

# ***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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*Hosted by The Research Council of Norway, Oslo*

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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 purposed, interactive nature of presentations, dialogue and social interactions, and the expected outcomes, and post-meeting activities and communications.

#### **Speakers:**

- Welcome – Norway, Fridtjof Unander, division director, The Research Council of Norway
- Previous work of the group, Rationale of the workshop, Expected outcome – Rob Kool
- IEA's Smart Grids Technology Roadmap, ISGAN's Review of feasible technologies for enhanced capacity and flexibility and the IEA's ETP 2014 – Luis Munuera, IEA
- Norway: Energy21, Strategy for energy research– Lene Mostue, Energy21

### **Session 1: 11:00-14:45 (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?

Chair: Herbert Greisberger,

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?*

#### **Speakers:**

- Residential Demand Response – an iPower view on how it can contribute to a smart grid, Project leader Dr. Henrik Bindner, Technical University of Denmark
- [Commercial Building](#) (speaker from Austria, speaker/title to be confirmed)
- Transport – Representative from Finland, Dr. Kari Mäki, Finland
- ISGAN – Comprehensive/Integrated View, Michael Hübner, Austria

### **Session 2: 15:00-16:30 (including lunch) 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.

Chair: Bob Marley, DOE

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?*

**Speakers:**

- Regulation and framework conditions as obstacles to obtain the benefits – EU (?)
- Case: Focus on challenges of bringing products to scale – Buildings sector; Wolfgang Rieder, Austria
- Case: Other Experiences with Implementation and Making a Business Case, (Italian)
- ...

**Session 3: 16:45-18:30 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.

Chair: Rob Kool

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?*

**Speakers:**

- Presentation from DSM “Closing the Loop”, Dr. Sylvia Breukers, Duneworks, The Netherlands
- Smart Consumer, Smart Customer, Smart Citizens, Ludwig Karg, Germany
- Market, money and morals, Understandings of Norwegian energy households / consumers / end users, Åsne Godbolt Lund, Sintef, Norway
- End user behavior, Swedish project, (speaker to be confirmed)
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**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?

Chair: Birgit Hernes, RCN Norway

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?*

**Speakers:**

- **ISGAN's "Spotlight on Demand Side Management":** lessons learned in in developing and deploying technologies, (speaker to be confirmed)
- The Netherlands experiences – Nicole Kerkhof - Senior Advisor RVO, The Netherlands
- Intelligent Energy in the built environment – Helle Juhler-Verdoner, Danish Energy Association
- Charge flex, management of loading of electric vehicles, Knut Johansen, CEO eSmart Systems
- Ecogrid2015 – Experience with energy management systems and customers. Maja Felicia Bendtsen, Østkraft, Denmark

**Session 5: 12:00-14:45 (including lunch) 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.

Chair: Estathios Peteves

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?*

**Speakers:**

- EUs smart grid initiative , Henrik Dam – DG Energy, EC
- Smart grid gives new business possibilities, Dagfinn Wåge, FoU & Innovasjon, Lyse energi, Norway
- Experiences in Japan, Atsushi Kurosawa, The Institute of Applied Energy, Japan

**Session 6: 14:45-16:00 Summation**

Chair: Birte Holst Jørgensen,

The session will sum up the lessons learned in the previous sessions.

- Discussion & Round-the-Table - Take-Aways
- Closing Remarks
- Follow-Up Actions (Reports, Communications, Briefs to CERT)

**Participation**

The workshop is by invitation only, but interested parties may contact Diana Louis, IEA ([Diana.louis@iea.org](mailto:Diana.louis@iea.org)).

## **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



## **Directions from City center**

The range of public transport alternatives to Lysaker include train, airport express train and bus . It takes nine minutes to travel by train from Oslo Central Station to Lysaker, with seven trains departing every hour in each direction. The airport express train departs every 20 minutes.

If you are arriving by train, the Research Council is only a five-minute walk from the Lysaker train stop. Leave the train station area through the south exit and walk east towards the river. Follow the pedestrian walkway down (east) to the road below the E18 highway. Go right, walking under the E18 highway, and then go left, heading east on the south side of the highway.

## **Hotel recommendations**

**The hotel situation in Oslo this week is difficult, due to some large international conferences. We therefore advise all participants to book hotels as soon as possible.**

The access to the Research Council from the center of Oslo is easy, 7 minutes by train (frequency every 10 min). So all the hotels downtown Oslo are well suited for participants.

## **Group reservation: Important - must be booked before 1. of May:**

Because of the difficult hotel situation, some rooms have been reserved for participants, at the following hotel near Oslo: Thon Hotel Oslofjord in Sandvika, a small town outside Oslo 15 minutes by train (frequency every 10 minutes) – in the same direction as the location of the meeting.

The price for this hotel is 1995 per room, per night (for single room).

<http://www.thonhotels.com/hotels/countrys/norway/sandvika/thon-hotel-oslofjord/>

### **Booking reference:**

Thon Hotel Oslofjord, tlf +47 67556600 / oslofjord.booking3@thonhotels.no

Booking code: 22222224

**Important:** These rooms must be booked before 1.of May.