Moving Towards The Smart Grid: The Norwegian Case

The Norwegian Smartgrid Center
Grete H. Coldevin
grete.coldevin@smartgrids.no

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1. What is the Norwegian Smart Grid Centre (NSGC)
   - Characteristics Norwegian Power system

2. Moving towards the smart grids
   - What does the NSGC do?

3. A few comments on R&D policy for smartgrids
Energy21 strategy 2010:

- Cross-sectoral membership organization
- Industry-led stakeholder forum
- Address cross-sectoral R&D-D challenges
- Mobilisation and dissemination function
- "Permanent working group" within high level priorities of Energi21

Recommendation p. 31
A national team: 48 members

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### Utilities and grid operators
- Statnett SF (TSO)
- Lyse Elnett AS
- Hafslund Nett AS
- NTE Nett AS
- Skagerak Energi AS
- BKK Nett AS
- Fredrikstad Nett AS
- Trønder Energi AS
- Istad Nett AS
- EB Nett AS
- Helgeland Kraft AS
- Eidsiva Nett AS
- Energi Norge AS
- Agder Energi AS
- Bodø Energi AS
- Sogn og Fjordane Energi

### "Power and automation"
- Eltek
- ABB
- Siemens
- Smart Grid Norway AS

### Communication
- Telenor (tele operator)
- Nexans Norway AS (cables)
- BKK Fiber (power communication)

### AMS and AMI:
- Aidon Norge AS
- Kamstrup AS
- Landis+Gyr
- Valider

### ICT safety and reliability
- DNV GL
- Greenbirds

### IT solutions and services
- Powel AS
- Enfo Energy AS
- Bitreactive AS
- eSmart System
- Logica Norge AS
- Rejlers AS
- EPOS Consulting
- Tieto Norway AS
- Devoteam daVinci AS
- Embriq AS
- Greenbirds Solutions
- Trimble (Tekla)

### R&D and Education
- NTNU, Faculty of ITE
- SINTEF Energy and SINTEF ICT
- University of Stavanger
- University College of Narvik
- University College Østfold
- EnergiNorge (industry association)

### Commercialization (regional clusters)
- ARENA Smartgrid services (mid-norway)
- NCE Smart energy market (south-east Norway)
Steering Committee

- **Chair:** Eilert Henriksen, CEO grid, *Fredrikstad Energi (DSO)*
- Knut Samdal, R&D Director, *SINTEF Energi*
- Bjarne Helvik, Vice Dean, *NTNU*, Faculty of ITC, Mathematics and Electrical Engineering
- Stig Løvlund, Manager Regional Control Centre, *Statnett (TSO)*
- Trygve Kvernland, CEO grid, *NTE (DSO)*
- Bjarne Dybvik, Vice president Market, *Sogn- og Fjordane Energi (utility)*
- Sigurd Kvistad, Manager Smartgrid, *Hafslund Nett (DSO)*
- Kjetil Storset, Vice President Smart Grid, *Powel (IT)*
- Svein Kåre Grønås, CEO, BKK Fiber (*Communications*)
- Hilde Bekkevård, Projectleader, *NCE Smart energy market (regional cluster)*
- Trond Lein, COO Smartgrids, Norway, *Siemens*
- Stian Reite, R&D Manager, *ABB*
- Åshild Helland, Director Grid, *Lyse Elnet (DSO)*

**Observers:**
Representatives of NVE; RCN; Innovation Norway; Enova
Norwegian Power System

• Average annual electricity use for households: **16 000 kWh**

• Large share of electricity in the domestic sector used for space and water heating
  – offers much flexibility for demand response and demand side management schemes.
  – Flexibility estimates: **3000 MW** in industry and **1700 MW** in households & offices

• Well-developed electricity markets in the Nordics: Significant volumes for day-ahead, intra-day and balancing services.

• Fast growing use of battery based **electric vehicles** due good incentives (tax exempt., free parking, free use of toll roads and bus lanes etc.)
  – 50 000 EVs
  – 2 electrical busses in operation in Stavanger
  – Scenario of large scale deployment of electrical busses in Oslo

• App. 500 000 companies and 2.8 millioner households connected to the power grid

• Reliability of the power system: **99,9 %**
Norwegian (Power) System

- App. 2.8 million Smart Meters (AMS) to be rolled out by 1.1 2019.
- Centralized dataHUB for smart meter values in operation 1.2 2017.
- Well-developed broadband communication to homes and increased use of fiber-to-home communication network
  - 1,3 million households with high-speed/broadbands
  - 842 000 with access to fiber-to-home networks
- Overall reliability of the telecom network: 96%
- AMS + Gateways + Broadband = > Platform for smart home automation and the development of smart home services, including EE and DR
- Relatively smart operation at TSO level due to the handling of a large amount of hydropower
- Distribution? Not smart.
  - 125 924 Secondary substations
  - 132 144 distribution transformers
- Significant part of the LV distribution system is of type 230 Volt IT system (230 V line voltage) different from the 400 Volt line voltage systems in most of Europe.
- Weak grids with approx. 40% of the supply terminals weaker than the standardized EMC reference impedance give more severe voltage quality problems when connecting EVs, PVs etc. than many other countries.
Investments in transmission and distribution

