011.*
14. *P. Richardson, D. Flynn, and A. Keane, "Optimal charging of electric vehicles in low-voltage distribution systems," IEEE Trans. Power Systems, vol. 27, no. 1, pp. 268–279, Feb 2012.*
15. *J. de Hoog, D. A. Thomas, V. Muenzel, D. C. Jayasuriya, T. Alpcan, M. Brazil, and I. Mareels. "Electric Vehicle Charging and Grid Constraints: Comparing Distributed and Centralized Approaches". Proceedings of the IEEE Power and Energy Society General Meeting, July 2013.*
16. *Productivity Commission, "Electricity Network Regulatory Frameworks – Inquiry Report Vol.1, Chapter 9: Demand", 9 April 2013, http://goo.gl/dYluy, accessed 13 July 2013.*
17. *Z.Angelovski and K.Handberg, "Demand management of electric vehicle charging using Victoria's Smart Grid", DiUS Computing, May 2013, www.dius.com.au/chargeiq, accessed 3 July 2013.*
18. *K.Handberg, "Creating a Market: Victorian Electric Vehicle Trial Mid-term report," Victorian Government, June 2013, http://goo.gl/QrJNE, accessed 7 July 2013.*
19. *Victoria Integrated Survey of Travel and Activity (VISTA), 2009, http://goo.gl/XEPZx, accessed 3 July 2013.*
20. *Headberry Partners and Bob Lim & Co., "Does Current Electricity Network Regulation Actively Minimise Demand Side Responsiveness in the NEM?", report for the Total Environment Centre, June 2008, http://goo.gl/PyAQi, accessed 14 July 2013.*
21. *United Energy, "Customer Charter – Your rights and obligations explained", November 2011, http://goo.gl/L1Rxi, accessed 1 July 2013.*
22. *Australian Energy Market Commission (AEMC), "National Electricity Rules – Chapter 5: Network Connection, Planning and Expansion: Version 56", Australian Government, http://goo.gl/S4s9v, accessed 12 July 2013.*
23. *G.Parkinson, "Electricity suppliers look to EVs to save their business models", Reneweconomy, 15 April 2013, http://goo.gl/1dbd5, accessed 13 July 2013.*
24. *Australian Energy Regulator, "AER approval of 2011 Demand management incentive scheme expenditure for Victorian DNSPs", 5 December 2012, http://www.aer.gov.au/node/18691, accessed 18 July 2013.*
25. *California Public Utilities Commission, "Public Utilities Code Section 748 Report to the Governor and Legislature on Actions to Limit Utility Cost Increases", June 2013, http://goo.gl/TMrlK, accessed 18 July 2013.*
26. *G.Dahlenberg, "Ergon EV Trial", presentation made to Victorian EV Trial participants, 14 September 2012.*
27. *Clearly Energy, "Residential demand response programs", 2013, http://goo.gl/VHgNt, accessed 20 July 2013.*
28. *Massachusetts Institute of Technology, "The Future of the Electric Grid – Chapter 7: Engaging Electricity Demand", 2011, http://goo.gl/x0R3r, accessed 13 July 2013.*

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LOAD CONTROL AT DAKOTA ELECTRIC

A WINNING CONSERVATION PROGRAM

By Michael E. Hoy

How does an award winning conservation program begin? With a clearly stated objective.

Farmington, MN-based Dakota Electric Association's objective was to "build the next power plant one kilowatt at a time." While the objective was easy to understand and repeat to employees and the public, exactly how do you build a power plant one kilowatt at a time?

As a member-owned electric distribution cooperative, located south of Minneapolis and St. Paul, Dakota Electric's territory was situated in the right place during the home building boom happening in the 1990s and early 2000s. Building energy codes were being stiffened, Earth Day was very popular and energy conservation movement was gaining traction. A load control study indicated that cycling central air conditioners during times of peak demand could reduce load and help Dakota Electric avoid building that next power plant.

The concept of Cycled Air Conditioning ®is simple; a licensed electrician attaches a load control receiver to the house next to the central air conditioner disconnect and on the hottest days when market prices for electricity are the highest, the utility cycles the unit on for 15 minutes then off for 15 minutes. The furnace fan continues to operate allowing air to circulate throughout the home. This allows Dakota Electric to save 1 kilowatt off its monthly demand for each controlled compressor and the participants receive a $12 credit on each bill for June, July and August. Dakota Electric explains to members that there could be a 2-4 degree rise in temperature, and provides a satisfaction guarantee.

Dakota Electric installed thousands of the load control receivers during the housing construction boom, so many homeowners have never experienced a summer without control. They accept that this is how their air conditioning system is designed to work and often do not realize they are controlled.

Dakota Electric turned to our trade allies in order to install load control receivers on as many air conditioners and air source heat pumps as possible. By educating and financially rewarding builders, HVAC and electrical contractors they became our "outside sales force." Dakota Electric also rewarded any employee that signed-up a consumer. Dakota Electric paid Bonus Bounty Bucks at a rate of $5 each for the first 50 sign-ups, $10 each for 100 sign-ups and and $15 each for over 100 sign-ups to contractors and employees. Bonus Bounty Bucks ended after installing 20,000 load control receivers in three years. Various campaigns over recent years to reach more voluntary participants included $10 gift certificates to the local shopping mall, Dairy Queen and Pizza Hut.

Dakota Electric pays the installing electrician $75, plus a permit fee or $15 trip fee if they cannot install the load control receiver. They have 10 days to complete all assigned installations, and cannot receive additional work until past work orders are returned.

Currently, Dakota Electric controls 43,200 residential (45.6%) and 1,380 commercial (19.5%) central air conditioners/air source heat pumps. The percentages would actually be higher if we accounted for window units and members without air conditioning. Combining the load reduction of Cycled Air with controlled crop irrigation, water heaters and commercial members with on-site generators, Dakota Electric is able to reduce our summer peak by over 20% and save our members $18 million annually in wholesale power costs.

The combined success of load control programs of the 28 member cooperatives of Great River Energy has indeed eliminated the need to build a peaking power plant – one kilowatt at a time.

Dakota Electric is honoured to have received The Peak Load Management Alliance (PLMA) Outstanding Program Participation Award. According to PLMA, this award recognizes Dakota Electric's "success and ability to achieve a significant amount of customer participation and load reduction." MI

ABOUT THE AUTHOR
Michael Hoy is the energy and member services manager for the 102,000 member Dakota Electric Association. He shares his 37 years of progressive electric utility experience by serving on various industry groups including chair of the Energy Innovations Member Advisory Group for the Cooperative Research Network.
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BILLING VERSUS SETTLEMENT

A TRICKY BALANCING ACT FOR ENERGY SUPPLIERS

By Richard Cullen, Practice Director, Engage Consulting

The goal of every energy supplier is to bill customers correctly, on time, and to recover revenue for all their services to ensure they are profitable.

In Great Britain, settlement is the process of reconciling how much energy a supplier is deemed to have delivered to customers with the amount of energy the supplier has bought in the wholesale markets.

Imbalance gaps between settlement and billing exist in many businesses and in some cases this can amount to millions of pounds of lost revenue.

In this article we look at why imbalances between costs and billing continue to blight suppliers, the consequences of discrepancies and what suppliers can do to have greater revenue and margin assurance in the future.

THE CAUSES OF IMBALANCE GAPS

An imbalance gap between billed volumes and income, and settlement volumes and costs is a common problem for many suppliers. Any number of factors can contribute to this issue in energy companies. These include:

- Inaccurate meter readings – caused by mistakes made when reading the meter, or faulty meters
- Inability to access premises, or to obtain readings from customers – resulting in the use of estimated readings
- Meter reading validation issues – again, resulting in the use of estimated readings
- Inaccurate information held in billing systems – resulting in billing inaccuracies or the inability to raise a bill
- Incorrect or incomplete information held in settlement systems – resulting in inaccurate settlement volumes
- Theft of electricity or gas, by bypassing the meter entirely.

BILLING AND SETTLEMENT – WHY PROBLEMS OCCUR

The processes involved in billing and settlement are highly complex. They are often managed separately within companies and this can be problematic, making it difficult to match and analyze both sets of data together and interpret it in any meaningful way.

Customer bills are produced based either on an actual or an estimated meter reading. Settlement also uses these readings, but it determines the aggregate energy delivered by each supplier and then disaggregates this into settlement interval volumes (half hourly or daily) by applying average customer usage profiles. Any inaccuracies in this process are smeared across all suppliers – so that the energy entering the physical network is all accounted for.

One of the problems with this aggregation is that the granular detail about each individual customer is lost. The smearing of unallocated energy across all suppliers also masks underlying issues, meaning that it is extremely difficult for a supplier firstly to identify there is an error and secondly to determine its cause. As a consequence, billing and settlement reconciliation is a very difficult process to manage.

A further complication is that the reconciliation process can be lengthy. Typically it can take more than a year to complete and income gaps or discrepancies go undetected for this entire period. This time-lag can make it hard for suppliers to correct mistakes, and codes of practice limit the extent to which they can back bill for lost revenue. Another challenge that companies face is that it takes highly skilled analytical experts to manage and analyse billing and settlement data. For this reason, they often call in consultants in this area when they need them. This approach can work well but the focus is often on recovering revenue rather than identifying and fixing the cause of the issues so that they don't reoccur.

THE CONSEQUENCES OF IMBALANCE GAPS

Imbalance gaps directly impact gross margin and so energy companies deploy large teams to try and identify issues and correct them – which increases their costs. They also consider the impact of the residual imbalance gaps when setting their tariffs – accepting that they are unlikely to be able to bill all of the volume that they have to buy in wholesale markets.

Correcting issues can result in suppliers sending retrospective and unexpected bills to correct issues. This often results in a poor customer experience and is one of the reasons why billing accounts for more than half of customer complaints, according to the data submitted by suppliers to the regulator in Great Britain, Ofgem.

SMART METERING AND IMBALANCE GAPS

With smart meters being rolled out in Great Britain from autumn 2015, there is a real opportunity for suppliers to obtain more meter readings and to deliver new and improved services to customers. The way in which suppliers manage these increased volumes and ensure data integrity and improve customer billing could make or break their business.

Although the coming of smart meters promises to improve the method and frequency of data collection from meters, we won't see an end to imbalance gaps. The meter exchange process associated with the rollout could expose many longstanding errors that have as yet gone undetected. In addition, unless suppliers have good data integrity, and are in control of their imbalance gap position before smart meters are put in place, the extra data they have from smart meters could make discrepancies between billing and settlement even more difficult to identify.

Smart meters are expected to result in suppliers offering new and improved services to customers – such as rewarding them for changing their usage patterns. Many of these benefits will require alignment between billing and settlement and so those suppliers with mismatches will be at a real disadvantage.

Prior to the completion of the rollout of smart meters, which is scheduled for 2020, I expect that settlement processes will be looked at so that smart meters are accompanied by "smart settlement" which will use smart meter data to more accurately reflect customers' actual use of energy. Until then, the customer profiles used in settlement will still be derived from statistical samples that look at just a few hundred customers – thus making the process of converting meter readings taken every month or so

into half hourly or daily values for settlement purposes a complex one where it is very difficult for suppliers to ensure that billing and settlements reconcile.

SOLVING THE ISSUE

Key to operating a successful supply business is the ability to identify and correct errors as they occur and uncover and solve the root causes of problems so they are not repeated. Many suppliers opt for the finger in the dyke approach – solving major issues that have erupted but not truly getting to the heart of the matter to ensure they do not happen again.

