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Smart Energy Networks partnerskab

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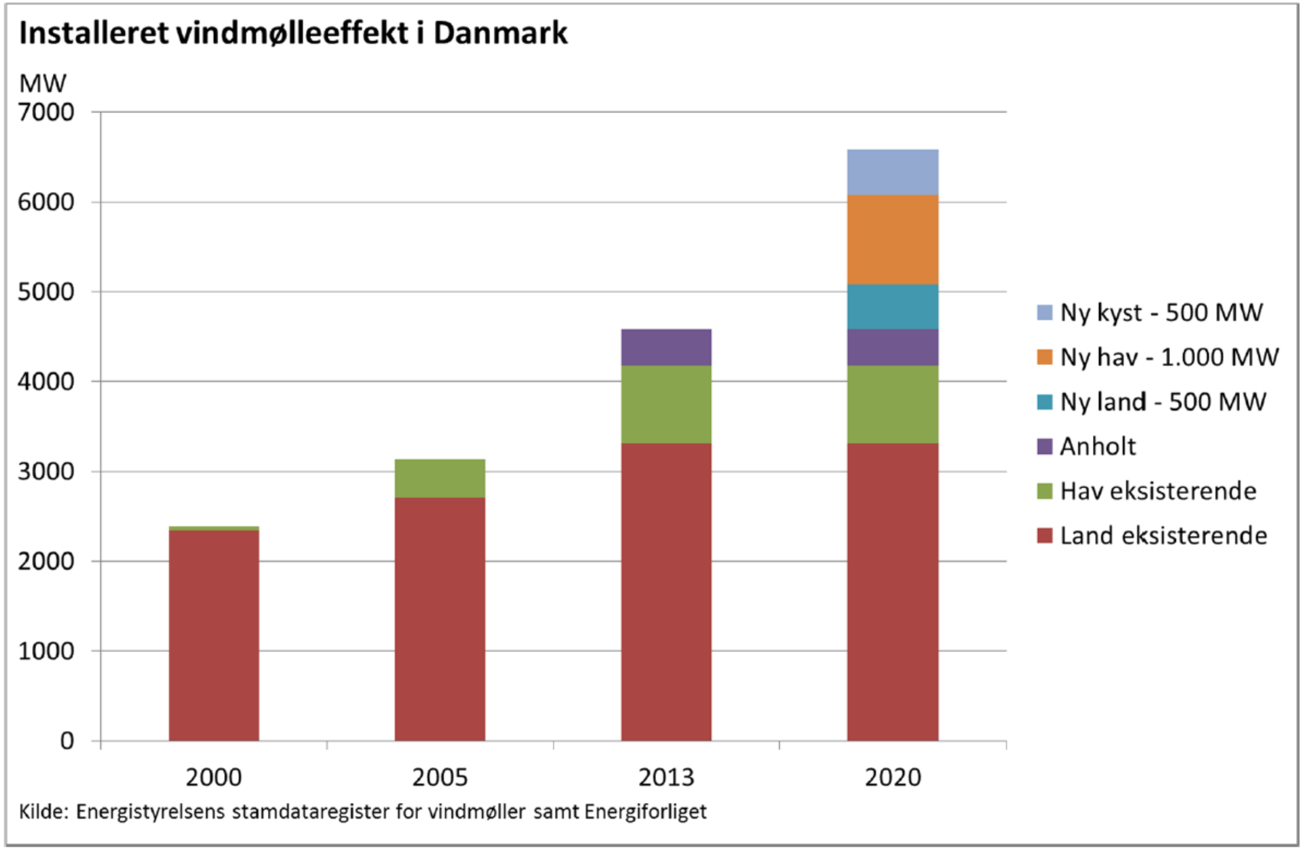
Gastekniske Dage
14. maj 2014

