The transition of small-scale CHP into market-based smart energy systems

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The relevance of Combined Heat and Power (CHP)

Electricity capacity in Denmark

![Electricity Capacity in Denmark](chart.png)

*Figure based on data from: Danish Energy Agency. Energistatistik 2013. Copenhagen: Danish Energy Agency; 2014.*
Electricity production in Denmark

Electricity production by type of producer

Figure based on data from: Danish Energy Agency. Energistatistik 2013. Copenhagen: Danish Energy Agency; 2014.
Electricity prices on Nord Pool Spot

Monthly average Elspot market price

Figure based on data from: Energinet.dk,
Example of the type of small CHP units focused on here

- Approx. 4,000 consumers, with a total sale of heat in 2012 of 89,535 MWh and a heat loss in the grid of 21.6%

- Natural gas fired engine (8.8 MWe, 10.3 MWth)
- Electric boiler (12 MWth)
- 30,000 m² solar panels (22 MWth)
- 4 natural gas boilers (total 40 MWth)
- 3 heat storage tanks (1,500 m³ and 4,500 m³)
Going forward – An example from the CEESA project


International Conference on Smart Energy Systems and 4th Generation District Heating, Copenhagen, 25-26 August 2015
The role of small district heating plants in the CEESA scenario

Load duration curve for CHP in small DH plants

DH = District Heating
The role of small district heating plants the CEESA scenario

Load duration curve for HP at small DH plants

HP = (compression) Heat Pumps
Increasing CHP economic viability
Challenges/potential extra costs for CHP plants on balancing reserves

• The plant has to produce non-useable or non-storable heat by operating the CHP unit in order to be able to deliver balancing reserves.

• Participation on balancing reserves reduces the spot market trading. This can for example occur due to the displacement of heat production using thermal storage systems.

• Etc.
Organising balancing reserves for small CHP plants

- Set the gate closure for bids as close to the actual delivery time as possible, or make it possible to change bids for activation close to the actual delivery time. Additionally, not requiring winning capacity in order to be allowed to deliver activation would help.
- Keep the period of delivery as short as possible. If a long period of delivery is necessary, then make it possible for participants to deliver balancing reserve electricity without having to already be in operation.
- Avoid basing balancing reserves on the pay-as-bid settlement principle, unless it is likely that an actor will be able to exercise market power.
- Keep the minimum capacity or energy requirement for participation as low as possible.
- Make the balancing reserve asymmetric.
The business case for flexible small CHP plants in future energy systems

On the system level, participation on balancing reserves is not sufficient to make up for the reduced sale on the spot/day-ahead markets.

Other options to consider:
• Capacity Remuneration Mechanisms
• Tax rules
• Subsidies
• Etc.