The cause of gaps between billed revenue and settlement costs can be difficult to identify and time consuming to resolve. Energy suppliers would benefit from a way of identifying the discrepancies between their billing and settlement position to help them close the gap.

Having an automated system in place to track, monitor and analyze billing and settlement on an ongoing basis and flag up mistakes and discrepancies in time for issues to be resolved before they impact customers will be critical. Such a system could also provide companies with a far deeper understanding of their business, as well as knowledge about the profitability of every customer. With the move to smart meters approaching, the suppliers that are on top of this will be ready to provide the best customer experience and are likely to reap the greatest rewards.

Engage has launched a new Software as a Service system and solution – Revenue & Margin Assurance ("RAMA") that uses suppliers' data to help them identify the source of energy volume and cost discrepancies across their electricity and gas and customer portfolios.

In using such a system suppliers save time and effort in identifying the source of discrepancies, and can quickly discover which meter end-points are causing the problem – so protecting their revenue and enabling them to provide a better deal and service to customers. Our system has been designed by energy sector technical experts with deep understanding of customer billing and settlement processes, and data analysts with many years' experience working with energy suppliers on these issues. It provides suppliers with that competitive edge – enabling them to win and retain customers through more attractive tariffs and a better customer service, whilst still achieving target profit margins.

Getting the balance right between settlement and billing can be tricky for suppliers. With the countdown to the smart meter rollout in Great Britain underway, now is the time for suppliers to get on top of their billing and settlement processes and put systems in place that will help them maximise the opportunities in the smart world. MI

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Richard Cullen is a co-founder and Director of Engage with more than 20 years' experience in the sector. He is an industry expert in the development, implementation and operation of the electricity trading arrangements, and has provided advice and guidance to many market participants on a broad range of topics – including smart metering, smart grids and revenue and margin assurance.

ABOUT THE COMPANY

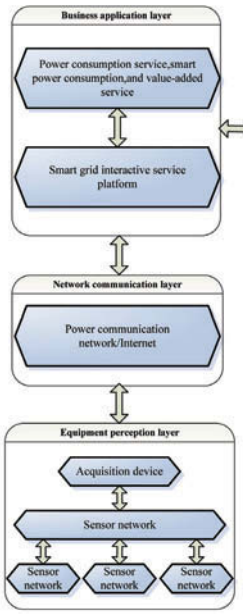
Engage Consulting is a specialist energy and utilities consultancy, with core service areas energy and utilities consultancy, smart metering and smart grids, revenue and margin assurance, and information services for the energy and utilities sector. The company's deep experience and understanding of the utility sector allows it to anticipate and help manage the operational, technological, commercial and regulatory factors that facilitate long-term business success.

www.engage-consulting.co.uk

INTELLIGENT ELECTRIC INTERACTIVE SERVICE PLATFORM

By Wang Jiayuan

The interactive service platform is the basis for interaction between the grid and users. Supported by electric power systems operations, including power information acquisition (AMI), charging and battery-swapping of electric vehicles, the 95598 call service, automation of low voltage distribution and marketing of business applications, a smart services system will complete data extraction, integration and analysis for all supportive systems through various business application modules and provide relevant services to user application modules and to users according to their needs.



Schematic of smart interactive service platform

Further, based on the distributed access and management capabilities of the platform, the system should not only meet the demand of current users, but should also be able to incorporate more service terminals in the course of project development. The platform should have an open standard development interface for value-added applications from third parties, through which social content and service provider applications can be provided to support commercialization of the project and maximize investment returns, Moreover, the platform should provide a consistent user experience. All types of intelligent interactive terminals such as PCs, mobile phones and tablet computers should achieve seamless access in order to complete the business applications and smart services.

MAJOR FUNCTIONS OF PLATFORM

- Acquisition of user's power consumption information – collect household power consumption information by intelligent gateway and smart socket.
- Two-channel service of smart power consumption – realize resource integration for power service by interconnecting SG186 and 95598 (the company's service hotline).
- Fault monitoring service – send fault alarm by intelligent circuit breaker, network power meter and 0.4 kV LV distribution network.
- Charging and battery-swapping service for electric vehicle – human-computer interaction, charge pile navigation and orderly charging and battery-swapping for electric vehicles.
- Distributed energy access – access, management and bidirectional metering of distributed energy, e.g. solar, wind, etc.
- Value-added services – provide e-commerce and push advertising based on smart community platform.
- Performance analysis – provide energy consumption analysis tables and energy saving information based on analysis of users' power consumption information.

APPLICATION PROSPECTS

As the processing of information is the basis for user friendly interaction between the grid and users and a key link for the grid corporation to build out a smart electricity service system, the smart service platform could effectively enhance the existing power consumption service by bringing new smart power consumption services and support third parties to develop social value-added services. The smart service platform is an integration of many technologies including application software, communications networks, and sensing and measuring, whose promotion and application will eliminate the traditional information silos. It supports information sharing and business applications, and will promote the large scale application of internet, cloud computing and intelligent services in the field of energy information.

TYPICAL APPLICATIONS

Conventional power consumption service improvement

Businesses which previously needed to be transacted via counter service or office check can now be done in virtual mode, e.g. via website, phone or self-service terminal. The sale and payment of electricity can be settled through a bank electricity fee payment system or the power supply enterprise network of other third parties.

Smart power consumption service enrichment

Smart grid will generate new forms of power consumption which accordingly will bring new service content. Access of users' distributed power, energy storage devices, measurement and monitoring of charging for electric vehicles, and their home requirements could all be managed and realized by the smart interactive services platform.

Third party services

Third party services refer to non-electricity services provided by social content or service providers through the smart service platform, and could include community property, advertising, security alarms health surveillance, healthcare, payment to utilities, online shopping and triple play. Third party services will further strengthen the social responsibilities of grid corporations and expand their service provision areas. MI

ABOUT THE AUTHOR

Wang Jiayuan is an electronics and information engineering major, with a Computer Software Embedded System Programmer Certificate. He is engaged in research and development of electric power information systems and smart meters, and has rich experience in these areas.

ABOUT THE COMPANY

NARI Group Corporation's Communication and Power Consumption Technology sub-company focuses on smart power consumption in the smart grid. The company has been devoting itself to becoming a leading integrated solution provider to the advanced smart power industry, through core support of smart chips, intelligent measurement and communications based on over 30 years of technical and engineering expertise.

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OUTDOOR SPLIT-CORE CURRENT TRANSFORMER FOR REVENUE-GRADE DISTRIBUTION TRANSFORMER MONITORING

By Wangsam Jang, CEO, J&D Electronics

Recently, the world s leading power companies have been installing competitively priced smart meters to provide accurate electric power consumption information for their clients. The smart meters can also be used to monitor and manage electric power losses from the distribution transformer. In addition, transformer monitoring companies have started to produce revenue grade distribution transformer monitoring equipment, which includes the power quality management functions from the watt-hour meter and protection functions for the measurement of electric power losses.

For these new technologies and products a current sensor with a precise measurement technology is essential.

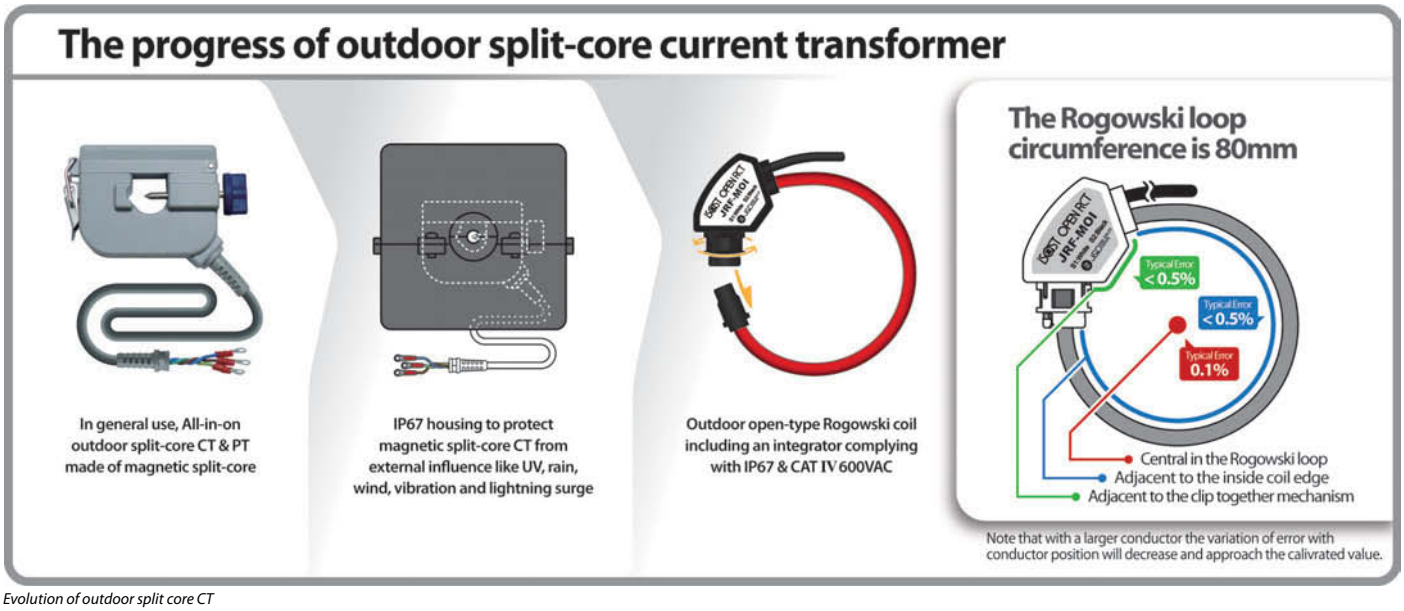
OUTDOOR OPEN-TYPE ROGOWSKI COIL

In general, the outdoor split core current transformer (CT) which is being used for distribution transformer monitoring is designed to meet the IP67 standard. However, this type of current sensor is vulnerable to UV, rain, wind, vibration, and lightning surges. Therefore, when installing the product, the CT has to be covered with a protective housing in order to protect it from external influences, which results in increased installation and maintenance costs. In addition, the split magnetic core CT design has the inherent problems of phase shift or ratio error, which can occur due to the varying air gap where the core halves meet.