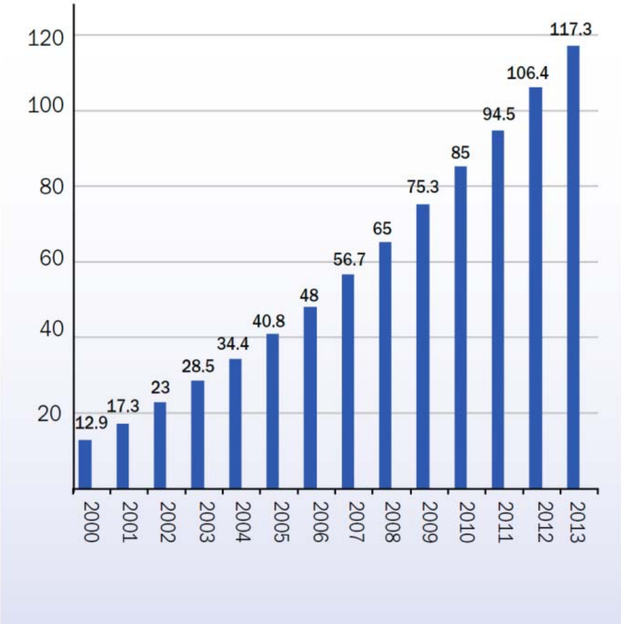
Wind Energy Penetration in Denmark



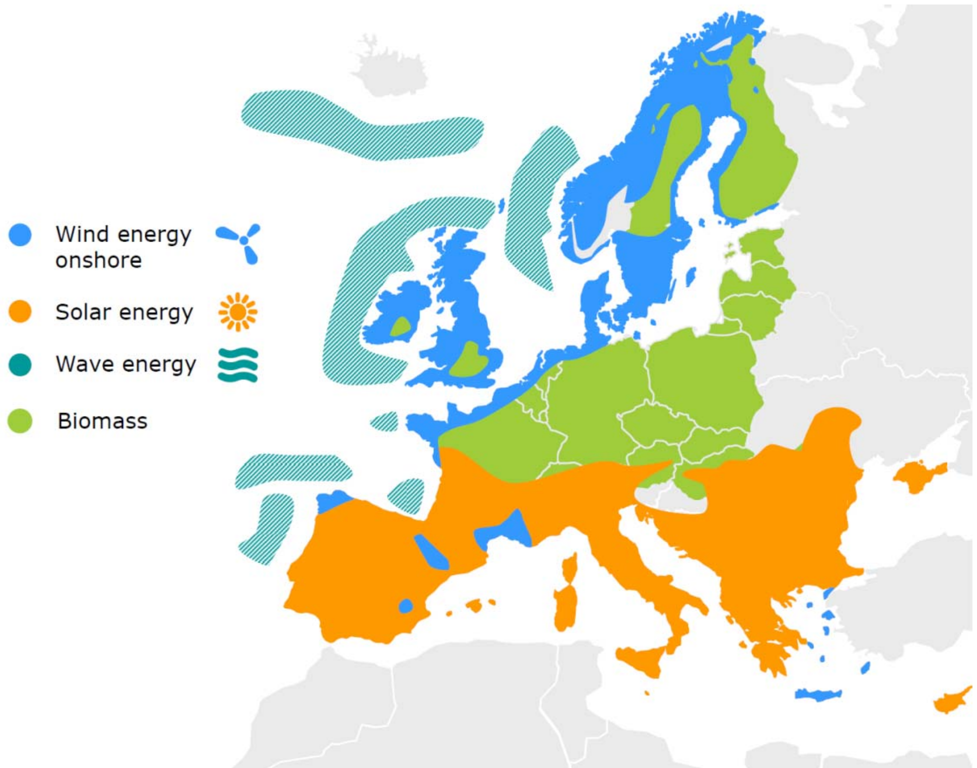
Courtesy: Dansk Energi

Renewable Energy Penetration in our Nabouring Countries

Cummulative wind power installations in the EU (GW)

