

Will a smarter grid lead to smarter end users – or vice versa

Smart grid applications at end-user points

***The Research Council of Norway
Oslo 3-4 June 2015***



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3-4 June 2015

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Rationale

Rapid evolution in the character of electricity supply and demand requires increasingly strategic approaches of how to balance the two and provide reliable cost-efficient electricity services to end-users. Effectively implemented, smart grids can accomplish this optimization by integrating a range of advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of all end users. These technologies are essential if the global community is to achieve shared goals for energy security, economic development and climate change mitigation. However, the exact role of the electricity consumer in the uptake of smart grids and the evolution of the power sector more broadly is still emerging.

The IEA's *Smart Grids Technology Roadmap*, ISGAN's Annex 6 review of feasible technologies for enhanced capacity and flexibility, and the IEA's *Energy Technology Perspectives 2014* identify smart grid applications at end-user points in several areas: 1) Energy efficiency, 2) Peak load (the maximum power that the grid delivers during peak hours), 3) Electrification of buildings (e.g. heat pumps for both water and space heating), 4) Electrification of transport (e-mobility systems connecting vehicles to grid), 5) Deployment of distributed generation technologies (e.g. solar photovoltaics with microgrids and local storage solutions).

Substantial challenges caused by changing electricity demands must not be overlooked. In many developed economies, electricity demand is flat or declining, stressing traditional utility business models. In many developing economies, electricity demand is rapidly increasing causing a number of technical, regulatory and economic challenges. The demand for higher power *quality* is increasing around the world as more sensitive electronic appliances and equipment are added to the grid. The shift to electricity in end-use sectors such as home heating (via electric heat and combined heat and power) and transportation (via electric vehicles), if not managed effectively, could drive up both base-load and peak demand, stressing existing infrastructure. In markets with flat electricity tariffs, changes in peak demand could also strain the financial sustainability of electric systems since the added investment costs to meet the peak may not be adequately recovered by additional revenue from annual demand. In urban settings, expanding or upgrading network capacity to ensure adequacy can be complicated due to space constraints or negative effect on busy urban centers during implementation (e.g. tearing up roads to bury power lines). Unlike most other low-carbon energy technologies, smart grids must be deployed in both new power systems as well as existing power grids (which in some cases are well over 40 years old). In many cases, these technologies must be installed while the existing systems are operating at full speed and, thus, must minimize disruption to the daily operation of the electricity system. These challenges do not detract from the opportunity to gain significant benefits from developing and deploying smart grids.

However, technological approaches to smart grids cannot ignore the vital role of the electricity consumer for ultimate success. Though the exact role of the consumer in the evolution of power sectors is still unclear, what is clear is that if consumers do not see the value, either in terms of the solutions available for their home, mobility or energy needs, in terms of the amount they must pay for electricity services, or in terms of perceived societal benefits that match their personal values, they will resist the expansion of

smart grids.

Every aspect of the smart grid comes with a cost, and utilities typically rely on ratepayer recovery mechanisms to finance deployment of smart equipment. Public utility commission approval is usually required for these rate cases, with changes in utility rates being obviously more palatable under favorable economic conditions. Similarly, intelligent endpoint applications for the smart grid (e.g., demand response, energy efficiency, distributed renewables and storage, etc.) require some sort of investment (e.g. time, attention, technology, etc.) by the commercial, industrial, and residential consumer. Such investments are made more willingly during periods of prosperity and with clear benefits for the end-user.

While the opportunities from smart grids are huge, there are also a number of policy, market and behavioral hurdles that need to be overcome for smart grids to deliver the promised benefits. Many are questioning whether a singular focus on ratepayer recovery mechanisms to finance smart grids and simplistic division of consumers into basic commercial, industrial and residential categories is sufficient. For the transition to truly smart and clean power systems, a more sophisticated understanding is needed across the following to align investment risks with the receipt of benefits:

- **Business and operating models** that take advantage of widespread sensors and controls and dynamic two-way communications with end-users, though quite new within electricity markets, have a long tradition in other industries (e.g., ICT, e-commerce). New models are needed that will give clearer incentives and responsibilities to the different actors and open up opportunities for new financing paths.
- **Regulatory and standards frameworks** (and related planning processes) must take into account how smart grids integrate technologies and operational concepts from different sectors, thereby creating potential benefit streams that are not captured under current frameworks, but also opening the door to more expensive, proprietary solutions. Can open source innovation play an important part, or will big industrial companies try to control the developments?
- Understanding **end-user behavior** is critical to realize the potential benefits of intelligent end-point applications of smart grids. Smart integration of information and communications technology (ICT) will influence end users ways of living, working, learning and traveling.
- Related to this, **consumer engagement and empowerment** must become a core function of electric service providers, built on deep understanding of customer demographics and interests within market segments that are far more granular than simply commercial, industrial and residential and treat customers as a utility asset, not a liability. Other industries, such as consumer electronics or retail, have a much more nuanced understanding of their customers than does the electricity sector.
- Smart grids also introduce some **risks and vulnerabilities**, primarily in the realm of cyber security, through increased dependency on ICT. Those these are outweighed by the foreseen advantages and benefits to consumers and society more broadly, effective information security and privacy management will be important.