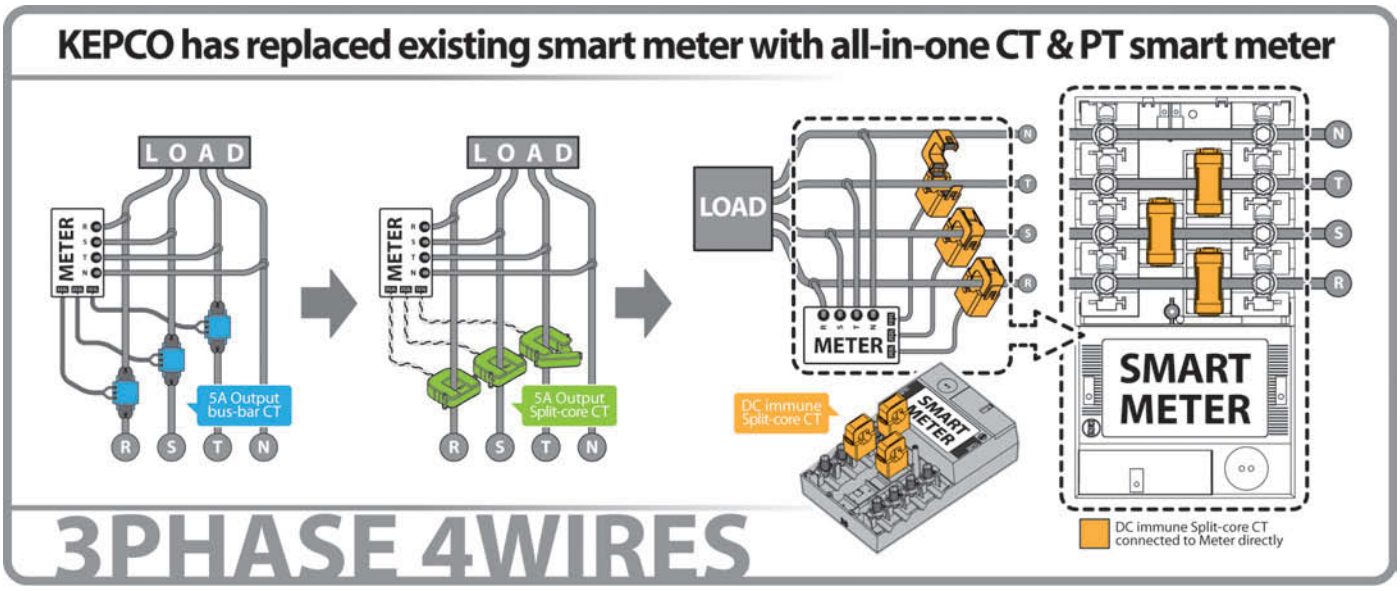
To solve these problems, J&D has launched the iSAST outdoor open-type RCT-M series of precision current sensors for revenue grade distribution transformer monitoring.

The iSAST outdoor open-type RCT-M series current sensor is based on Rogowski coil technology. Utilizing a high precision coil winding technique the RCT-M offers minimal accuracy variance over the operating current range and reduced positional errors which can result from the position of the primary conductor within the current sensor. Advanced shielding techniques minimize the influence of external magnetic fields. The split, open flexible structure enables the product to be easily installed on the powerline, even in tight spaces without taking the primary current off-line. As the iSAST outdoor open-type RCT-M series is composed of an air core, it is less susceptible to UV, rain, wind, vibration and lightning surges. In addition, it meets the standards IP67, UL2808 and IEC60044-8 with 0.5S accuracy, and has acquired the international safety certification IEC61010-1, IEC61010-2-032, UL61010-1, UL61010-2-032 and EN61010-1, EN61010-2-032.

The iSAST outdoor open-type RCT-M series is designed in two different configurations, the Rogowski coil with a voltage integrator and the Rogowski coil without the voltage integrator. In the case of the Rogowski coil without the voltage integrator, the smart meter manufacturer or transformer monitoring company can incorporate the voltage integration function with their product design. The Rogowski coil with voltage integrator configuration can replace the existing CT directly. The developer that uses the standalone Rogowski coil current sensor should design their product with the voltage integration taking into consideration the 90° phase difference before applying the signal to the smart meter or transformer monitoring equipment.



Evolution of outdoor split core CT



KEPCO smart meter arrangement

The iSAST outdoor open-type RCT-M series can measure 100 A to 6,000 A of rated primary input current range and satisfy internal diameters of 35, 55, 80, 105, 125, 130, 150, 200, 250, 300, 500 mm. The product configurations are iSAST outdoor open-type RCT-M series with voltage integrator and iSAST outdoor open-type RCT-M series without voltage integrator.

DC IMMUNE SPLIT CORE CT BY HALL EFFECT TECHNOLOGY

A successful example is the case of Korean Electric Power Corporation (KEPCO). KEPCO chose the latest J&D model as a key component when installing solid state type electronic watt-hour meters. KEPCO has replaced existing meters with all-in-one CT meters to solve power theft and safety problems and the cost increase when connecting an outer mounted CT and metering outfit of a 5 A watt-hour meter. The new solid state watt-hour meter adopted J&D's split core CT which meets the standard of IEC62053-21 in open-type with DC Immune CT. There is no need to cut off the power when replacing the meter, resulting in economic installation.

The open-type CT with DC Immune has solved the problem of without DC Immune split core CT, by using the principle of a Hall effect element and Rogowski coil technology. It cannot be applied to existing 5 A smart meters, thus developers should redesign in order to apply it to smart meters.

The Hall effect technology of with DC Immune split-core CT requires that the primary current passes the magnetic core first. The primary current induces an initial magnetic field, and generates a voltage proportional to the primary Hall element. The amplified voltage is converted into a secondary current, which generates a voltage at the output position. It complies with the standard of IEC60044-1 with 0.5S and 1 Class, and can measure the AC/DC range of 100-2,400 A. In addition to this, it satisfies with inner diameter of 24, 36, 35*38, 62*73, 62*141 mm. The main application areas are DC meters, AC meters, and AC/DC combination meters. The technology is also used in other applications including PV monitoring, motors, inverters, rectifiers, UPS, welding equipment, and throughout the railway industry.

ENERGY SAVING MULTI GREEN ENERGY METER

The Multi Green Energy Meter (Multi-GEM) was recently launched with an advanced technology in the area of current sensor. Multi-GEM is an energy management device that monitors panel board and distribution board in real time. It automatically measures electric power quality in various loads, including voltage, current, power factor and maximum demand power. The basic idea of this product is to calculate the power with the current monitored from each current transformer and the voltage from each terminal. A simple installation and flexible applicability enables Multi-GEM to be easily re-arranged and to monitor without changing wiring. The flexible arrangement helps in analyzing energy consumption patterns of different loads, and saving electric charges and time. Multi-GEM measures a maximum six feeders of three phase loads (and eight feeders in a three phase three line system), and a maximum 18 single phase loads. It can also be used in a combination of three phase and single phase load. This flexible product was developed for applications such as internet data centres, shopping malls, buildings and other industrial sites.

J&D will standardize products based on innovative DNA technology in the current sensor field, and contributes to global smart metering with stable products. As a future-oriented front runner in the CT manufacturing field, we will provide the best solution for cost cutting and high precision current measurement. MI

ABOUT THE AUTHOR
Wangsam Jang is the Chief Executive Officer of J&D Electronics. He is an expert engineer with a focus on best quality and customer satisfaction.

ABOUT THE COMPANY
Founded in 1994 on the principles of best quality and efficient development, J&D Electronics has been providing solutions including split core current transformers, clamp-on Rogowski coils and clamp-on Rogowski coil transducers to customers as a global leader. The company professionally manufactures power, voltage and current sensors for the smart grid.
www.hqsensing.com

FAIR METER INITIATIVE: SERVING PEOPLE AND OUR PLANET

By Hans Nooter

The Fair Meter Initiative is an open network to promote sustainable practices in Europe's smart meter rollout. Principles concerning undisputed raw materials, responsible and transparent supply chain practices, energy neutrality, circular economy, as well as co-creation and reciprocity to stakeholder demands necessitate that the next generation smart meters should be sustainable.

The Fair Meter Initiative wants to launch a sustainable smart energy meter on the market – a smart energy meter in which the parts are produced and used without harming human beings or the environment and that promotes sustainable use of energy. From the housing and batteries to the metal parts and displays: all are to be "fair". The Fair Meter Initiative not only focuses on the design and technical development of the energy meter. By actively seeking dialogue with stakeholders we also draw attention to the working conditions of those along the supply chain, the conditions for exploration of materials as well as the production processes of smart meters. Design processes should also take into account customer preferences and the opportunities for future digital innovations. Offering choices and information about the fair aspects of the meter to customers is part of the concept. As Dutch grid operators we encourage the design, production and market demand for a fair meter, and want to enthuse consumers and other parties to participate. You are invited to share your ideas and contribute to this joint task.

SMART METERS NEED TO BE SUSTAINABLE METERS

Economic growth, a growing population and an unprecedented demand for energy are giving rise to new challenges and investments all around the globe. The fast growing demand for energy and subsequent impacts on social and environmental conditions stresses the urgent need for sustainable energy solutions. As part of worldwide energy related innovations, millions, if not hundreds of millions, of smart meters are being introduced to and launched on the public. Smart meters will help customers to save energy by offering direct feedback on actual energy consumption, billing options and comparative information on energy consumption. Many countries are on the brink of introduction of smart meters. The European Union aims at a widespread rollout: 80% of the customers in EU member states are to be served by a smart meter by 2020.

The planned, large scale introduction of smart meters has raised questions from stakeholders in several countries. Issues under discussion are related to, for example, privacy conditions, data and data ownership, electromagnetic fields, presence of a switch within the meter and the operating standards. Meanwhile it seemed that little or no attention was paid to legitimate questions from stakeholders with respect to these and other issues. In the end it appears that questions on sustainability affect many stages of the smart meter value chain, customer preferences and set up by contractors.

Preparing for the first rollout of smart meters in The Netherlands, the Dutch network and grid companies joined together to discuss their approach to the introduction of smart meters. In a workshop in which the larger grid companies participated, themes with respect to social responsibility and sustainability were introduced and demonstrated in a vivid way. For instance, the workshop started with a session on the contents of used meters and cell phones. A short documentary was shown on the problematic situation with the excavation of minerals and metals in the east Congo area. Human rights and labour conditions are very much at stake in these areas while the revenues of the mining activities do not contribute to local opportunities and peace.

It became clear to the participants that as an important link in sustainable energy grids, energy efficiency and customer relationships, the smart energy meter itself should be demonstrably sustainable and socially responsible. "The millions of smart meters we are going to introduce in the next decade also means that we need to take responsibility to deal with their disposal" was the clear conclusion at the end of the day. Considering the massive flow of meters in The Netherlands and more broadly in Europe and globally, one could conclude that a big difference can and should be made!

THE IMPACTS OF THE SMART METER CHAIN

The impacts of the smart meter chain deserve clear investigation. With respect to the Fair Meter Initiative we collected data by searching the internet for publications and studies. We spoke to local experts and were inspired by the evidence, material, approach and enthusiasm of, for instance, the Dutch FairPhone organization. FairPhone is a social enterprise that was started in 2010 and aims at raising awareness about conflict minerals in electronics. By now FairPhone has launched a first smartphone that meets social and sustainable standards. The participation of large telecoms companies, such as Vodaphone and KPN, is conspicuous. (Information can be found at www.fairphone.com.)

What then are the impacts linked to the smart meter chain? We identified five areas that deserve attention from the perspective of sustainable and social responsibility.

Impact: Raw materials

A wide range of raw materials and elements are used in the production of smart meters. Especially the electronic components of the communications module may include rare and disputed materials. These include tin, copper, steel, iron and parts such as polycarbonate, glass fibre, ABS, printed circuit board, and electronics components. Tantalum may also be found within the electronic parts. The impacts of the most disputed materials are elaborated. Besides the excavation of raw materials, production, and labour, human rights practices need special attention.

Tin is a conflict mineral. The largest tin mines today are in Eastern Congo, where the army tries to control mines by demanding that the

miners pay a toll at the entrance. This way illegal mining of tin is stimulated. At mining sites and in the illegal mines forced labour practices are recorded. Tin is used to solder elements to the print board.

