Smart Grid og Måleteknik

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Agenda

- Hvorfor Smart Grid?
- Danske og internationale Smart Grid aktiviteter
- Smart Grid er andet end elnettet
- Smart Grid er andet end intelligente elmålere
Hvorfor Smart Grid?
The Danish Power System

- Many decentralized plants
- Strong grid and reliability
- Strong inter connectors
- Synergies between Power Grid, District Heating Network and Natural Gas Network
- Biomass in Central power Plants

[Map showing 25 Years, Central power plants, Local CHP plants, Wind turbines, capacities and connections]
Large offshore Production in the Future

Reference: Energinet.dk
Large Potentials for Heat Pumps

District Heating
Natural gas
Oil burners (potential for Heat Pumps)

BBR and DEA Energy data (www.ens.dk)
Smart Grid a positive business case (6.1 bDKK)

Traditional grid upgrade to meet future demand by laying new cables requires 7.7 bDKKK in investment (NPV).

Smart grid implementation requires 9.8 bDKK (NPV) but will generate 8.2 bDKK in savings. Net expenses are thus 1.6 bDKK.

Total = 8.2 bDKK

- Savings on contingency services & reserves: 4.4 bDKK
- Savings on power production: 2.4 bDKK
- Savings on "energy savings" initiatives: 1.4 bDKK

Source: Dansk Energi, ENDK – Smart Grid in Denmark
Danske og internationale Smart Grid aktiviteter
Denmark - the EU27 front runner in Smart Grid

- 22% of all smart grid projects in EU27 are located in Denmark
- The Distribution System Operators (DSO) are playing a leading role in coordinating smart grid deployment across Europe (27% of all projects and 67% of investments)
- Projects in EU are representing investments of €5 billion

Source: Smart Grid projects in Europe, JRC 2011
## Forecast of Smart Grid Investments

### Selected regions and countries

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Forecast of Smart Grid investments</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Union</td>
<td>€56 billion by 2020</td>
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<tr>
<td>USA</td>
<td>€238 to €334 billion by 2030</td>
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<tr>
<td>China</td>
<td>€71 billion by 2020</td>
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<tr>
<td>South Korea</td>
<td>€17 billion by 2030</td>
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</table>

Source: Smart Grid projects in Europe, JRC 2011
The American Dream
Danish Reality

DENMARK's PROGRESS OVER THE PAST TWO DECADES

- Small CHP (Combined Heat & Power)
- Large CHP (Combined Heat & Power)
- Wind

Centralized System of the mid 1980's

More Decentralized System of Today
ForskEl PSO Funding 2012-1

- Biomass and Waste: 16%
- Biogas: 2%
- Fuel Cells: 23%
- Wave: 3%
- Photo Voltaic: 6%
- Smart Grid & Storage: 23%
- Wind: 19%
- International: 6%

Energinet.dk, Total Smart Grid funding: 42% ~ 58 Mill DKK
EV-Projects: Green eMotion

- EC FP7 Demonstration project with total budget of app. 40 mil. Euro lead by Siemens
- 40 partners involved incl. Renault/Nissan, BMW, Daimler, Siemens, Bosch, IBM, SAP, Better Place, AREVA and a range of utilities covering 65% of the European energy supply
- DTI: Regional coordination, EV & battery testing, Safety and Training
EV-Projects: EasyBAT

- EC FP7 R&D project lead by Better Place
- 11 partners involved incl. Renault, Continental, Frauenhofer IPA and KEMA
- DTI: Battery expert role, battery degradation analysis and modelling, smart storage modelling and benchmarking
Smart Grid Projects in Denmark

Area represents size of projects
The *iPower* platform focuses on **power system integration** of large amounts of electricity from fluctuating renewable energy sources such as wind power and photovoltaic’s by **activation of flexible consumer demand**.

