PERSPECTIVES FOR RENEWABLE ENERGY IN THE DANISH ENERGY SYSTEM

CITIES Workshop: Integration of prosumer buildings in energy systems

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NEW ANALYSIS: SYSTEM PERSPECTIVE 2035

Why long-term analyses for the entire energy system?
• Ensure efficient operation and dimensioning of the el- and gas transmission system
• Contribute to an efficient green energy transition towards 2050

Link to System Perspective 2035: www.energinet.dk/sys35
INTEGRATION OF +50% RENEWABLE ENERGY

Instruments

El-integration – El as end consumption

- El-integration over distances: Grid expansion
  1. El-integration with Nordic hydro power
  2. El-integration between NW Europe and Eastern Europe
- El-integration over time: Elec. To elec. storage
  3. Elec. Storages (e.g. batteries, CAES etc.)

Conversion of electricity for other purposes - electrification

4. Electricity to heat and thermal storages
5. Electricity for transport
6. Electricity for high-value products (electrolysis/PtG/PtX)

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STRUCTURE OF THE ANALYSIS

Part 1: International Energy Scenarios

Part 2: System Perspectives for Denmark

Part 3: Positive interaction between central and distributed solutions

Part 4: Research, Development, Demonstration and Innovation (R&I)
GCA-scenario (Global Climate Action)
- "On track" with EU climate targets
- Strong international, green cooperation and regulation
- Moderate oil price – very high CO₂-price (IEA 450 PPM)
- 50 pct. electricity from wind and sun in Europe in 2040

DG-scenario (Distributed Generation)
- "(On track)" with EU climate targets
- A very high use of distributed solutions (solar/batteries)
- High oil price (IEA New Policy) – high CO₂-price
- 50 pct. electricity from wind and sun in Europe in 2040

ST-scenario (Sustainable Transition)
- "Not on track (but almost)" with EU climate targets
- Low oil and natural gas prices
- Moderate CO₂-price (IEA Low Oil price scenario)
MUCH MORE WIND & SOLAR POWER IN ALL SCENARIOS

Wind & Solar power - Share of consumption (Europe)

Wind & Solar power - Share of consumption (DE, UK, NL, DK)

*2020: Energinet Analyseforudsætninger 2017
DENMARK AFTER 2030

More hours with low and high electricity prices
NORTH SEA REGION SYSTEM BALANCING

- Need for hour/daily balancing for wind/solar fluctuations
- Need for ancillary services incl. Inertia to operate without thermal units
- Need for strong grid and sector-coupling to integrate RE in longer periods with high wind/solar production
Battery storage is essential for hourly balancing – but too expensive for large scale storage
• Sector coupling to gas and heat can deliver more cost effective large scale storage
• Essential to analyse cost effective sector couplings!

"For all the growth in battery installations that BNEF is forecasting, the total volume of grid-connected batteries by 2030 will be sufficient to meet the world’s power needs for just 7,5 minutes" Michael Liebreich, Bloomberg New Energy Finance, March, 2018
EFFICIENT RELATION BETWEEN AND CO-EXISTENCE OF LARGE SCALE- AND DISTRIBUTED SOLUTIONS
ANALYSIS OF DISTRIBUTED RESOURCES
ANALYSIS OF INVESTMENTS IN DISTRIBUTED RESOURCES

LCOE – Wind and PV

Estimated price: Lithium-ion battery (excl. Installation)
INVESTMENTS IN DISTRIBUTED RESOURCES
INVESTMENTS IN DISTRIBUTED RESOURCES

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Assumed available power:
- 4 kW uptake per house
- 2 kW feed-in per house

• The model typically investing in 12 kW PV and 15-25 kWh battery storage
• The prosumer becomes net-exporter of electricity
• Total off-grid solutions does not seem economically attractive. Not even if the price for PV and batteries decline further.
• Large surplus of electricity during the summer.
• “Storage” from the system: approx. 4 MWh
• Needed storage during winter: 1-1.5 MWh

• Congestions in the electricity network can occur at times with high PV production or at times with simultaneously charging EV’s (at large power draws from the net)
EFFECT OF PV/BATTERY DEVELOPMENT ON SYSTEM

What is break even for off grid and how does it influence the grid and solutions based on offshore wind power?
Reduction of batt prices (1/2, ¼, ...) at fixed PV prices
SUMMING UP

European Agenda sets a framework

- ENTSO-E/G show significant increase of wind/solar in NS-region in all scenarios. *More than 50% RE => Need for sector coupling*

Electrification and sector coupling are essential

- A strong power grid is needed

- Sector coupling to the gas, heat, fuel and transport sector is essential for integration of RE

- Large scale solutions (offshore wind, strong grid, PtG/PtX) can co-exist with distributed solutions (prosumers: PV, battery)

Prosumer analysis

- Investing in around 12 kW PV and 9-26 kWh battery

- With changing prices for PV/batteries the investment changes => if DK neighbours does the same (lower prices), the driver for PV/batt investments is lower

- Total off-grid solutions does not seem economically attractive. Not even if the price for PV and batteries decline further.
THANK YOU FOR THE ATTENTION