Tantalum is a rare, conflict mineral. In eastern Congo tantalum is mined illegally at low cost. The raw material (cobalt) is often found in the deeper grounds of rainforests. Therefore mining is very harmful to the flora and fauna in Africa. Tantalum is used as a capacitor and enhances the development of smaller devices. Prices have increased sixfold in the past 3 years.

Impact: Emissions
Nearly all stages of the smart meter life cycle give rise to emissions. Most of the emissions are CO_2 and NO_x due to transport and energy usage. Furthermore emissions to the air due to excavation and production processes and pollution of water at mining sites are reported. Exposure to electromagnetic fields and its potential health effects are a topic in the media. This media raises public concern and uncertainty, not only about electromagnetic fields emitted by mobile phones, but also about electromagnetic fields emitted from base stations and other wireless networks.

Impact: Use of energy
Energy use is related to excavation of raw materials, production, stock, set up, use and end of life processes. A lot of energy is used for transport at all stages of the meter chain.

Impact: Labour
Labour issues pertain to excavation and mining conditions, and conditions at production and assembly lines. Human rights are at stake in conflict regions. On the other hand there are chances for a social return on the investment, for example at the redundancy phase of meters. Results from Alliander's project on recycling old mechanical meters show that recycling figures are best when the meters are dismantled by hand. This also contributes to jobs for less qualified workers.

Impact: Data exchange
The ways data are dealt with is an issue that is publicly questioned. In different countries public discussions have unrolled on privacy of customers, as well as on the management and ownership of data. The involvement and needs of stakeholders and customers are an important and necessary input in this. As the smart meter is intended to serve clients and contributes to a sustainable energy system it may reasonably be expected that transparency about data and data exchanges should meet high standards.

FROM IMPACTS TO ACTION
Considering the impacts of the smart meter life cycle and value chain the Dutch DSOs concluded that they should call for action. Therefore the Fair Meter Initiative was introduced calling for fair and sustainable standards. Four domains are identified as relevant to action from the DSO's point of view:

- Fair mining and production of raw materials, and the fair production of smart meters. Suppliers make the supply chain and the sources of materials transparent. Suppliers are willing, together with partner organizations, to actively work on improvements in the material chain, especially in circularity and production conditions.
- Fair use and handling of waste processing. The supplier is transparent about the energy consumption of the meter – the aim is an energy neutral meter. The meter design meets principles of circularity. The starting point is maximum reuse of the meter at the end of its lifecycle. Meters can be disassembled at the end of their lifecycle with the raw materials fully recognizable and separable.
- Fair tendering and procurement principles including co-creation with suppliers. Suppliers are willing to cooperate with DSOs, customers and suppliers on innovation giving way to improvements of the meter.
- Fair offer to our customers – the reciprocity principle. Aspects of the meter, such as electromagnetic radiation, privacy and functionality as part of energy management for the customer can be tailored and made consistent with the wishes of the customer. Includes the ability to not use certain options (opt-in, opt-out). Packaging of the meters ensures minimal resource consumption and minimum transport volume, and package material is fully recyclable.

Beyond these domains there is a need for transparency on the whole of the smart meter life cycle and value chain. This includes transparency on social, sustainable and human rights issues and the constituency of the meter itself. The transparency imperative is also a key element for stakeholder information and the development of fair trade practices within the value chain related to smart meters.

The fair meter not only complies with functional aspects (measuring, communicating, switching, etc.), but also ensures the stakeholders have a proper story. This leads to lower environmental impact and resource depletion in rollout, better acceptance by the customer and thus a positive impact on energy saving. Parallel to the four areas on which the Dutch DSOs are calling for action, a couple of principles have been formulated in order to provide focus. These principles are to be further developed, in consultation with stakeholders and manufacturers.

Shared vision
The Dutch grid operators have developed a shared ambition. They are willing to make social and environmental aspects an integral part of their own processes as well as the procurement processes.

For a broad audience the smart meter is the most visible component of the grid operators. Demonstrability of social value and lasting quality are key elements in the expansion of smart meters. If parts of the introduction are not in order, this may increase the social backlash to the smart meter.

The smart meter is a necessary part of smart energy networks that support the energy transition. Congruence with other sustainability aspects is therefore of great importance. Corporate social responsibility is an important motivation and is part of a business driven approach.

The sequel: Dialogue and co creation as steps in the process
The ambitions of the Dutch DSOs depend on the meaning and ambition that stakeholders, experts and manufacturers show towards this initiative. This should lead to a concrete elaboration on the ambitions and principles. We stress the importance of the contribution of knowledge and ideas of stakeholder and market parties. Dutch grid operators are open to further ideas and have therefore a preference for a competitive dialogue aimed at implementing fair meter principles.

STAKEHOLDER CONSULTATION
The vision of the Dutch DSOs' partners on the fair meter has been introduced to several stakeholder groups. These include smart meter suppliers associated with ESMIG and European DSOs.

The consultation of a random selection of meter suppliers was a first test of the concept of a fair meter. Overall conclusions that were recorded showed clear interest and recognition from suppliers.

As this was a first request meant for introduction and opinion, this round did not give way to explicit deals or alignment to the initiative.

Regarding raw materials, suppliers indicate that this is a complex matter at a specific country level. The origins of materials are often not clear and there is a lack of evidence. Information on specific countries is not well looked after or is not being used.

With respect to transparency on the supply chain it is said that first and second tier suppliers seem easy to disclose on, but other stages in the supply chain seem more difficult to report on. As described above, the Fair Meter Initiative encourages suppliers to examine all stages of the supply chain and give weight to social and environmental conditions and fair trade principles: for example, by actively tracking and tracing, and auditing on mining and production locations.

Energy neutrality happens to be a theoretical concept rather than an ambition in the industry. Energy efficiency is preferred as a criterion, which of course is easier to attain at a sole company level. Probably this illustrates the need for cooperation and overarching solutions at a sector level.

Prevailing European regulation can contribute to the fair concept, as suppliers are working on programmes to comply with these regulations. For example, the ROHS and WEEE directives are mentioned. From a fair meter perspective we encourage the absence of hazardous materials in order to support a cradle to grave approach.

Suppliers consider the common notion of social responsibility as a normal part of their business. Sustainability criteria have been developed during the last decade and tend to normalize regular businesses. Standards and certification have become part of many supply chain initiatives. They recognize and value fair aspects and principles as potential new ground. However, the concept of an integral fair meter and the rethink of the meter design are, of course, new and innovative to the current metering business.

INTRODUCING THE FAIR METER INITIATIVE

At the Metering, Billing/CRM conference 2012 the Fair Meter Initiative was presented to the participants at the exhibition. A striking market stand was located at the heart of the exhibition area. Visitors were asked what they thought a fair meter could be, information on the impact of electronics was presented and there was a challenge to compose one's own fair meter with recycled materials. Many visitors were curious to hear about the initiative and contributed by making suggestions and composing their own meter examples.

Compose your own fair meter at the market stand at Metering, Billing/CRM 2012 in Amsterdam

PARTICIPATION

The Fair Meter Initiative is an open initiative. As Dutch grid companies we challenge ourselves and parties connected to smart meter developments to work together on this concept with the objective to set a new meter standard and to meet the challenges of a circular and thus sustainable economy. We are determined to walk the talk. Nevertheless it's of great importance that others participate and join the initiative; finally then the fair meter will be the result of innovating cooperation to fulfil the legitimate demands of stakeholders and a larger public.

NEXT STEPS: CALL FOR IDEAS AND ACTION

We invite interested parties on the quest for fair meters to meet the challenge of aligning parties and unite for a coalition in order to really implement fair meter principles in our day to day business processes. At the upcoming European Utility Week in Amsterdam, the Fair Meter Initiative will be present. We suggest that a Declaration of Intent should be prepared by interested parties. The event will be the beginning of a shared journey to further developing a fair meter. We are open to your participation and call for your ideas! MI

Special acknowledgements to Bas van Abel, employees of Waag Society Amsterdam, Sander Molenaar (Enexis), Elif Cengiz, Lij-Saan Wong, Willem Janssen van Doorn, Marjolein van Leeuwen, Koen Eising (Alliander).

Reference

Ida Lund Segnant. "Assessing the Environmental Costs and Benefits of Households' Electricity Consumption Management". Master of Science in Energy and Environment, Department of Energy and Process Engineering. Norwegian University of Science and Technology.

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Hans Nooter holds a managing position in Alliander NV's policy of corporate social responsibility and sustainability. He has origins in environmental and political sciences and holds a degree in environmental business administration. His research and practices cover different aspects of CSR, stakeholder dialogue, reporting, environmental and change management.

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WAITING FOR DARKNESS

By Bedrich Benes

Power systems in Central Europe are systematically facing critical situations. An enormous power market deformation (public subsidies of renewable sources, import of cheap coal from the USA due to shale gas usage) is leading to many negative impacts. Modern gas and coal power sources as well as (surprisingly) nuclear reactors are often beyond the line of economic profitability.

This situation brings unexpected results. One of them is an ongoing utilization of already depreciated brown coal sources with no emissions decrease. The second one is power production in unpredicted sources. Let's add senseless subsidies that drain money from needed projects and we have a description of Central European power engineering. Later can be added positive impacts of subsidies to the development and production of photovoltaic panels (also in small scale installations which contributes to the power independency of customers).

All the above-mentioned facts create enormous tension in keeping equal balance between power production and consumption. We are witnesses of irreversible changes that are permanently modifying the requirements of today's power engineering. However, the external political intervention that put these changes in motion did not state the most important thing: how will it all be regulated?

Without any doubt, smart grid system application is suggested. However, it also has a small fly in the ointment. With subsidized solutions that are introduced within these projects, the basic economics are often forgotten. Quietly and naively, it is hoped for installation of high speed transmission with 100% coverage that solves projected data transfer inefficiencies, including orders generation and communication protocols inefficiencies. Let's try to look for possible procedures that could keep these effects to a defined scale.

In order to complete power energy system control, we can use a decentralized element as a basic step. Its main task is to create and maintain balance on the local level, or impose limitation on power overflow to higher voltage levels. The power system is thus forming into small local islands with one or several distribution transformers. This element, the local control unit (LCU), should organize all the needs in the local distribution network based on the requirements of the larger system (Figure 1). This solution is based on working with a relatively small number of devices on both the production (distributed small sources) and consumption sides. It is possible to use technical tools that are already available, and are currently verified within pilot projects.

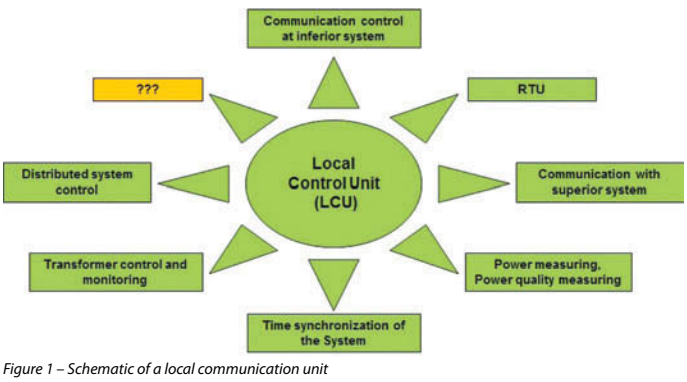

Figure 1 – Schematic of a local communication unit

The LCU is defined in such way that significantly decreases the cost due to its integration in comparison with the situation where single units cover single functionalities.