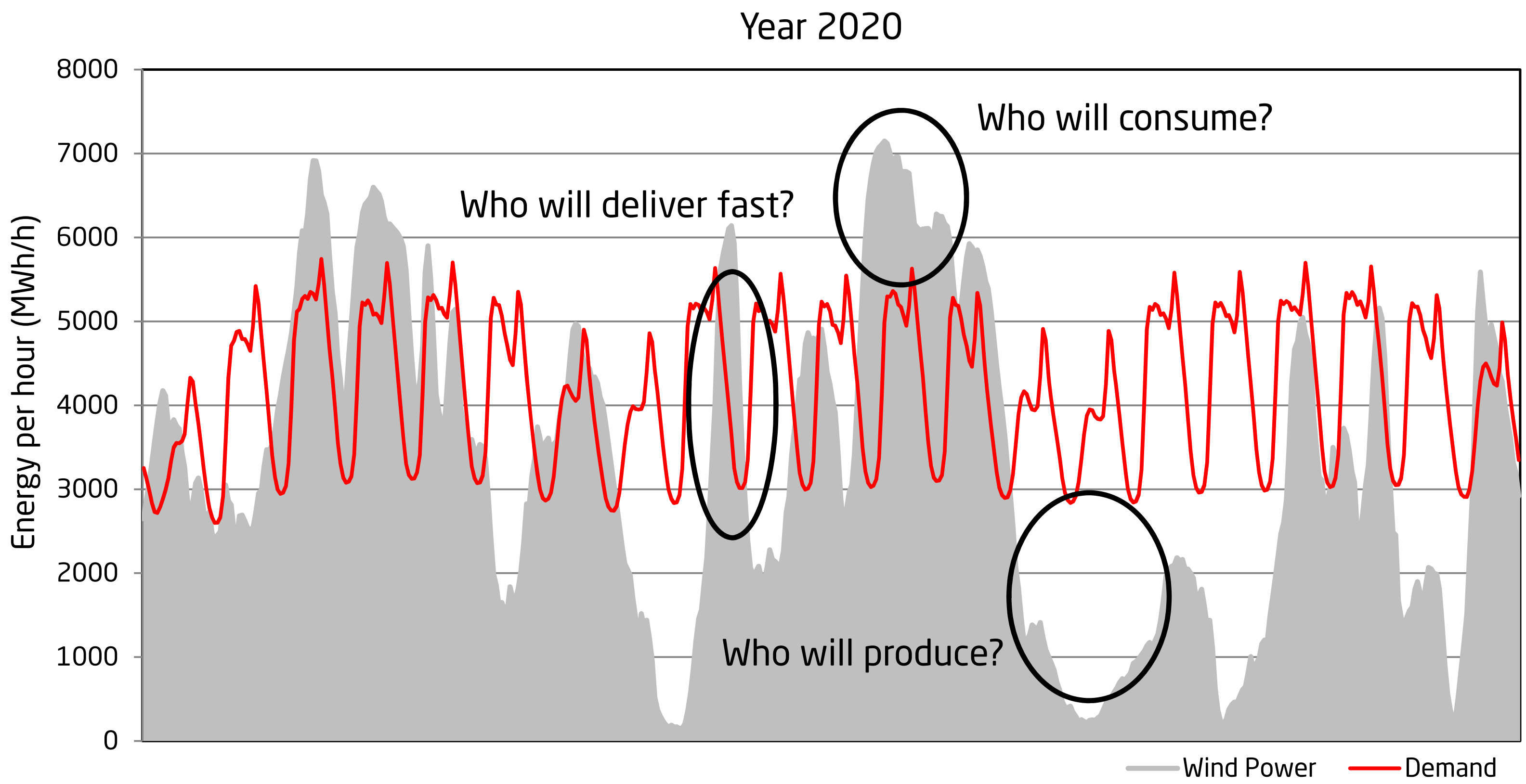


Ref.: EWEA

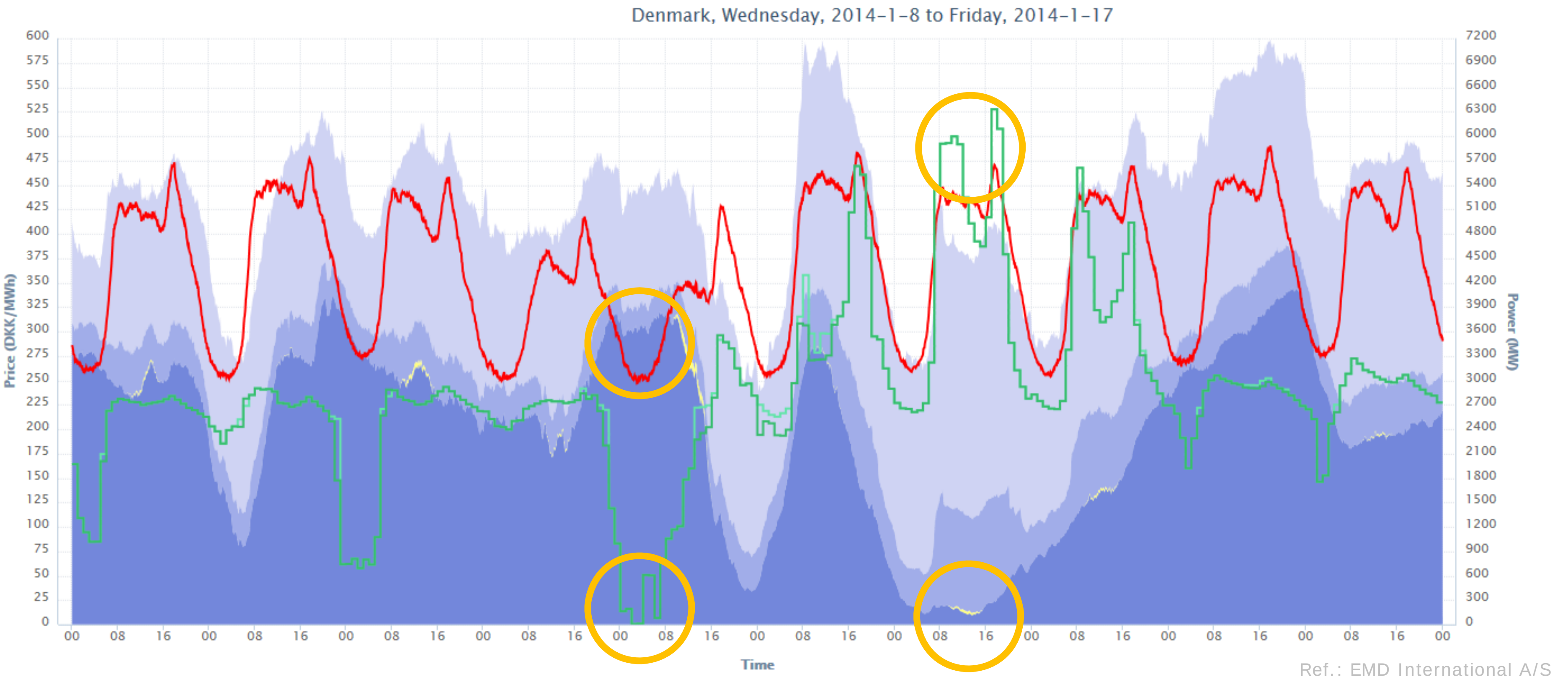


Ref.: The EU commission

The Challenges
Energy and Power Balancing



Wind Power Generation and Spot Price Volatility
Example from January 2014



Note: January 2014 the Danish wind power covered 63.3 % of the electricity consumption.