- Climate and Renewables targets
- Old infrastructure
- Urbanization and growth of population
- Increasing peak load; power-efficiency & energy efficiency
- Power quality issues. Increased use of sensitive electronic appliances

Source: SSB, NVE % Statnett
From Eivind Reiten’s «Et bedre organisert strømnett», 5. mai 2014
Changes 2000-2013:
- Electricity use (kWh): 4% increase
- Peak load (W): 15% increase

Today's load profiles

Future load situation (fluctuations and increased peak load)

*Illustrations: NVE and Agder Energi
Moving Towards The Smart Grid

What does the NSGC do?
What we do (1):

Common prioritites


Common R&D-D challenges for DSO's

Scientific Committee: Research strategy

Norwegian Smart Grid Research Strategy

Prepared by

The Scientific Committee of the Norwegian Smart Grid Centre

Version: April 2014
What we do (2):
Coordination and mobilization

National Coordination: "Demo Norway for Smart Grids"

Committee for national demo-activities: living labs & off-grid lab
4 meetings a year

Aim:
knowledge sharing; need for new activities; replication and scale.

Funding!

Trendspotting & sharing:
ETP Smart Grids (EU)
GSGF and ISGAN

Mobilizing for Selected Calls:
FME (national)
H2020 (EU)

FME = Centres for Environment-friendly Energy Research (open call)

EU Horizon 2020:
Funding for test/demo

Role of NSGC:
Industry relevance in R&D & good dissemination mechanisms
Demo Smart Grid for Norway

**Distribution**: AMS (4500), residential and businesses, communication solutions, tariffs, customer behaviour, information security

**Utility**: Fiber to home, AMS+ generic gateways (160 000), smart home services & welfare services

**Transmission**: Congestion management, SVC, WAMS, PMU, load management, TSO/DSO cooperation

**Demo Lyse**

**Demo Steinkjer**: NTE

**Smart Energy Hvaler**: FEAS

**NCE smart, Halden**

**Pilot North: Statnett**

**Univ. College Narvik**

**Smart grid Lab at NTNU/SINTEF**

**Skarpnes plusshouses**: AE

**Distribution**: AMS (8000), holiday houses, smart substations, DMS, PV, EV, tariffs, local market

**Distribution**: 40 Plusshouses, PV, CSP, energy well, power variations, grid interaction, planning tools, aggregators

**Demo Smart Grid for Norway**

*smartgrid The Norwegian Smartgrid Centre*
New test/demo activities

Statnett (TSO)
Replication and scale in load management through TSO-DSO cooperation:
  – From 45 units in pilot (2014) to 200 units in large demo (2015)

BKK (DSO)
Strategies for grid automatization:
  – 20 secondary substations with different degrees of automatization and different geographical location
  – Communication systems

SFE (Utility)
Smart Valley/Smart Rural grid for the whole electrical value chains:
  – Customer services; grid operations; production with large amount of small scale hydro power plants

Hvaler kommune & Fredrikstad Energi Market & FEN Nett (DSO)
  – Island grid operation for PV installations (60-100 units)
  – Local market (R&D)

Lyse Elnett:
Smart grid for the historical city of Stavanger:
  – 25 smart secondary substations, smartmeters with gateway, DMS and SCADA systems
What we do (3):
Trendspotting & Dissemination
National Smart Grid Conference

2013, 10.-11 sept., Trondheim

- 200 Participants
- 30 Presentations
- 10 PhD students w/ poster and pres.

2014, 10.-11 sept., Oslo

- 283 participants
- 32 Presentations
- 22 exhibitions of solutions
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3. A few comments on R&D policy for smart grids
Different types and pace of innovation

Continous evolution of established systems

ICT Revolution; "Internet of energy"

Radical Microgrid-DER movement

R&D policies/incentives:

- To encourage TSO and DSO to test and to deploy new technologies
- Speeding up innovation through replication and scale
- Industry wide dissemination
- Ensuring interoperability and standardization
- For development of "Smart Regulation"

R&D policies/incentives:

- Speeding up adoption/migration of ICT solution from other sectors
- Allowing new players into the field
- Innovation in business models and work practices
- ICT security and reliability
- Relevance and quality in cost-benefit methods

R&D policies/incentives:

- Development of low cost, stand alone systems
- Contributing to "electricity access to billions"
- Consumers'/prosumers' ability to participating in innovation
- Reliability and security

R&D Policies: Different innovation cycles and types going on: This calls for a broad toolbox
**T2 & T8: Activating and engaging the consumers:**

- High Policy Importance, but mature topic -> Little need for R&D?
- High priority on technology in R&D. Low priority on "soft issues"?

*Source DG Ener., EEGI 20.03.2015*
• Consumers have a weak voice in setting the priorities of R&D policies.

• A need for "smart regulation" in the smart grid development:
  – "Public – Private - Regulator Partnerships" in setting the priorities and deciding on the instruments

• A framework of "Systems thinking" in R&D-I policies (ref IEA ETP 2014)
  – Evaluation of R&D proposals: Easier to recognize potential for innovation in single components than in system performance

• Exchange/mobility of scientists and students:
  – An idea: Exchange and sharing between test/demonstration sites