Distributed system control is the essential attribute of an LCU. Modern electronic meters (with breakers and intelligent frequency relays) together with the customers' cooperation enable them to control and use their production and accumulation capacities. This relation to the customer is thus a basic tool for system control.

An integral part of the connection between the LCU and e-meters is also theft detection and localization, as well as failure prediction. Monitoring and identification of sources emitting deformed power to the network belong to the further very important functionality.

Time synchronization is used. The time stamp is primarily derived from a GPS signal, and subsequently is used for synchronization of all devices placed in the distributed system. Such time synchronized measurements enable operation state analysis.

Among other characteristics of the LCU, we can mention monitoring and control of substation operation, with the possibility of acting in transformer settings. Support of safe communication and secured inferior system control is a natural thing. The result is thus a relatively very powerful, financially unambitious unit containing all requested functionalities for effective inferior distributed system control.

From the hardware point of view, the LCU comprises satisfactory computing power and is ready for multi-processor solutions. This means that (if necessary) every process can run on its own independent processor with possible use of the precisely time defined operation system. The LCU must be independent of protocols and standards. It is enabled to use the protocols of the customer, their modification, and exchange. This is also valid for single software components of the LCU.

As one book said, the Rubicon is crossed, and there is no return. All of those with connection to power engineering know we are very quickly getting closer to the moment when we will not be successful in maintaining power production and consumption in balance, which will result in darkness. It is certain that it will happen, just that we do not know when and for how long. All the participants hope that, based on this darkness, the lights will be turned on in the heads of the elites and that they will take the appropriate steps. In the end, however, maybe the most reasonable thing will be to do nothing and leave it to those who really understand! MI

ABOUT THE AUTHOR
Bedrich Benes is manager for strategic planning responsible for research and development activities. As mayor of the City of Sezimovo Usti, he was member of the Board of Directors of the biggest South Bohemian water operating company. He is a successful patent holder in the electromechanical engineering area.

ABOUT THE COMPANY
Based in the Czech Republic, ModemTec is a leading R&D company within smart metering/smart grids area. Cooperating with large utilities such as CEZ and PRE, ModemTec is a well-known producer of products based on reliable PLC, including smart meters for residential use, powerline modems and data concentrators. The company also develops multi-utility solutions and implements security standards.
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COST RECOVERABLE TARIFFS

INCREASING WATER SERVICE COVERAGE OF POOR HOUSEHOLDS

By Natalie Chun, Economics and Research Department, Asian Development Bank

While significant investments have been made in water and sanitation services over the past 20 years, progress toward achieving universal coverage of urban households in developing countries for water and sanitation services has been slow. In 2011, an estimated 5% of urban households in developing countries still had no access to treated water, 26% did not have access to piped water on household premises, and 9% remained without sanitation services that meet minimum standards of hygiene (WHO and UNICEF 2013).

These households without coverage are inevitably some of the poorest and least well-off, but are where significant positive impacts to health and well-being can be achieved through provision of these services. A large part of the failure to achieve universal coverage may potentially be attributed to rigidity in financing and tariff structures used to cover the costs of such services. In reviewing past experience, a reasonable conclusion would be that expanding services to the poor is largely in conflict with cost recovery and can only be done through heavy subsidies and development aid.

More innovative financing and tariff structures can serve as a cost effective way to further social objectives while ensuring that service provision is financially sustainable. However, potential misperceptions regarding the efficacy of current tariff structures and inadequate data and models that provide systematic evidence on the impacts that changing connection charges and tariffs can have on coverage rates may be hindering a re-examination of financing cost recovery through tariffs. While differential tariffs are commonly used by public utilities in developing countries – with 90% of water utilities using some form of differential tariffs in 2005 – they often only distinguish between broad residential and industrial consumer groups or differentiate based on volume consumed (Komives et al. 2005).

The usage of increasing block tariffs is one of the more prevalent types of tariffs used for water services in developing countries. These tariffs charge larger fees per cubic metre as total water consumption passes certain thresholds of total consumption. Since the initial blocks are typically set well below the cost of service provision these tariffs are often perceived as pro-poor and redistributive in nature. In theory, richer and less price sensitive customers are assumed to consume more, resulting in a larger burden of payments and a higher average tariff paid by higher income groups. However, in practice, increasing block tariffs often fail to meet pro-poor objectives as they are computed on a household basis rather than a per-person basis. Poor households which are often larger, therefore usually pay a similar or even higher amount per quantity of service under increasing block tariffs. Thus, even though these tariffs may have a useful role in potentially curbing excessive consumption by charging higher prices to people who consume more, they often do little to cross-subsidize poor households and increase access.

Even though current tariffs may not be that effective, absence of data and adequate models to identify appropriate tariffs and quantify the effects has made it difficult to encourage change. However such data and analytical investments may have large payoffs toward achieving financial sustainability and extending service provision. Many existing models of service provision omit key aspects of the problems consumers face when deciding whether to connect and utilize a service. Upfront connection costs, for example, are not always modelled, but often serve as a greater deterrent to gaining access to a service than monthly charges.

COST RECOVERABLE TARIFF MODEL

To analyze various connection costs and tariffs the following model is used which captures key aspects of water supply and demand:

i) The service provider is assumed to be a monopolist who sets tariffs to ensure that all costs are recovered
ii) The provider faces both variable and fixed costs
iii) The provider uses a flat monthly volumetric charge
iv) New consumers decide whether to access a service based on the one-time connection charge in addition to the monthly charge
v) There is a variety of different types of consumers (businesses and households; connected and non-connected) with different levels of demand for the service.

To contextualize the discussion, data from a contingent valuation survey for the Water Supply and Sanitation Project covering the Metropolitan Cebu Water District (MCWD) in Cebu, Philippines is used with the described model.[1] MCWD is a water provider which charges the one-time connection charge and then uses a monthly two-part tariff which charges a small initial flat fee covering 10 m^3 of water consumption and a volumetric increasing block tariff thereafter. The high one-time connection charge amounting to Php4,950 (US$115) and the higher burden of payments as a percent of income that poor households face under the current tariffs may be a major reason why only 12% of poor households currently have access to water services compared to 48% of higher income households.

Despite MCWD using an increasing block tariff system, poor households face the same burden of payments per unit of consumption of water as higher income households as seen in Table 1. Poor households consume only 1.5 m^3 of water less than middle income households and consume 0.2 m^3 more than high income households, even though poor households have 2.4 more people than middle income households and 3.6 more people than high income households. Thus, water fees account for a higher proportion of the income of a poor household at 7.3% compared

Water service (Connected HH)				
Per capita income group	**HH size**	**Mt. water consumption (m^3)**	**Mt. Fee (Php)**	**% fee of HH income**
All	4.7	24.6	502.8	3.1%
Poor	7.6	24.3	496.7	7.3%
Mid	5.2	25.8	537.5	4.8%
High	4.0	24.1	486.6	1.8%

Table 1 – Water consumption and monthly fees by household per capita income groups
Source: Estimates based on SEUW's Water and Supply and Sanitation Contingent Valuation Survey. Chun (2013).
Note: Per capita income groups are as follows: Poor = below poverty line (₱1,556, or ~<$36 per month per person<); Mid = 1-2.5 times the poverty line (~$36-$90 per month); High = above 2.5 times the poverty line (~>$90 per month).

1. For more background and discussion of the model utilized and the resulting tariffs identified see Chun (2013).

to only 1.8% for a high income household. It suggests that creating tariffs that directly lower the burden of payments for poor households rather than trying to achieve it through increasing block tariffs may help to expand services to this group.

Eight different tariff structures described in Table 2 are considered where tariffs vary among three categories of household groups (poor, mid, high) and businesses and cost recovery of the provider is imposed. It ensures that when different tariffs are charged to household groups under zero profit cost recovery that the different groups have roughly equivalent levels of demand. The monthly volumetric tariffs considered assume a uniform price per cubic meter of water consumption.

The analysis finds that amortizing the connection charge into the monthly charges of all households being provided with water services can result in a 32% take-up rate of water services by poor households (Figure 1, S2Z) which is a 20 percentage point increase over the current base connection cost-tariff structure. Tariff structures which vary depending on levels of household wealth (poor, mid, high) result in a 56% take-up rate or an increase of 24 percentage points over the structure which only amortizes connection charges into a flat volumetric monthly tariff (Figure 1, S5Z). Since screening each household by level of poverty may be difficult or costly, an alternative tariff which screens by three different degrees of poverty in an area (poor: 33% or higher rates of poverty, mid: 10-32% level of poverty, high: < 10% poverty) is also considered. This results in 61% of poor households taking up services (Figure 1, S8Z).

Large and substantial increases in the percentage of poor households who have access to water services potentially can be achieved through alternative connection charges and tariff structures with only small increases in the average tariff rates for even high income households. In particular, using a tariff structure where connection charges are amortized into monthly demand,

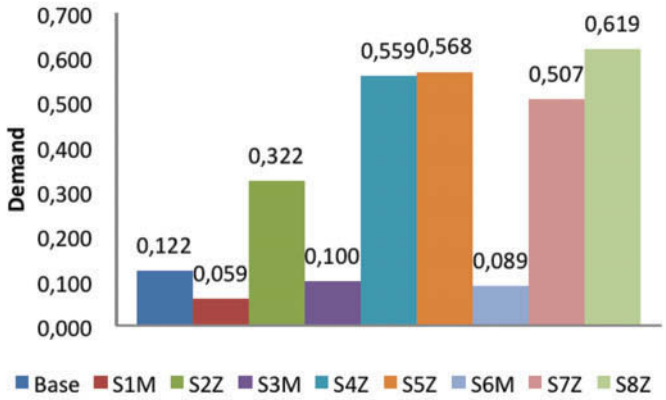

Figure 1 – W: Water service demand for poor households by tariff structure
Source: Chun (2013)

demand is equivalent across different groups, and the firm has zero profit cost recovery (Figure 1: S5Z, S8Z), caused only ₱3 ($0.06) increase for high income households over the base average per cubic metre charge. The enlargement of the customer base that allows a greater number of people to share the large fixed costs of supplying water relative to the variable costs is the main reason why there are only marginal increases in unit costs. Expansion of the customer base occurs through amortization of connection charges into the monthly tariff and the differentiation of charges between businesses and different types of households. This provides the means to use higher income households and businesses that are less sensitive to marginal changes in charges to explicitly cross-subsidize poor households and increase the overall percentage of people accessing water services.[2] While there are many additional tariffs that could be considered, such as greater refinements in charges depending on the income status of a household or ensuring that no households are worse off from the change in tariff structure, these are still likely to produce significant increases in take-up rates by poorer households over the current pricing structure.