Courtesy: Energinet.dk

The Challenges
System Stability and Reliability

Udfordringen i et VE-baseret energisystem

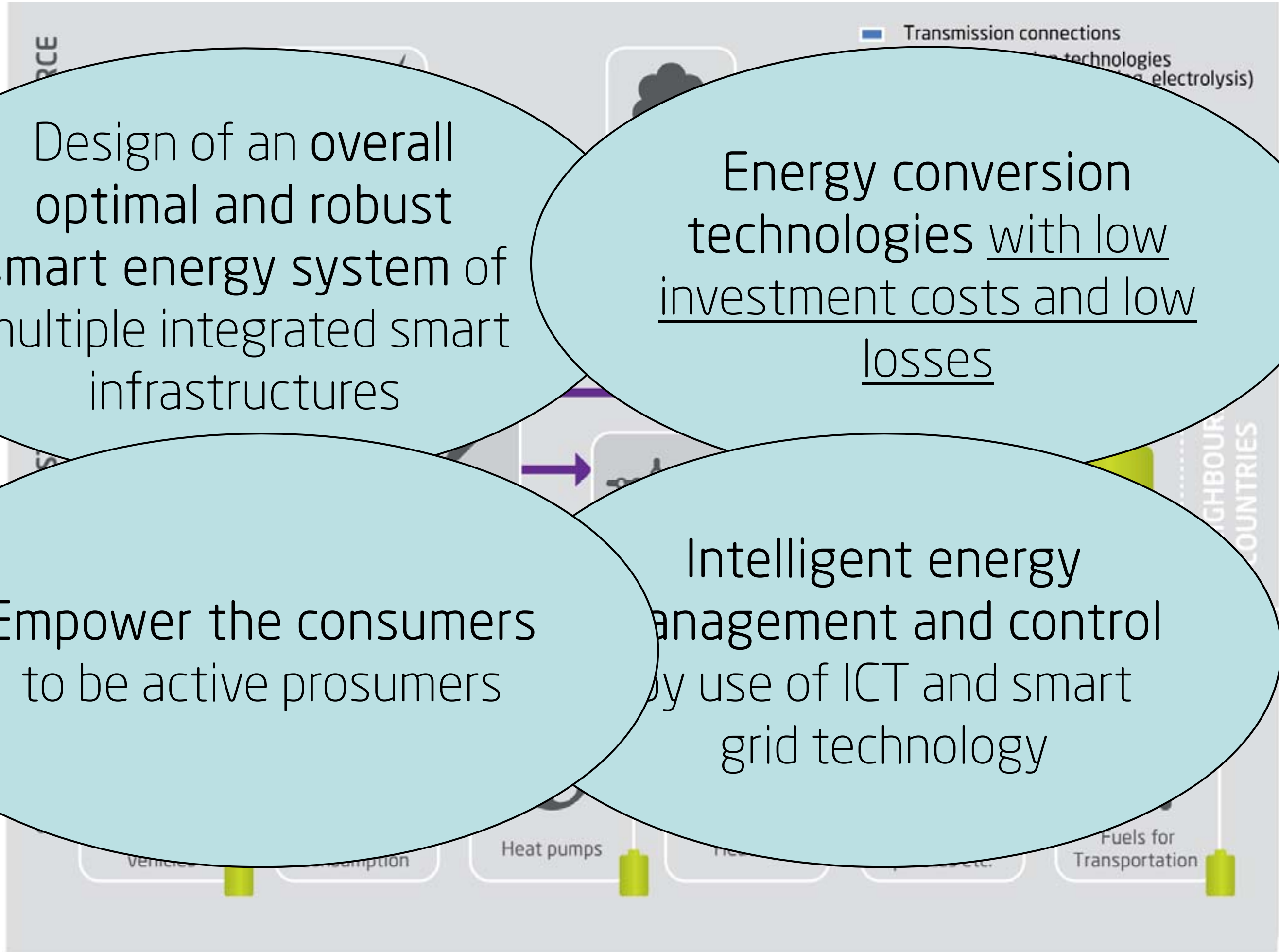
- Teknologier til **korttidsbalancering** i elsystemet for at sikre el-nettets stabilitet

- Løsninger, der over **længere tid** kan lagre store mængder af energi, der kan bruges til at producere el, når der ikke er vind og sol nok

Main Sources of Flexibility in the Future Energy System

- **Biomass** in the electricity generation
- **Long distance power cables** for balancing across regions (>500-1000 km)
- **Flexible electricity demand** enabled through smart grid technology
- **Energy storage technologies**; pumped hydro, compressed air, batteries etc.
- **Integration of multiple energy infrastructures** operating together in an optimal system

Integration of the Energy Systems can provide Flexibility



Design of an overall optimal and robust smart energy system of multiple integrated smart infrastructures

Energy conversion technologies <u>with low investment costs and low losses</u>

Empower the consumers to be active prosumers

Intelligent energy management and control by use of ICT and smart grid technology

Ref.: Østergaard et.al, 2013.

