

smar+ en ci+y



The Smart and Integrated Energy System Approach

Per Alex Sørensen
PlanEnergi, 4. October 2017

TOWARDS SMART ZERO CO₂ CITIES ACROSS EUROPE
VITORIA-GASTEIZ + TARTU + SØNDERBORG

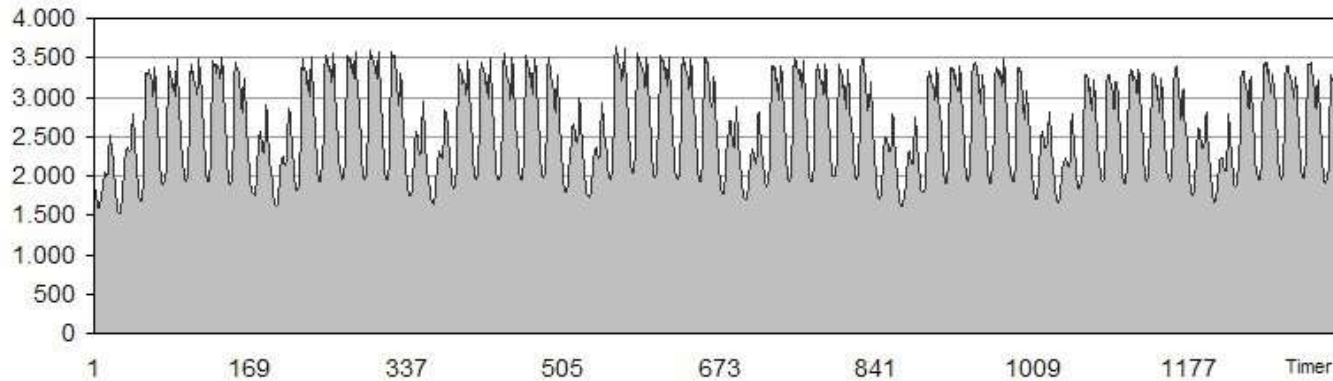


- **Why Smart Energy Systems**
- **The concept**
- **Examples and workshop introduction**