Code	Definition
Base	Current structure of water provider. Standard tariff for all consumers and no-amortization of connection charge into monthly charge.
S1M	Standard tariff for all consumers; amortization of some of the connection charge into monthly charge; profit maximization.
S2Z	Standard tariff for all consumers; amortization of some of the connection charge into monthly charge; zero profit.
S3M	Different tariffs charged such that profit maximized for each household income and business sub-groups; amortization of connection charge into monthly charge.
S4Z	Different tariffs charged such that demand equalized across household income and business sub-groups; amortization of connection charge into monthly charge; zero profit.
S5Z	Different tariffs charged such that demand equalized across household income sub-groups and profit maximizing tariff to business; amortization of connection charge into monthly charge; zero profit.
S6M	S3M but tariffs charged by degree of poverty in area (geographical tariff differentiation)
S7Z	S4Z but tariffs charged by degree of poverty in area (geographical tariff differentiation)
S8Z	S5Z but tariffs charged by degree of poverty in area (geographical tariff differentiation)

Table 2 – C: Connection and tariffs examined

CONCLUSION

The potential for changes in connection charges and tariff structures to improve coverage of key services for poor households in developing countries and ensure financial sustainability of the service provider should be examined. However, investing in gathering the right data and applying an appropriate model may be the necessary step toward convincing political players and stakeholders of the efficacy of making changes to connection fees and tariff structures. Ultimately such changes may be critical to achieving universal coverage of such important services that can be sustained over the longer term without heavy reliance on outside financing. MI

References

Chun, N. 2013. Cost Recoverable Tariffs to Increase Access to Basic Services among Poor Households. ADB Economics Working Paper Series No. 342. Manila: Asian Development Bank.
Komives, K., Foster, V., Halpern, J. Wodon, Q. 2005. Water, Electricity, and the Poor. Washington D.C.: World Bank Publications.
WHO and UNICEF. 2013. Progress on Sanitation and Drinking Water 2013 Update. Geneva: WHO Press.

2. Some of the limitations of the data may cause some of the results to differ from reality. First, contingent valuation methods are not always able to mirror actual situations and therefore introduce some measurement or imprecision into the analysis. It is considered second best compared to deriving demand from observational data. For this set of data, demand responses to various tariffs were found to be in the range of those estimated for water using observational data from developing countries. Second, the data made it impossible to incorporate how a consumer may adjust their consumption of water in response to different volumetric tariffs. Instead optimal consumption of water was assumed to be fixed depending on certain consumer characteristics and that consumers had an optimal target per cubic metre that they were willing to pay. This is unlikely to have large effects on total consumption behaviour as water consumption would still account for a relatively small portion of overall budget and utilizing increasing block tariffs could ensure that most consumers stay within a relatively small range of total consumption.

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Natalie Chun is an Economist in the Economics and Research Department of the Asian Development Bank. Her research covers a wide range of microeconomic topics as they apply to development in Asia. She received her Ph.D. in Economics from Stanford University.

ABOUT THE ORGANIZATION
Asian Development Bank (ADB), based in Manila, Philippines, is a multilateral development finance institution aimed at helping developing member countries in the Asia and Pacific region. The main instruments through which it provides assistance are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.
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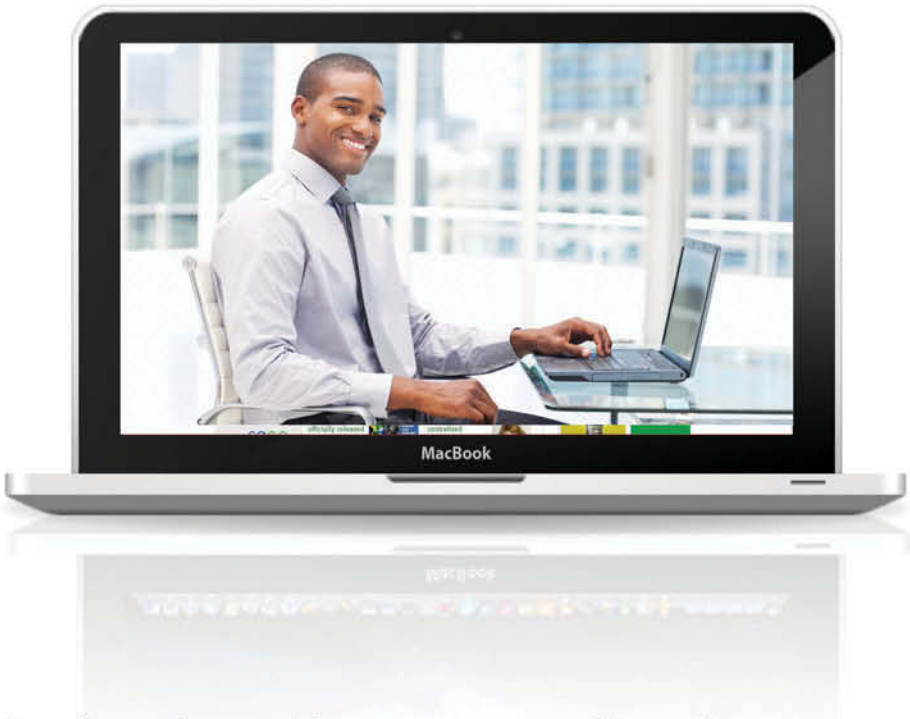

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RESIDENTIAL ENERGY USE DISCLOSURE

HELPING HOMEOWNERS MAKE SMARTER DECISIONS WITH INCREASED INFORMATION ON A HOME'S ENERGY USE

By Rachel Cluett

Interest in residential energy rating and disclosure to increase transparency about home energy use is growing in the United States. While policies requiring disclosure of energy use information have gained significant attention in the commercial sphere, with mandatory policies recently implemented in a number of large US cities and others currently under consideration, more disparate policy efforts have characterized the residential sector.

A majority of these residential energy disclosure policies have been enacted in the recent past, between 2006 and 2012, making it a good time to assess how – and whether – these emerging policies are raising awareness of a home's energy use during the home buying or rental process and driving changes in the market for energy efficient homes or home retrofits.

Widespread residential energy rating and disclosure is promising for a number of reasons. While some disclosure policies are present in jurisdictions that have traditionally had progressive energy efficiency policies, other policies have popped up in areas where there are few, if any, other energy efficiency policies on the books. Additionally, energy disclosure supports the trend in increasing transparency of information around the home buying process in a post-mortgage crisis environment, adding increased consumer awareness around the costs of home ownership.

Increased information about a home's energy use can encourage consideration of energy consumption in home purchasing and rental decisions, inform homeowners about cost effective efficiency improvements, motivate homeowners to invest in efficiency improvements, and generate the information needed for better valuation of energy efficiency improvements in a home for appraisals and mortgage underwriting. In a recent report by the American Council for an Energy Efficient Economy (ACEEE), a review and analysis of existing residential energy use disclosure policies in the United States found a total of 14 jurisdictions (six states, one county, and seven cities) with policies in place mandating some type of energy use disclosure for portions of the residential building stock. Since the release of that report, one additional policy was passed in Boston, MA, which requires benchmarking commercial and multifamily buildings over a certain size.

This article reviews the types of residential energy use disclosure that are currently required in different parts of the United States, explores the trends in policies requiring energy use disclosure, and provides recommendations on how to move forward in designing and implementing effective disclosure policies.

AN OVERVIEW OF RESIDENTIAL ENERGY USE DISCLOSURE POLICIES

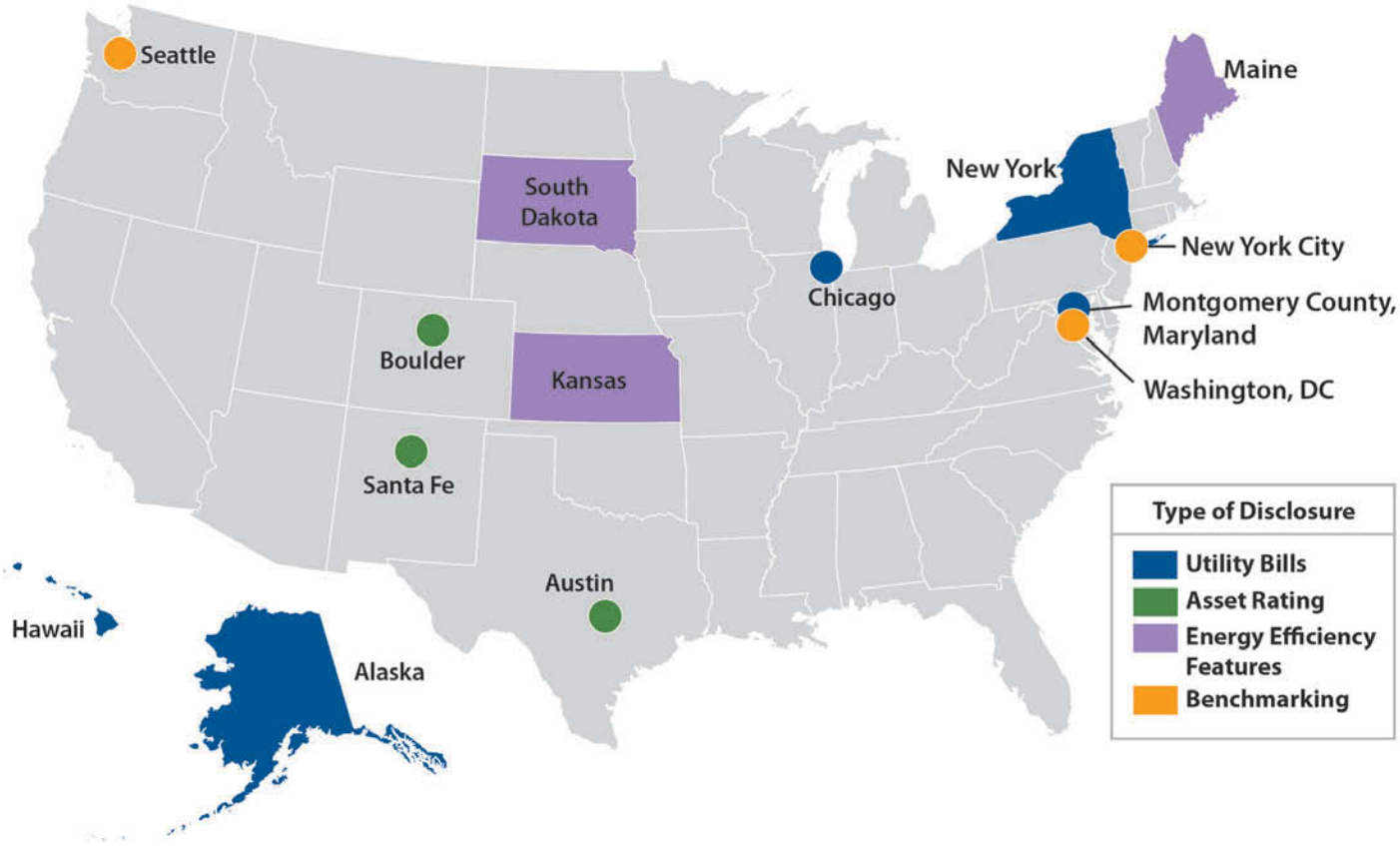
Residential energy disclosure policies affect both single family and multifamily homes, both owner-occupied and rentals. Disclosure of building energy use or building energy performance generally takes one of two forms: an asset rating designed to indicate a building's energy performance as-built, based on building characteristics and systems; or an operational rating that reports on building energy consumption during building operation. Both types of disclosure are used in the United States.

Asset and operational ratings have discrete value in different settings. Asset ratings are valuable for a residence that will have new occupants with presumably different consumption behaviour and number of occupants. Asset ratings are more permanent, since ratings will only change with large alterations to the building envelope or significant system upgrades. In comparison, most operational ratings are done on a yearly basis, and incorporate a year's worth of utility data into a rating. For new homes, asset ratings are the only feasible rating option since energy has not yet been used in the home. Operational ratings are beneficial for large buildings where a full energy audit and asset rating is more costly, and for tracking changes of energy use in a building where occupancy and behaviour are constant (Dunsky et al. 2009). Operational ratings can also be crucial in helping to provide information about how behaviour and building systems interact to affect performance.