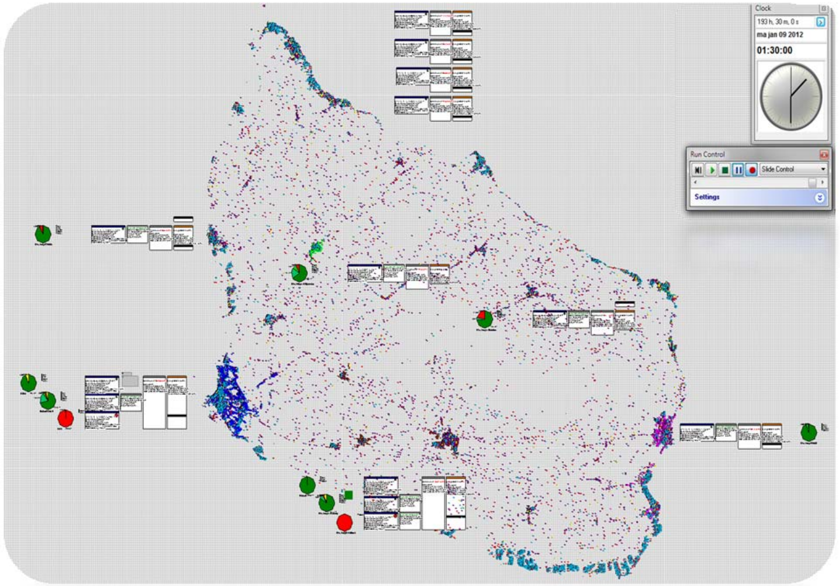
Fuld demo: 18-19 November 2014

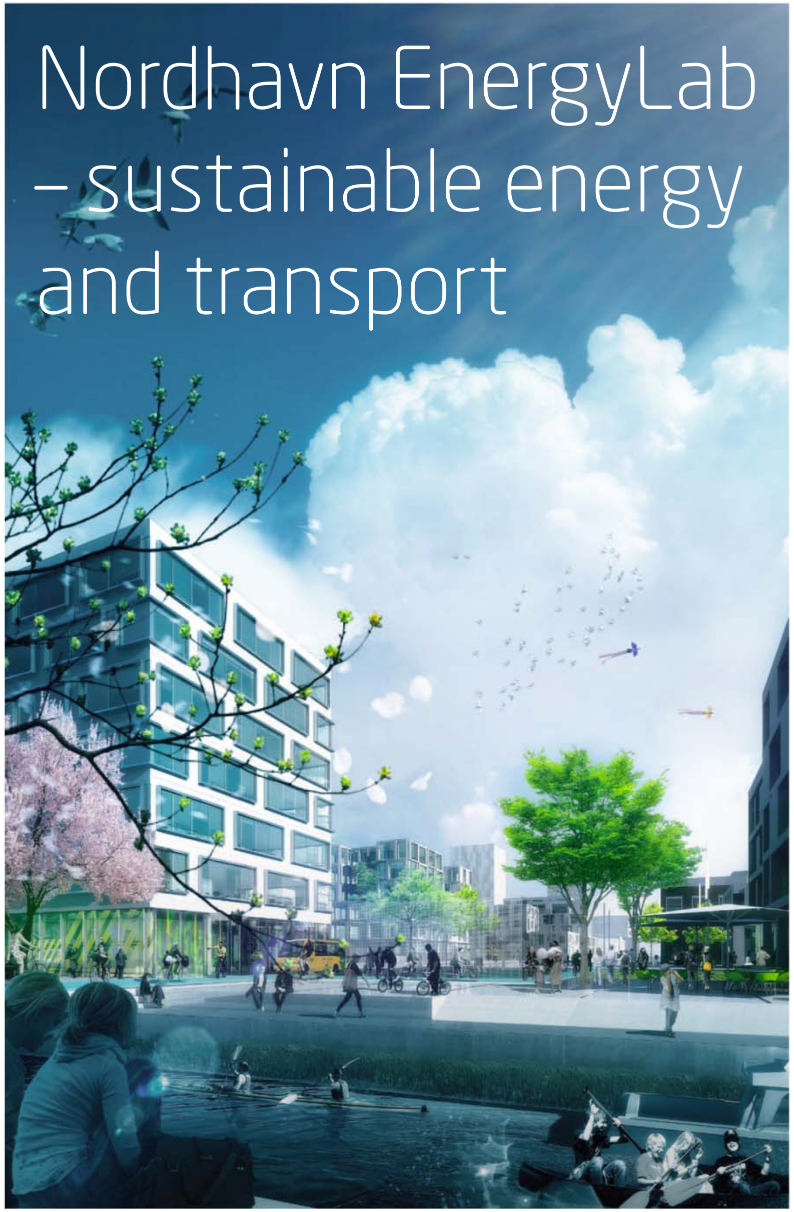
www.ipower-net.dk

EcoGrid EU
Large-scale Demonstration of the Future Intelligent Energy System

- EU FP7 ENERGY
- 2011-14
- Budget: 21 million Euro
- Integrated research and demonstration
- ~2,000 active customers
- EU fast-track to Smart Grids

Strategic Energy Planning Model
Analysing multiple infrastructures and data sources.

