The Challenge to Integrate the Growing Fluctuating RES-E Power at Different Vertical Entries in the Energy System

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“Market Potential”

• According to the research firm IHS, the energy storage market is set to “explode” to an annual installation size of 6 GW in 2017 and over 40 GW by 2022 - from an initial base of only 0.34 GW installed in 2012 and 2013.

• An IMS Research report expects the market for storing power from solar panels – which was less than $200 million in 2012 – will catapult to $19 billion by 2017.

• In Sweden around 2 TWH will be dumped annually in the future
Overview

- Introduction
- Grid Extension vs. DSM
- Current Situation
- Vertical Integration
- Storage Systems
- Results
- Discussion
- Conclusions
Introduction

- European goals of reducing greenhouse gas emissions
- Shift in energy supply and power sector
- Increase of distributed RES-E mainly wind and solar power
- Increase started with WP in Denmark
- Later the FIT in Germany resulted in a massive increase of capacity and a price decrease of WP and PV
- Result: RES-E is competitive and abundant
- Current increase of RES-E on a European and international level
- Next generation WP 8 MW and PV at 19% efficiency
- Increasing number and size of peaks in the future grid

Grid Extension vs. DSM

- Different solutions
- Different stakeholders
- Power grid extension – shift in place
- DSM integration in the smart energy system of tomorrow
  shift in time
Future Focus

Power to Power
  ↓
  Electricity
  Electrochemical
  Mecanical

Heat to Heat
  ↓
  Latent
  Thermochemical
  Sensible

Power to Gas
  ↓
  Hydrogen
  Methan synt.

Water
etc
Vertical integration

National Power Grid

Peak power from WP

Peak power from large PV

Local Power Grid

Non urban areas

Consumer without DH

Residential PV

Local DH

Power

DH - central heat storage

DH grid

Urban areas

Consumer with DH

Housing areas

Consumer without DH

Storage Systems

• Who will
  – develop it
  – at what level in the system
  – in which system: heat or power

• This could be done by the
  – DH company
  – Housing owners, the developer of the area, or
  – TSO
Storages in DH Systems

- Storages are commonly available in DH systems
- The DH grid often acts as a storage itself
- Different ways to load storages:
  - Electrical boilers are common (cheap but less efficient)
  - HP is already available in a number of places (+100; Stockholm 480 MW) mainly in Norway, Sweden, Denmark
  - HPs are large investments and a free heat source must be available
  - Currently HPs compete with DH scheduling - availability at the “right” time
  - Free storage capacity at what time and what level in the system
Storages within Housing Areas

- Development of battery storages within housing areas for PV
- Local Thermal Energy Storages (TES)
- Sequential heating with TES

Pro/ Cons
- Currently mainly electricity storages
- Cluster efficiency - close to consumer
- Responsibility
- Pricing dependent on national regulation and system level
- Mainly power storages
Final Consumer – Smart Home

Future household installations

- PV
- Solar thermal
- Heat
- External supply for heat
- Local TES storage
- Heat consumption
- Local power storage
- Power consumption
- Transport

Power and Peak power

- Off peak power

- HP or direct resistance heat

In a Smart Energy System these features can develop in small and large scale systems

- HP with TES (single houses - single house areas without DH)
- Boilers with TES or building mass as storage
- PV and battery storages in single houses
- Additional HP with TES in regions when FIT is running out
- HP without TES but with battery storages (German case)
Storages at the Final Consumer
Pros/Cons

– Easy to adapt to national regulations
– Hard to predict a European development, local markets
– Different national PV developments
– Share of HP heating differs within Europe
– Low power prices and high volumes of HP
– Low energy buildings (LEB) foster HP
Results

• The heat demand in the building sector has large capacities and the ability to shift power to heat and in time.
  – Via DH
  – Via HP and TES
• Fluctuation and storage not always in the same grid/TSO (Stockholm HP)
• High and Low voltage grid issues (WP, PV and residential PV)
• Residential PV and storage heat and power will grow
• DH can take fluctuative power
• Single houses with ICT (clusters) can make use of fluctuative power as well
• Heat storages with DSM can reduce investment in grid expansion
Discussion

• When is DH getting to complex?
• Legal framework for power and heat storages
• Real time tariffs
• Future development of RES-E
  – Temporary fluctuation
  – Power curtailment
  – Ramping issues
• Future HP with storage and ICT for peak power
Conclusions

• Large potential for integrating Power in the building sector
• Urban areas via DH
• Non urban areas directly with HP and TES
• Smart grid necessary
• National differences responsible for local development
Thanks