The primary time in the homeownership life cycle for requiring energy performance disclosure in existing policies is at the time of sale or rental. There are at least three discrete points at which energy performance disclosure can occur during the broad "time of sale" designation: the listing of the home, the contract period, and the closing date. Most jurisdictions currently require disclosure to occur before a purchase contract, which kicks off the contract period.

Disclosure of energy use information earlier in the home sale process, at the time of listing, is required as a part of only one mandatory US energy disclosure policy, in Chicago, IL. In Chicago, utility data can be uploaded and linked to the local Multiple Listing Service (MLS) website when a home is listed for sale. This policy sets an example for how policymakers can design energy disclosure laws to leverage existing infrastructure and mechanisms that are well known and widely used during the home buying process, such as a regional MLS, to get information about disclosure out in a uniform and widespread manner.

The existing residential rating and disclosure landscape in the United States can be categorized as follows:



Leveraging increasing availability of operational energy use data (Source ACEEE)

- Asset rating
- Disclosure of specific energy efficiency features
- Utility bill disclosure
- Benchmarking

The following map shows the number and type of residential energy disclosure policies currently in effect in the United States.

Residential disclosure policies in the United States have predominantly been characterized by operational energy use information (with the exception of Austin, TX and Santa Fe, NM). This differs from the approaches that have been tried internationally. In the Australia Capital Territory, asset ratings with energy performance labels have been required since 1999. In Denmark, energy labelling has been in place since 1997. In the EU, asset ratings are required in all member states as a result of the 2003 EU Energy Performance Buildings Directive. A primary value of asset ratings lies in the ability of a consumer to compare buildings on an equal footing, exclusive of how previous occupants may have operated the home. This has led to a price premium for highly rated buildings that has been documented in the Australia Capital Territory and in the Netherlands (EWHA 2008; Brounen and Kok 2010).

While the value of asset ratings are apparent from international experience, operational ratings also play a useful role as a less costly option, which can continue to grow with increasing ease of access of energy information. Recent advancements in the access of utility data for homeowners can help energy use data reach a broader audience. Through a call-to-action from the White House in 2011, the Green Button Initiative was launched to give consumers tools to help reduce their energy bills. With the increasing trend in widespread availability of energy use information, barriers that currently exist for customers trying to obtain past utility bills are greatly reduced. Standardized access to a year or two of energy use information reduces barriers cited by opponents of utility bill disclosure in the real estate transaction process, including confusion associated with different types of utility bills, which was highlighted by opponents of the utility bill disclosure requirement in Hawaii, and challenges in obtaining a year's worth of energy data.

Providing homebuyers with energy use information gives buyers a platform for discussing trends in energy usage. For a homebuyer, viewing utility bills in conjunction with conversations with sellers about occupancy can help consumers make more informed decisions. Experience has shown that comparison of operational data use between households can be very effective in rousing behavioural change in home dwellers.[1] Concerns regarding difficulty interpreting what utility bills mean are alleviated with increasing standardization of bills, increasing comprehensiveness of utility information (e.g. fewer estimated readings), and development of web and smartphone applications in concert with Green Button technology to ease interpretation of energy use information.

Operational ratings are required for all but one multifamily disclosure policy (in Austin, TX, multifamily buildings must have an energy audit). While an asset rating would certainly help to prioritize energy improvements for a large multifamily building, ratings quickly become prohibitively expensive in large buildings. Operational ratings have been successful in filling a role in the management of energy information that otherwise may slip through the cracks for building owners that don't traditionally have time to allocate to observing energy use patterns. Compilation of energy use data for multifamily buildings in particular, allows owners to observe whole building that they have not yet had access to (in the case of individually metered units). Case studies from Seattle, WA demonstrate the value of energy use disclosure in helping a property owner with multiple buildings distinguish the high energy users in a portfolio of similar properties, to recognize problems and prioritize upgrades (SDPD 2012). In

1. Studies on the work of OPOWER, a company that partners with utility companies to send individualized energy report letters to customers that provide comparison of energy use between neighbours, have shown considerable reductions in energy use across the country (Allcott 2011).

addition, an analysis by the Environmental Protection Agency (EPA) in 2012 found in a pool of 35,000 benchmarked buildings, that consumption decreased by 7% between 2008 and 2011. While these buildings were not necessarily benchmarked as part of a mandatory city policy, results serve as an indicator of the effect of observing energy use information by a building owner or manager (EPA 2012).

RELYING ON A TRUSTED RATING SYSTEM

The value of asset ratings has been demonstrated in parts of Australia and the European Union. However it is critically important to ensure the infrastructure and tools for implementation are mature enough before requiring implementation of a specific energy rating system for asset rating.

"A successful energy disclosure policy requires infrastructure for implementation and evaluation"

The first years of implementation for labelling in The Netherlands were marked by a dramatic decrease in the number of homes labelled with an Energy Performance Certificate (EPC), from 25% in January 2008 to 9% in August 2009 that was attributed to uncertainty regarding the consistency and reliability of the energy label from consumer organizations and the real estate industry (Brounen and Kok 2010). While there has been progress with a number of rating systems in the United States (including home energy score, energy performance score, and the home energy rating system), barriers still exist regarding accuracy and cost, and applicability to new versus existing homes, which must be addressed before adoption of an asset rating system on a widespread scale.

LEVERAGING EXISTING INFRASTRUCTURE FOR SUPPORT

Disclosure policies that have been passed and implemented with the most success in the United States are characterized by engagement and open communication with stakeholders including the realtor community (Montgomery County, MD; Austin, TX; and Chicago, IL) and home builder associations (Santa Fe, NM). In Austin, TX, collaboration with the Austin Board of Realtors (ABOR) in the development, passage, and implementation of the ECAD Ordinance was important to the success of the program. Involvement of the Greater Capital Area Association of Realtors (GCAAR) in the development of a disclosure policy in Montgomery County, MD helped to win the support of business-oriented members of the County Council. Collaboration with Midwest Real Estate Data (MRED) in Chicago has been important to developing an implementation strategy to complement the passage of amendments to the existing ordinance. In Santa Fe, disclosure laws requiring a home energy rating system (HERS) score familiarized local stakeholders, including the local homebuilder's association, realtors, and HERS raters with the labelling requirement, leading to a collaborative effort to enact HERS rating requirements that are now successfully met by builders.

CREATING MECHANISMS FOR TRACKING AND PROGRAM IMPROVEMENT

A successful energy disclosure policy requires infrastructure for implementation and evaluation. While a host of disclosure laws were passed in the United States between 2007 and 2009, the majority of the policies were limited by lack of follow through that led to low rates of awareness and compliance. As a result of limited allocation of resources to program implementation and data management, there has been little to no evaluation done on whether the data being received by homeowners is being used to influence decision making thus far.

In Austin, tracking the number of audited homes that performed retrofit work revealed very low rates of action, prompting the city to require disclosure of energy audit results earlier in the home buying transaction. The comprehensive program structure that is characteristic of Seattle, Washington, DC, and New York City's benchmarking policies sets up jurisdictions to implement regulations that building owners are more likely to comply with, and that results are available for, for future evaluation and alteration.

Tracking results of an energy disclosure policy is crucial to continuous improvement for better performance of the policy. Periodic evaluation is also crucial to supporting and justifying present and future disclosure efforts.

RESIDENTIAL ENERGY USE DISCLOSURE AS A PATH TOWARDS MORE EFFICIENT BUILDINGS

Residential energy use disclosure is a promising area for policy intervention that is increasingly on the radar of policymakers, program administrators, and advocates alike. The significant variety in existing policies provides a valuable look at best practices from a wide variety of jurisdictions and locations in the United States. There is also a clear need for further tracking and evaluation of existing policies to determine how energy use disclosure can affect home purchasing and rental decisions, and motivate homeowners to invest in efficiency improvements, which is crucial to supporting this promising policy option for passage in additional states and cities.

Disclosure of energy use has the real potential to help people quantify the full cost of owning a home, facilitating more financially sound decisions that result in fewer defaults on mortgages (Sahadi et al. 2013). With limited bureaucracy and low program costs, valuable information can be made available for homeowners through residential energy disclosure policies, and it stands as a promising policy option for improving energy efficiency and transparency in the home buying process. MI

This article draws from a research report published by the American Council for an Energy Efficient Economy (ACEEE). For the full report, Residential Energy Use Disclosure: A Review of Existing Policies, please visit the ACEEE website at: http://aceee.org/research-report/a131

References

1. *Allcott, H. 2011. Social norms and energy conservation. Journal of Public Economics. 95 (9-10), 1082-1095 (Oct 2011).*
2. *Brounen, D., N. Kok. 2010. On The Economics of EU Energy Labels in the Housing Market. RICS Research Report. London, UK: RICS.*
3. *Dunsky, P., J. Lindberg, E. Piyalé-Sheard, R. Faesy. 2009. Valuing Building Efficiency Through Disclosure and Upgrade Policies: A Roadmap for the Northeast U.S. Montreal, Quebec.*
4. *[EPA] U.S. Environmental Protection Agency. 2012. ENERGY STAR Portfolio Manager Data Trends: Energy Use Benchmarking.*
5. *[EWHA] Australian Government Department of the Environment, Water, Heritage, and the Arts. 2008. Energy Efficiency Rating and House Price in the ACT. Canberra, ACT: Commonwealth of Australia.*
6. *Sahadi, B., S. Stellberg, C. Yue Tian, N. Kaza, R. Quercia. 2013. Home Energy Efficiency and Mortgage Risks. Washington, DC: Institute for Market Transformation. http://www.imt.org/resources/detail/home-energy-efficiency-and-mortgage-risks.*
7. *[SDPD] Seattle Department of Planning & Development. 2012. "Benchmarking: Unlocking Energy Savings in Residential Buildings." Seattle, WA: Seattle Dept of Planning & Development.*

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Rachel Cluett has worked for ACEEE since 2012. Her work focuses on residential sector energy efficiency including labeling and energy use disclosure, efficiency program design, and product standards and labeling. She is a BPI-certified Building Analyst and Envelope Professional and a certified HERS rater and comes to ACEEE after two years of work conducting residential energy assessments. She holds a B.S. in Natural Resources from Cornell University.

ABOUT THE ORGANIZATION

The American Council for an Energy-Efficient Economy (ACEEE), a nonprofit, 501(c)(3) organization, acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, and behaviors. ACEEE was founded in 1980 by leading researchers in the energy field. ACEEE carries out its mission through analyses, advice giving and working collaboratively, among other activities.
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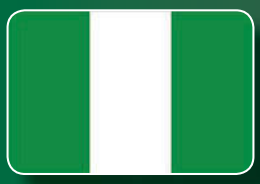

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SMALL CELLS 101

By Graham Wright CEO, Small Cell Forum

It goes without saying that the cell phone has become pivotal to modern culture, even indispensible. The need to always be connected, able to access emails, use social media like Facebook and Twitter, and browse the web pervades virtually every part of society. This has seen mobile networks shift from a focus on voice to primarily one of data. This thirst for mobile data shows no sign of subsiding with use set to grow 13-fold from 2012-2017 according to Cisco.