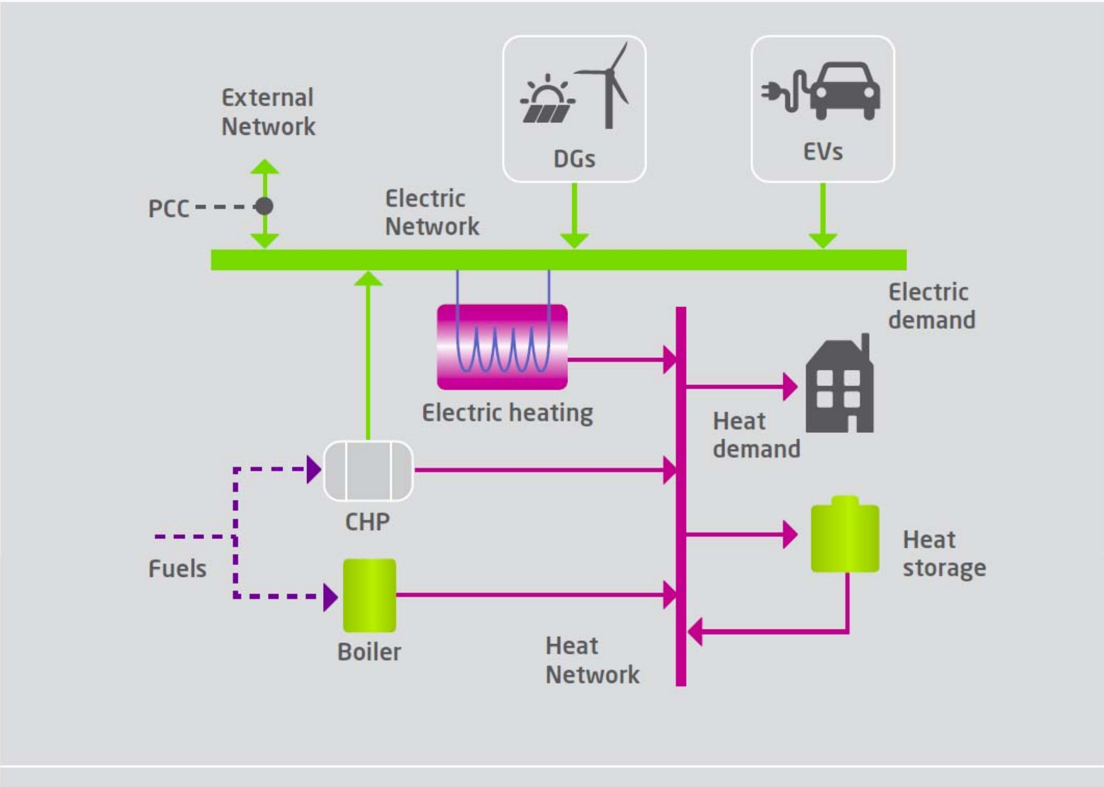




- Over the next 50 years, Nordhavn will develop into a **new district** with 40,000 residents and 40,000 jobs.
- The ambition is to become an **example of a future sustainable city**, while also contributing to the City of Copenhagen’s goal of becoming **carbon-neutral** by 2025.
- This requires **innovation** in urban design - not least of energy infrastructure.

Optimization of Local Energy System (Microgrid) with Electricity and Heat

Figure 41
A typical Microgrid with distributed generators, a low-voltage distribution system, heat and electricity storage, energy consumers and a communication network.



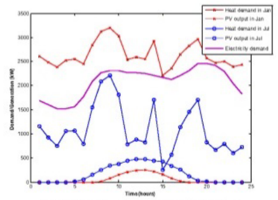


Fig. 2. Electricity and heat load profiles for a hotel

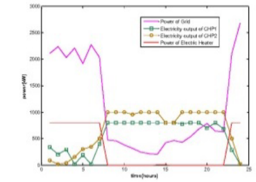


Fig. 3. Electricity power distribution from the main components for winter day

A Coordinated Heat and Electricity Dispatching Model for Microgrid Operation via PSO

The operation schedule of the electricity and heat systems is jointly optimized to minimize the total operational cost.

The proposed optimization model is formulated into an mixed integer nonlinear optimization problem (MINLP).