Meeting scope

The workshop will focus on the potential benefits of smart grids for end-users and society at large, with the goal of identifying novel approaches and critical aspects for realizing this potential as well as core R&D needs on this topic and similar areas that need attention. Examples of end user-applications, consumer segmentation and engagement schemes, and business models will be presented to illustrate state-of-the-art and examples of emerging international "best practice." Achieving the vision of smartening the grid between now and 2050 requires governments, research organizations, industry, the financial sector, consumer advocates, international organizations and other power sector stakeholders to work together.

Target audience

In addition to EGRD national experts, we are seeking input from RD&D decision-makers, strategic planners, and program managers from industry concerned with intelligent end-use and distributed energy technologies related to electrical grids. Participation is by invitation only.

Questions to be addressed by the participating technology experts include:

- *End-user Benefits: What are the most clear and/or most important benefits of smart grids for end-users?*
 - *Societal Benefits: What are the most clear and/or most important benefits of smart grids for society?*
 - *Business models: Who will pay for reducing risk and vulnerability? Will they also realize the benefits?*
 - *Regulation and standards: Who will drive the transition to smart grids: governments, regulators, utilities, vendors, consumers, new enterprises, or someone else?*
 - *Consumer engagement and end-user behavior: What do electricity service providers need to understand about end-users? How can end-users be empowered to become more effective participants in the power system?*
 - *Innovation: Is there a tipping-point for smart grid innovations?*
 - *Innovation: What possible breakthroughs or “game-changers” in smart grids technology, policy, regulation, standards, or economics should we wait for? How we can accelerate their development?*
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Day 1, Wednesday 3 June

Session 0: 9:00-10:30 Introduction

This session provides background and context for the Workshop. It reminds participants of the purpose, interactive nature of presentations, dialogue and social interactions, and the expected outcomes, and post-meeting activities and communications.

Introduction		
<i>Chair: Rob Kool</i>		
08:30	Registration	
9.00 - 10:30	Welcome	Fridtjof Unander, The Research Council of Norway
	Previous work of the group, Rationale of the workshop	Rob Kool, Chair EGRD, Netherlands Enterprise Agency
	Practical information	Birgit Hernes, The Research Council of Norway
	1 IEA's Smart Grids Technology Roadmap, ISGAN's <u>Review of feasible technologies for enhanced capacity and flexibility</u> and the IEA's ETP 2014	Luis Munuera, Energy Demand Technology Unit, IEA
	2 Norway: Energy21, Strategy for energy research	Lene Mostue, Energy21, Norway
3 Mowing towards the Smart Grid: The Norwegian case Experiences and actions taken by industry, academic and research sectors.	Grete Håkonsen Coldevin, The Norwegian Smartgrid Center	
10:30	Coffee break	

Session 1: 11:00-14:15 (including lunch)

Benefits of Smart-Grid/ICT End-Use Innovations

This session will focus on the possible benefits and opportunities that smart grids can enable for the end-users, illustrated by examples from different sectors. What kind of services and what kind of products can become available to end-users, and what kind of companies are most likely to be in the front of the development?

Questions to be addressed:

- *What benefits and opportunities will be the first to be realized, and what sectors or end-users might be expected to be front-runners?*
- *Are there significant differences among customer classes (e.g., between commercial buildings and residential buildings)?*
- *Who will pay and for what? What kind of business and financing models will enable more rapid changes?*
- *Is it possible to imagine a "tipping point" of smart grid technology?*

1. Benefits of Smart-Grid/ICT End-Use Innovations

Chair: Rob Kool

11:00	4	Residential Demand Response – an iPower view on how it can contribute to a smart grid	Henrik Bindner, Technical University of Denmark
11:30	5	Smart grid gives new business opportunities and end-user services	Dagfinn Wåge, Lyse Group, Norway
12:00	6	Integration of electric transportation with smart grids	Kari Mäki, VTT, Finland
12:30		Lunch	
13:30	7	ISGAN – Comprehensive/Integrated View	Michael Hübner, Ministry for transport, innovation and technology, Austria
14:00		Discussion	

Session 2: 14:15-15:45 Barriers to Realizing Benefits

If this is so smart, why doesn't it implement itself?

The session will focus on various kinds of barriers connected to implementation and use of Smart Grid systems. And give examples on how they barriers can be overcome.