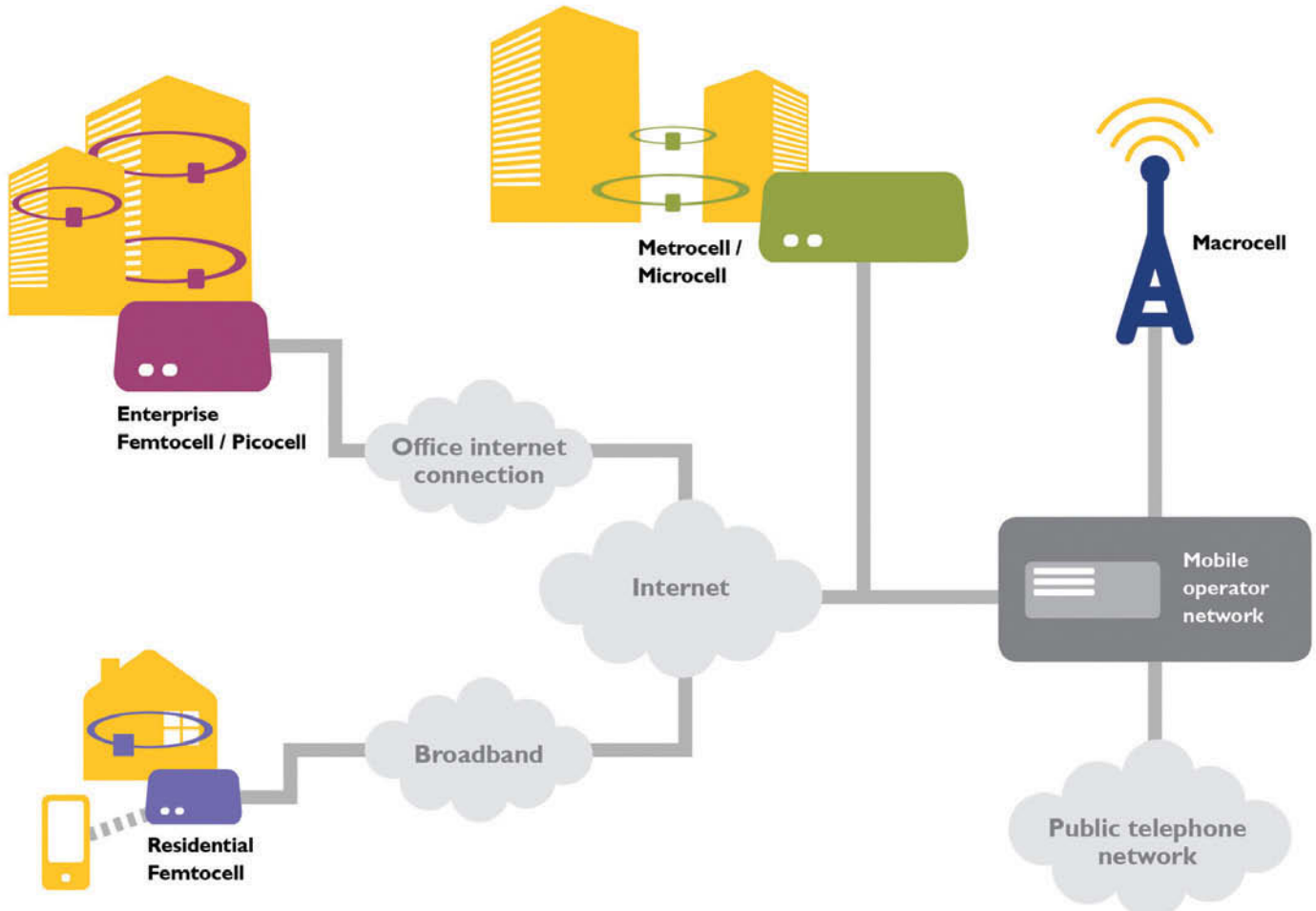
As such, mobile operators have tried to find ways to meet the data demands of consumers. The rate of growth and sheer volumes mean that just building more macro base stations is too costly and takes too long, so instead they're increasingly turning to small cells.

WHAT ARE SMALL CELLS?

Small cells are, essentially, shrunk-down versions of traditional mobile base stations: low power wireless access points that provide additional capacity and coverage to mobile networks. Small cells are self-optimizing and typically connect to an operator's core network (backhauled) via a regular DSL broadband connection, although various other backhaul solutions are available depending where the small cell is deployed. Residential small cells – known commonly as femtocells – were originally conceived as a tool to solve the problem of coverage black-spots in homes; a situation all too familiar to anyone who has had to stand at the end of the garden or by an upstairs window to make a phone call. This was exacerbated by the move to 3G which uses higher frequencies than legacy networks and as such has greater trouble penetrating building walls. By placing a small cell in a consumer's home, they have access to perfect cellular coverage and faster mobile broadband where previously they may not have even been able to even make a call.

Since US operator Sprint deployed its Airave service in 2007 (the world's first commercial femtocell deployment), the small cell's remit has grown far beyond that of residential coverage. While it remains that the majority of small cells deployed fit this description, new variants tailor-made for diverse settings and purposes are now being developed and rolled out. It quickly became apparent with the move to 3G that consumer appetite for data was almost insatiable and would cripple operator's networks through sheer demand. The introduction of more and more internet-enabled devices exacerbates this issue and 4G technologies with its higher data throughput will only serve to increase the demand for more and faster data access. The question of how to satisfy this demand has become the most pertinent consideration for operators the world over. There are numerous means of increasing network capacity but none with such marked gains as that of frequency reuse through increased numbers of cell sites, which can yield a gain of up to multiples of 1,600.

As previously mentioned, rolling out more traditional cell towers is simply not feasible. With small cells, however, these problems are largely mitigated. They can be rolled out quickly (a normal base station can take years to construct due to factors such as planning permission) and at a fraction of the cost of their larger cousins, representing something of a silver bullet to operators staring down the barrel of a capacity crunch.



Small cells

APPLICATIONS

With this in mind, small cells are being deployed in a mixture of urban and rural, indoors and outdoors locations. For instance, higher capacity small cells that can handle greater numbers of calls than the original femtocells are being used to deliver cellular coverage to areas which previously have not had great mobile signal, usually due to the high cost/low return of servicing these areas. While small cells are often backhauled via DSL or similar, in rural settings where even fixed line broadband is scarce, satellite can be utilized as the method of backhaul. Softbank in Japan was one of the first to utilize small cells in this way while Vodafone in the UK is operating a similar scheme to bring 3G mobile broadband to areas such as the Shetlands and other rural villages.

"Unlike residential users, however, enterprises tend to be a bit more demanding."

While rural deployments are typically a coverage play, urban small cells are largely used to add additional capacity to networks. Outdoor small cells deployed in urban areas are also capable of handling higher traffic capacity than residential versions, and can be deployed in areas of high usage such as busy high streets, where they are normally attached to the outside of buildings or street furniture such as lampposts. Outdoor urban small cells raise questions of site acquisition and planning permission that, while not on the same level as those relating to macro cells, is a challenge the industry is busy trying to overcome. Small cells are also being used in public buildings and areas where large groups of people often congregate and extra network capacity is needed such as shopping malls or transport hubs. One of the more innovative rollouts of small cells in public spaces is by Vodafone Greece which set up '3G hotspots' in 200 cafes and restaurants across the country for its customers.

Recently, there has also been a greater deal of synergy between small cells and Wi-Fi. Traditionally, the two were viewed by many in terms of either/or: "Why use small cells to add data capacity when Wi-Fi is readily available?" Now, however, the two are seen as two sides of the same coin – different tools for different jobs. In the Vodafone Greece example, Wi-Fi has been rolled out concurrently to support 3G. The Small Cell Forum itself is working closely with public Wi-Fi industry organisation the Wireless Broadband Alliance in an effort to further integrate small cells with Wi-Fi hotspots to provide consumers with the best possible mobile broadband experience.

Perhaps the area seeing most interest at present is small cells for enterprises. Similar to residential deployments, these are usually viewed as a means of providing cellular coverage to offices which can often be worse than in homes due to factors such as metallised glass. Unlike residential users, however, enterprises tend to be a bit more demanding. Oftentimes, multiple devices are required to provide blanket coverage to a large office or campus as the range of a normal residential small cell would not suffice. In this case, small cells can be deployed by internal Enterprise IT teams and integrated into existing communications networks.

This is also an area where operators see small cells as a means of adding additional value to its customers beyond just coverage and improved performance through increased capacity. By integrating small cells with a business' PBX (telephone exchange) it is possible to give any mobile phone access to advanced functions usually reserved for IP desk-phones such as call-forwarding, conference calling, extension dialling and much more. This allows businesses to replace desk phones and create a mobile workforce, lowering costs and improving employee productivity.

The desire to add additional value through small cells is not limited to the enterprise, however, with apps being developed since the early days that take advantage of their unique attributes. These include 'virtual fridge notes' apps for residential small cells that send reminders to your mobile when you come home and connect to your small cell. In a similar vein are apps for parents, which let them know via text message when their children return home from school and the child's phone connects to the femtocell in their home.

SMALL CELLS AND SMART METERING

As small cells begin to reach maturity and find themselves in a wider array of locales than ever before, operators are looking at other ways in which they can further leverage the capabilities of small cells. Thanks to their relative unobtrusiveness, ease of installation, low cost and capacity for secure and reliable two-way communications, they have been earmarked as a potential boon for the smart metering market.

With smart meters growing in use, particularly in Europe and the US, these can easily be installed with a SIM card and cellular radio through which it can transmit automated readings and the like to a small cell which can in turn connect to the utility provider. Moreover, this can allow the smart meter to connect to a home area network (HAN) where readings can be shown on an in-home display unit. As such, small cells can be used as the communication method of a wider smart utilities grid.

By extension, a small cell network can be used to underpin a whole 'smart city'. More and more devices are being fitted with cellular functionality. For instance, bins can be fitted with sensors that let waste management companies know when they need to be emptied and vending machines can be fitted in a similar way to let suppliers know when they need to be filled. A smart city creates greater efficiencies and lower costs for businesses and citizens but is nothing without a ubiquitous and reliable communications. By using a small cell network, blanket coverage and the additional capacity needed can be achieved with greater ease.

In the few short years since their inception, small cells have gone from disruptive technology to cornerstone of mobile network infrastructure. Furthermore, it seems they are still unlocking their full potential; as we move toward an ever more connected planet where even our home appliances are starting to have their own phone number, an omnipresent network which can shoulder the strain of the ever increasing capacity burden is absolutely vital. With businesses such as utilities providers and cities themselves moving to make their operations more streamlined and efficient, small cells will have a huge role to play. In fact, as we move closer to the reality of smart grids and smart cities it looks as if small cells will have a bigger role to play than we originally thought. MI

ABOUT THE AUTHOR

Graham Wright is the Chief Executive Officer for the Small Cell Forum, responsible for strategic planning, membership, building industry relationships and the Forum's effectiveness and compliance. He has over 25 years of IT and telecoms industry experience with companies including HP, Lucent Technologies and IBM.

ABOUT THE ORGANIZATION

The Small Cell Forum is an independent industry and operator association that supports, promotes and helps drive the wide-scale adoption of small cell technologies to improve coverage, capacity and services delivered by mobile networks in homes, enterprises, urban and rural spaces.
www.smallcellforum.org

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