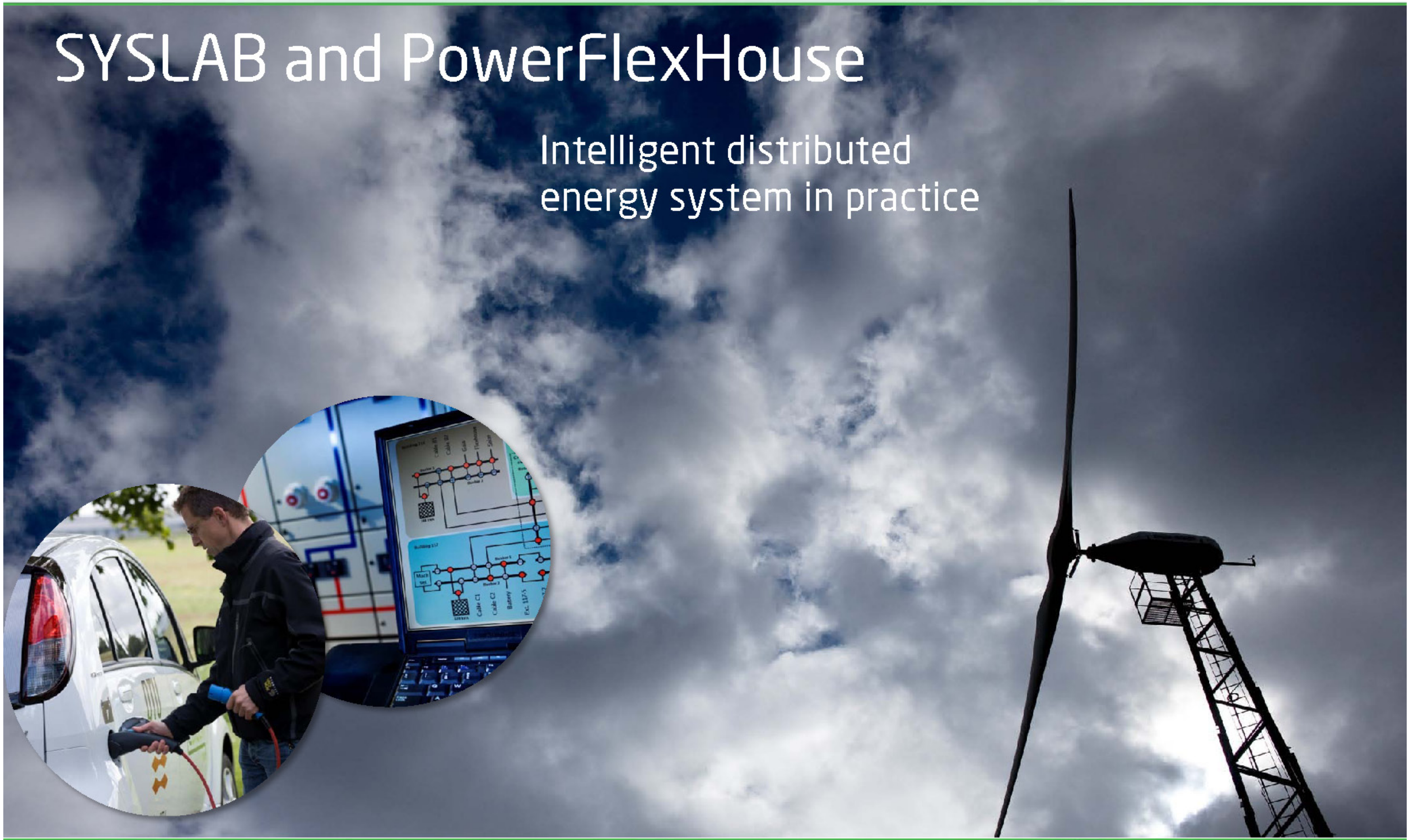
Theoretical case study two CHPs, one electric heater, one wind turbine, one boiler, and one heat storage.

Ref.: L. Xu, J. Østergaard et. al, Combined scheduling of electricity and heat in a microgrid with volatile wind power. *Automation of Electric Power Systems*, Vol. 35, No. 9, 2011, p. 53-60.

PowerLabDK

SYSLAB and PowerFlexHouse

Intelligent distributed energy system in practice



www.powerlab.dk

DTU Technical University of Denmark

INGENIØRHØJSKOLEN KØBENHAVN – University College

ØSTKRAFT energi til gode oplevelser

Bidirectional Hydrogen Plant (100/20 kW_e)

Electrolysis; Pressured Hydrogen Storage; Fuel Cells

Partnerskabet Smart Energy Networks - forskning, udvikling, demonstration

Partnerskabet skal:

- Tilvejebringe et kvalificeret og velfunderet grundlag for planlægningen af forsknings-, udviklings- og demonstrationsaktiviteter inden for Smart Energy området

- Bidrage til et forbedret samspil mellem aktørerne på tværs af sektorer

Partnerskabet Smart Energy Networks - forskning, udvikling, demonstration

Formål:

- Partnerskabets skal samarbejde om at skabe forudsætninger for en samfundsmæssig optimal realisering af de **langsigtede energipolitiske mål**, herunder sikre gode og bæredygtige **vækstmuligheder** for dansk erhvervsliv på både kort og langt sigt.

- Partnerskabet skal muliggøre en optimal udnyttelse af ressourcerne via en **internationalt orienteret strategisk planlægning** for forskning i samt udvikling og demonstration af fremtidens integrerede og intelligente energisystem.