The *iPower* platform **links research and demonstration to actual product development** by specifying methods, technologies and requirements for smart grid products, and enables the industry partners to become first movers in a new and growing world market.
Strategic Platform for Innovation and Research In Intelligent Electricity

- WP1 + WP2: End users
- WP3
- WP4
- WP5
- WP6
- WP7: DTI responsible for innovation activities and WP1, WP6 and WP7

Source: Based on drawing from Danish Energy Association
Project integration

EcoGrid.dk phase 1, EDISON, Celle Controller pointing to Bornholm as a full scale smart grids test site including EV integration.
DREAM videreudvikling af Celleprojektet

Eksisterende system

Vindmøller

Kraftvarmeværker

Store forbrugere

Celleregulator

Aggregator

Aggregatør

Aggregatør

Aggregatør

Aggregatør

Aggregatør

Aggregatør

DREAM: Samlet område med 100% SG, økonomiske modeller inkluderet, brugerinddragelse, offentlige, industrielle og private bygninger, HP+EV, fjernvarme

Netselskab
Produktions Balance Ansvarlig

∑ leverance

Produktions Balance Ansvarlig

Produktions Balance Ansvarlig
Demand response industry consumers

Electricity consuming industrial companies:
- Transparent energy consumption
- Reduced electricity costs

The society:
- Increased integration of electricity from wind turbines
- More stable electricity system

Result
- 7 demonstration companies from different market segments
- Minor price difference can give positive result

http://www.dti.dk/inspiration/27046
Battery project: Energy storage system

Objective: Benchmark solutions for providing short term system services (<15 minutes duration) in the Danish power system. Choose 2 technologies and demonstrate.

- **Phase 1 (Completed):** Benchmark of 5 different storage technologies, recommend a small scale demonstration system. Different battery vendors approached, primarily lithium-ion

- **Phase 2 (ForskEl approved):** demo systems to be established
  - **Battery** based storage system will be prototyped and tested at DTI, demo system will be build and operated
Heat pumps
active control possibilities in the future energy system

... HP is a well fit to the fluctuating wind power production

- Coherence between the periods with wind power and the demand for heating

- The heating system is a good storage media of the fluctuating wind power

- It is important to convert electricity to heat in an intelligent and efficient way

The market potential
Approximate 50% of the houses outside the district heating areas equivalent to 500,000 heat pump units- or 15 times of today
Smart Grid er andet end elnettet
Integrate across energy infrastructures

- Fluctuating production, demand response, and strong grid
- Use existing infrastructure
- New platforms for integration between infrastructures
Grid Interconnectors

Power Grid

X
Electrolysis
Heat Pump

District Heating Grid
Heat Pump

District Heating Grid
Y

District Heating Grid
Z

Gas Grid
Smart Grid er andet end intelligente elmålere
Smart Grid er lig med nye muligheder (1)

- IEA vurderer, at 44 pct. af investeringerne i udbygning af energisystemer frem til 2020 vil være relateret til distribution og transmission, der vil inkorporere en stor mængde Smart Grid- teknologier såsom sensorer og styringsteknologier.

- Det svarer til en samlet markedsværdi på 3.000 mia. USD i perioden 2011-2020, hvoraf størstedelen dog vil være traditionel udbygning af energiinfrastrukturen fx transmissionsledninger og transformatorstationer
Smart Grid er lig med nye muligheder (2)

- Nye markedsområder:
  - Infrastrukturen: el, gas, fjernvarme og vand
  - Industri: Frekvensomformere, energi, effekt, flow mv.
  - Boliger: Temperatur, fugtighed, lys, CO2 mv.
  - Transport: Energi, lagerkapacitet, GPS mv.

- Nye produkter:
  - Trådløse komponenter
  - Sensornetværk
  - Nye serviceydelser
  - Brugerplatforme/brugerinvolvering

- Nye standarder
  - SG Ready komponenter
  - International samarbejde
  - Fælles kommunikationsstandarder
Muligheder for Danmark

- Flere vidensarbejdsspladser
- Større brugerinteresse -> flere teknikerjobs
- Nye innovative virksomheder
- Innovative service koncepter
- Grøn vækst
- International førerposition, international demonstratorium
You Don’t Have to Be A Giant:
The Changing Dynamics of Global Competition Create Service Business Opportunities For Danish Firms

John Zysman, Professor, University of California, Berkeley
Thank you for your attention!

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