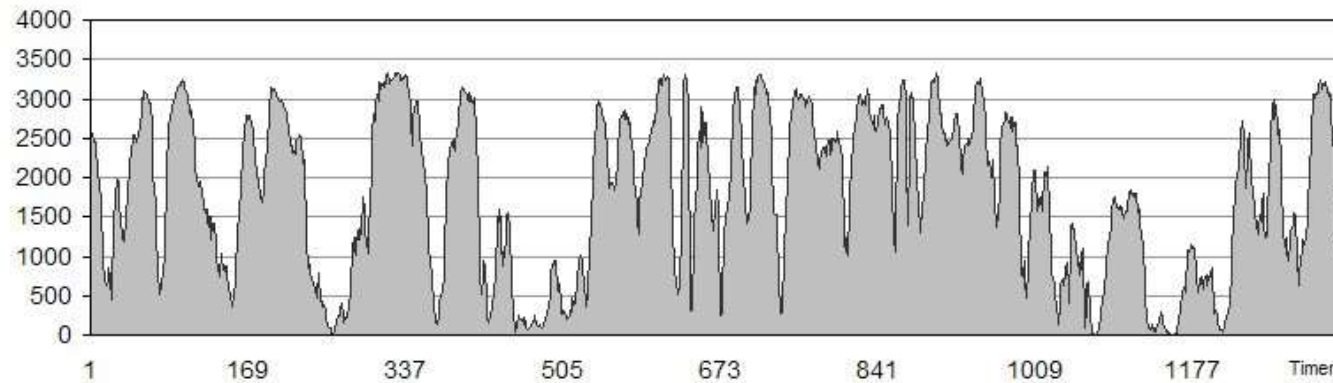


Fluctuating Power Production 50% wind

Demand first 8 weeks

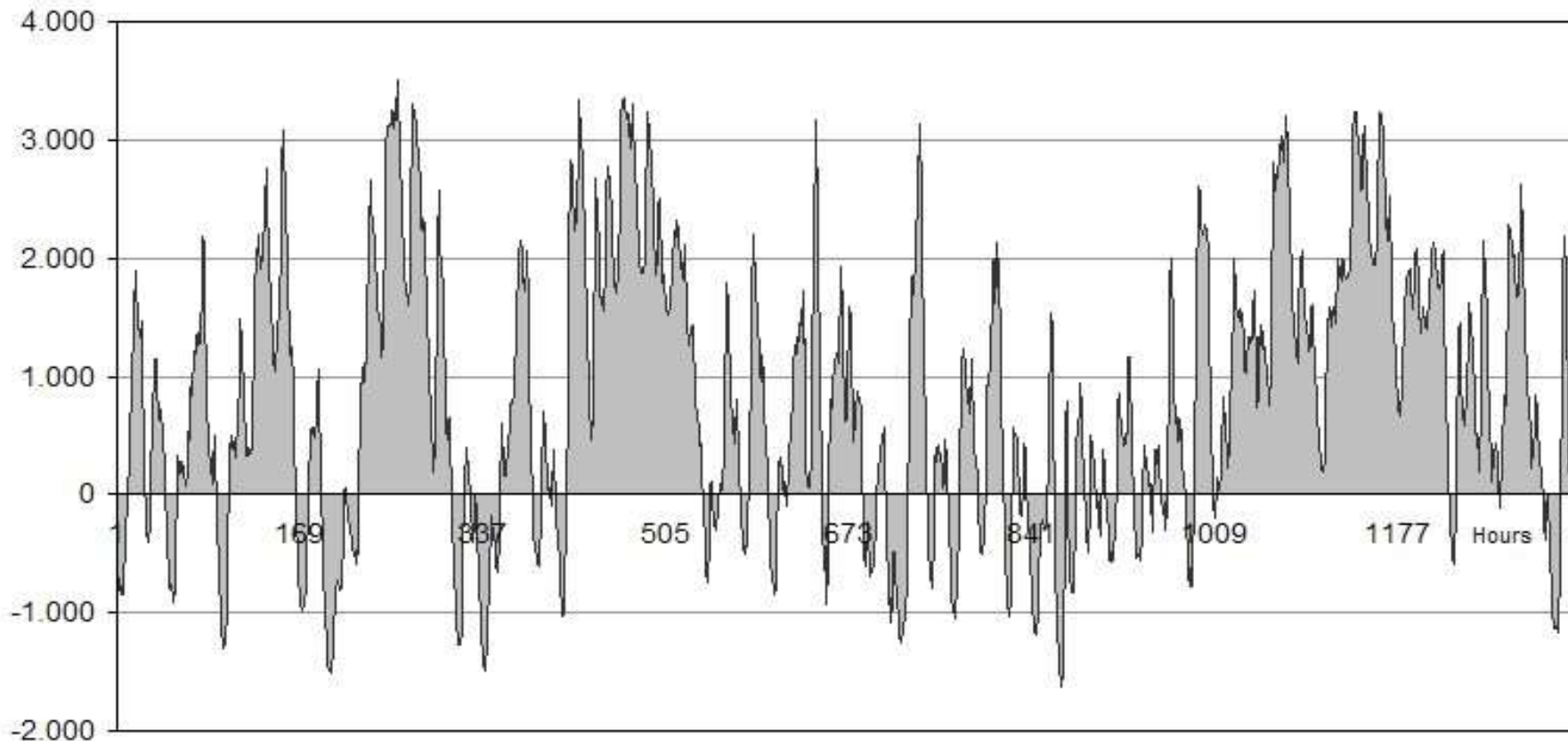


Wind power first 8 weeks



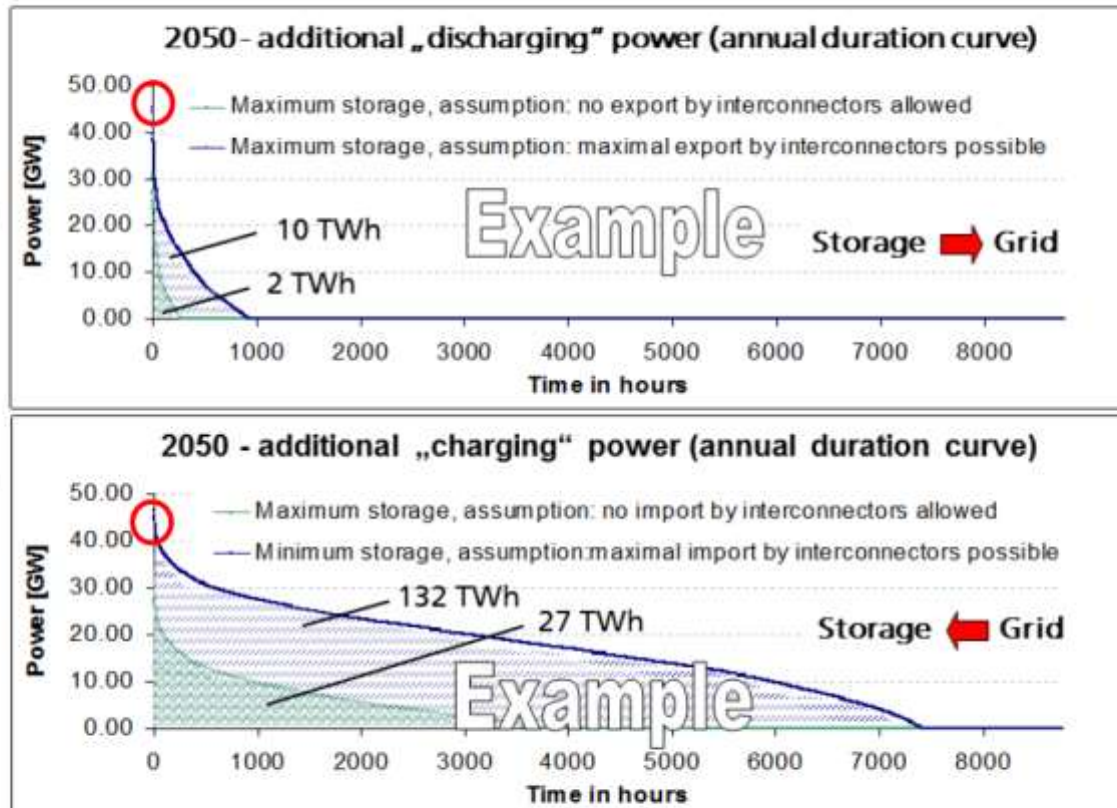
Fluctuating Power Production 50% wind

Residual market first 8 weeks



- ❖ **Energy plan 2030** from IDA (society for engineers) in 2006
- ❖ **Climate Plan 2050** from IDA in 2009
- ❖ **Heat Plan Denmark** from Danish District Heating association in 2008 and revised in 2010
- ❖ **4 scenarios for 2050** from the Danish grid operator Energinet.dk in 2010
- ❖ **Report** from the Danish Climate Commission in 2011
- ❖ **All the reports** were based on hourly simulations of the total Danish energy system and showed that 100% renewable energy is possible and that **district heating should grow from covering 50% of heat demand to app. 70% of heat demand according to socio economic calculations.**
- ❖ **Government decision in 2012** on 100% renewable energy in 2050 and 50% of electricity as wind power in 2020..
- ❖ **5 scenarios for 2050** from the **Danish Energy Agency** in 2014
- ❖ **Energy Vision 2050** from IDA in 2015

**Grid Balancing Demand Analysis:
Power vs. Yearly Stored Energy**



Example:

Grid
Balancing
Demand
2050

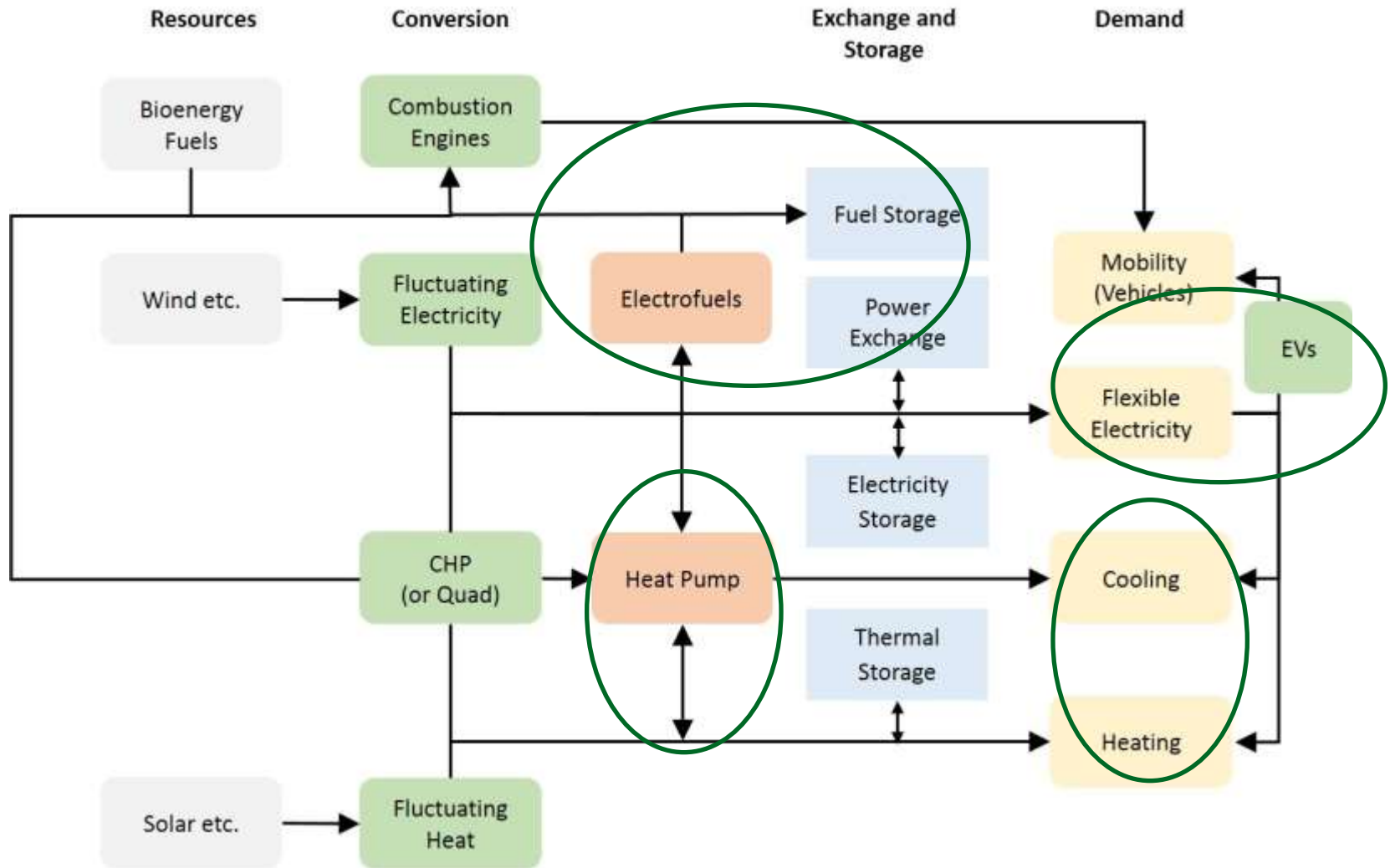
Discharging:
2-10 TWh

Charging:
27-132 TWh

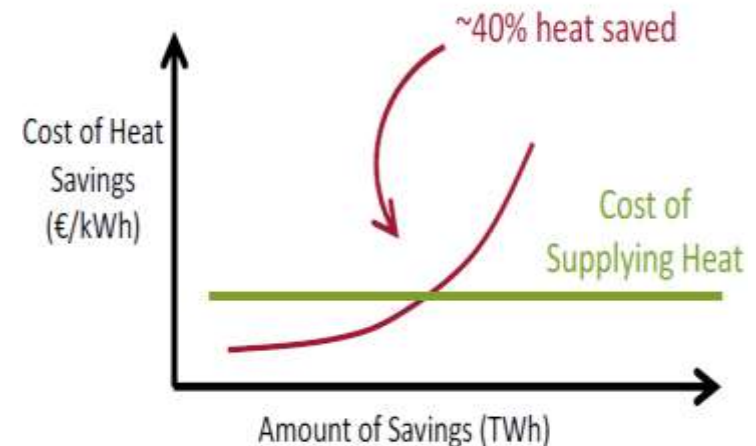
Dr. Christian Doetsch, Fraunhofer UMSICHT
2014-Oct-22, Berlin, IEA BMWI Meeting, Chart 22



Integrated Infrastructures



- ✦ "Future Green Buildings", Aalborg University 2016:
 - It is **essential that the building stock is part of the energy transition through energy savings by around 40% (to 80 kWh/m²)** between today and 2050. This will lower the consumption, the peak demand and the temperature level required from heat supply technologies
 - It is **less important to place focus on new buildings** to save energy in the future energy system since 90% of the building stock existing today will exist in 2050
 - Buildings **should be seen as a part of the storage capacity in DHC and not be prioritised as a source of flexibility** in the energy system since the flexibility can be provided by cheaper means in other parts of the system



15 MW GROUND WATER HEAT PUMP WITH CENTRIFUGAL COMPRESSOR FOR A2A FAMAGOSTA DISTRICT HEATING SYSTEM IN MILAN



Hybrid systems – Hamburg, Germany

PlanEnergi has set up a calculation model and calculated scenarios for district heating supply in Hamburg, Germany, because they want to outsource a coal-fired CHP plant and replace it with different renewable sources. The calculations have been carried out in cooperation with Hamburg Institut (local consultants)

The scenarios include

- biomass solutions,
- large scale heat pumps using cleaned sewage water and excess heat from industries as heat source,
- excess heat from industries,
- solar thermal and
- large scale heat storage (aquifer).

Simulations are carried out in EnergyPRO and the results are heat

prices in same level as the present heat prices from the coal fired CHP plant.



- ✦ Flexible charging of electrical vehicles
- ✦ Power to gas
- ✦ Power to liquid fuels and products
- ✦ ICT as optimizer, visioalizer and adding smartness

- ✦ What are the barriers we will meet and what are the solutions?
- ✦ Which organisational framework is needed?
- ✦ Which juridical boundary conditions are needed?
- ✦ Which economical conditions have to be changed?

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