Questions to be addressed:

- *Who will pay for system flexibility and resilience – do we need new business models?*
- *What kind of barriers do today's regulatory frameworks represent?*
- *What should utilities know about their consumers? Is a electricity end-user a system asset or a liability?*
- *Who will lead the smart grids transition? Will the development be led by existing utilities and enterprises or will new organizations form?*
- *What is most important, technology, business models, standards, or policy-regulatory frameworks?*

2. Barriers to Realizing Benefits

Chair: Herbert Greisberger

14:15		World café: Barriers and how they can be overcome	
15:00		Summing up and discussion	
15:30		Break	

Session 3: 16:00-18:30 Insights into End-Use Behavior

And what about smart users? Understanding the end-users behavior is crucial to realize the potential of smart ICT. The session will discuss end-users behavior with respect to Smart Grid applications and focus on lessons learned from case studies and knowledge from recent research and studies on end-users behavior.

Questions to be addressed:

- *How important is consumer confidence to ensure a successful implementation of the smart grid?*
- *What should consumers know about electricity? What if they do not care to know that?*
- *To realize the potential of the smart grid, will it be necessary for consumers to change behavior? What are the experiences in this sector or others on how people do or do not change behavior with available technology?*
- *Are there differences in behavior between private and professional end-users, and what does that mean?*

3. Insights into End-Use Behavior			
<i>Chair: Birgit Hernes</i>			
16:00	8	Presentation from DSM "Closing the Loop"	Sylvia Breukers, Duneworks, The Netherlands
16:30	9	Smart Consumer, Smart Customer, Smart Citizens	Ludwig Karg, B.A.U.M. Group, Germany
17:00	10	Demo Gotland,	Monica Löef, Vattenfall AB, Sweden
17:30	Break		
17:45	11	Market, money and morals. Understandings of Norwegian energy consumers	Åsne Godbolt Lund, Sintef, Norway
18:15	12	Touchpoints and practices in the smart grid,	Cecilia Katzeff, Interactive Institute Swedish ICT, Sweden
18:45	Discussion, close day 1		
19:00	Group Dinner – at The Research Council of Norway		
21:00	Boat trip on the Oslo fjord with transport to Oslo city center and Sandvika (optional)		

Day 2, Thursday 4 June

Day 2 of the workshop will focus on different solutions for implementing the smart grid and applications that can give benefits to end-users, businesses and the society at large. The day will be divided into two sessions; the first one will concentrate on technology and the second one on business models and framework conditions.

Session 4: 09:00-11:45 Technology/Software Solutions and R&D Priorities

The session will look the need for technology and software development that will be necessary. What should be the priorities for government support to R&D be, and what kind of enabling technologies will be important?

Questions to be addressed:

- *What kind of enabling technologies are most important, from an end-user perspective?*
- *What kind of priorities should government have in their R&D investments?*
- *What is the “killer app” for smart grids? How do we realize that potential?*
- *Is technology driving business models for smart grids? Or do good business ideas drive grid innovation?*

4. Technology/Software Solutions and R&D Priorities			
<i>Chair: Bob Marlay</i>			
09:00	13	ISGAN's "Spotlight on Demand Side Management": lessons learned in in developing and deploying technologies,	(speaker to be confirmed)
09:30	14	The Netherlands experiences	Nicole Kerkhof - RVO, The Netherlands
10:00		Coffee break	
10:30	15	Charge flex, management of loading of electric vehicles	Stig Ødegaard Ottesen, NTNU/E-smart, Norway
11:00	16	Ecogrid2015 – Experience with energy management systems and customers	Maja Felicia Bendtsen, Østkraft, Denmark
11:30		Discussion	
12:00		Lunch	

Session 5: 13:00-15:15 Policy, Markets, Government Interventions

The session will discuss the importance of regulatory framework conditions, business opportunities and the need of new business models. The section will also focus on the research needs in this area.

Questions to be addressed:

- *How important is regulatory framework to achieve benefits from the smart grid? Does it need to be changed and if so, what sort of change is needed?*
- *Which is better: national versus common frameworks? Which is feasible?*
- *Is there a need for more incentives for the industry, for the end-users?*
- *The combination of power systems and ICT opens up new business opportunities, likely cutting across sectors. How do we exploit these opportunities?*

5. Policy, Markets, Government Interventions

Chair: Estathios Peteves

13:00	17	EUs smart grid initiative	Henrik Dam – DG Energy
13:30	18	Intelligent Energy through flexibility across energy systems and activating flexibility in buildings	Helle Juhler-Verdoner, The Danish Intelligent Energy Alliance
14:00	19	Smart community demonstrations - experiences in Japan	Atsushi Kurosawa, The Institute of Applied Energy, Japan
14:30	20	Do we really need to change to make the most of the benefits of DC?	Pepijn van Willigenburg, De Haagse Hogeschool, The Netherlands
15:00		Discussion	

Summing Up

Chair: Birte Holst Jørgensen,

15:15		Discussion & Round-the-Table ; Takeaways from the workshop Closing Remarks Follow-Up Actions (Reports, Communications, Briefs to CERT)	
16:00		End of workshop	

Meeting Location

The workshop will be hosted by and located at the Research Council of Norway, Lysaker, Oslo.

Address: Drammensveien 288, 0283 Oslo, Lysaker

Meeting room: Abel



See paper with practical information.