Partnerskabet Smart Energy Networks - forskning, udvikling, demonstration

Det overordnede formål skal realiseres gennem aktiviteter med disse konkrete mål:

- At skabe et solidt grundlag for en **strategisk prioritering** af FUD-aktiviteterne

- At belyse og komme med anbefalinger til de danske **rammevilkår** for FUD-aktiviteterne, således at rammevilkårene bedst muligt understøtter udviklingen af nye forskningsbaserede teknologier og løsninger

- At bidrage til arbejdet i **etablerede innovationsnetværk og branchefællesskaber** via strategiske alliancer

- At bidrage til en effektiv **kontakt og erfaringsudveksling** omkring FUD-aktiviteter mellem de involverede interessenter

Partnerskabets styregruppe




Fra industrien:

- Thea Larsen, DGC (formand)
- Jørgen Christensen, Dansk Energi
- Jesper Koch, Dansk Fjernvarme
- Sune Thorvildsen, DI Energi
- Jeannette Møller Jørgensen, Energinet.dk

Fra vidensinstitutionerne:

- Ulrik Jørgensen, AAU
- Jacob Illeborg Pagter, AI
- Rune Hylsberg Jacobsen, AU
- Jacob Østergaard, DTU
- Bo Nørregaard Jørgensen, SDU
- Frank Elefsen, TI

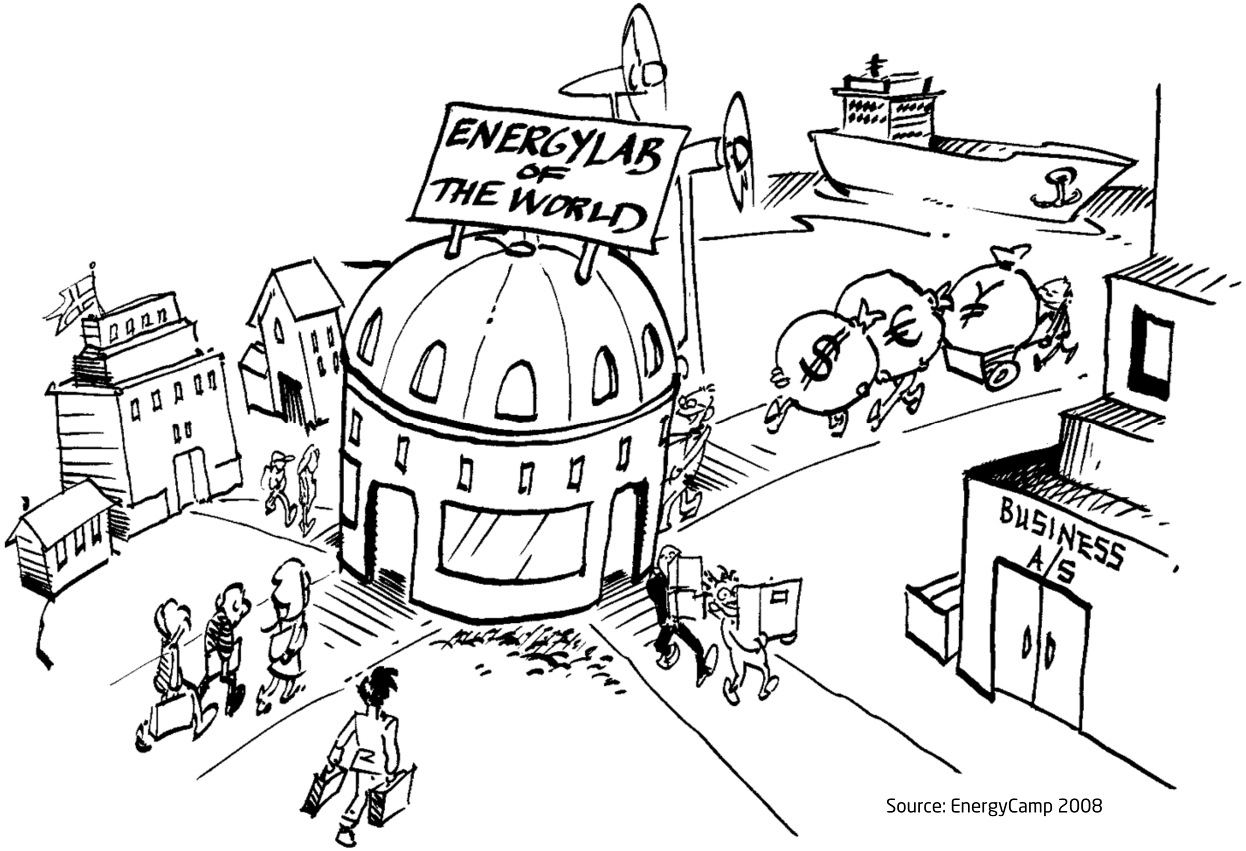





Partnerskabets planlagte opgaver (tentativt)

- Udarbejde vision for viden- og teknologiudvikling for smart energy
- Udarbejdelse af statusrapport for viden- og teknologiudvikling for smart energy
- Analyse af rammebetingelser for FUD inden for smart energy og dialog med beslutningstagere
- Roadmap for forskning, udvikling og demonstration inden for smart energy
- Udarbejdelse af materiale om de danske FUD-aktiviteter med henblik på international anvendelse
- Formidling af resultater

Invitation til et bredt samarbejde om fremtidens samtænkte smarte energisystem!



Source: EnergyCamp 2008

Thank you for the attention!

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