COGEN Europe
Briefing paper on Smart Grid and micro-CHP
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Summary

Micro-CHP is a flexible and controllable player in the new smart grid low carbon electricity market offering services to the grid and the opportunity to bring a whole new group of citizens into a new relationship with the energy market. The timing of the EED with its inclusive review of the CHP Directive is ideal to ensure through an appropriate policy structure that micro-CHP emerges successfully from its early market stage, playing its part in the success of Europe's Climate and energy strategy and empowering Europe's citizens.

Introduction

Our electricity demand continues to increase potentially doubling its share in energy demand by 2050[1], with peak demand posing particular problems where such demand outstrips supply. The intermittency of large-scale renewables, such as wind and PV cannot be relied upon to react to such peaks, leading to a mismatch in supply and demand, and the inevitable volatility in pricing.

The EU has set tough targets for 2020 – for reductions in CO2 emissions total energy consumption and for energy from renewables. This energy plan assumes strong growth in the penetration of large-scale renewables for centralised power generation, such as wind. To achieve this, grids will adapt to an increasing share of electricity generation coming from small embedded generators in the lower voltage networks, which will include micro-CHP, small-scale CHP, PV, small wind and small biomass plants.

The Smart Grid will impact all aspects of the electricity value chain. It will transform our approach to developing and deploying networks and necessitate new techniques, new participants and new markets within the industry.

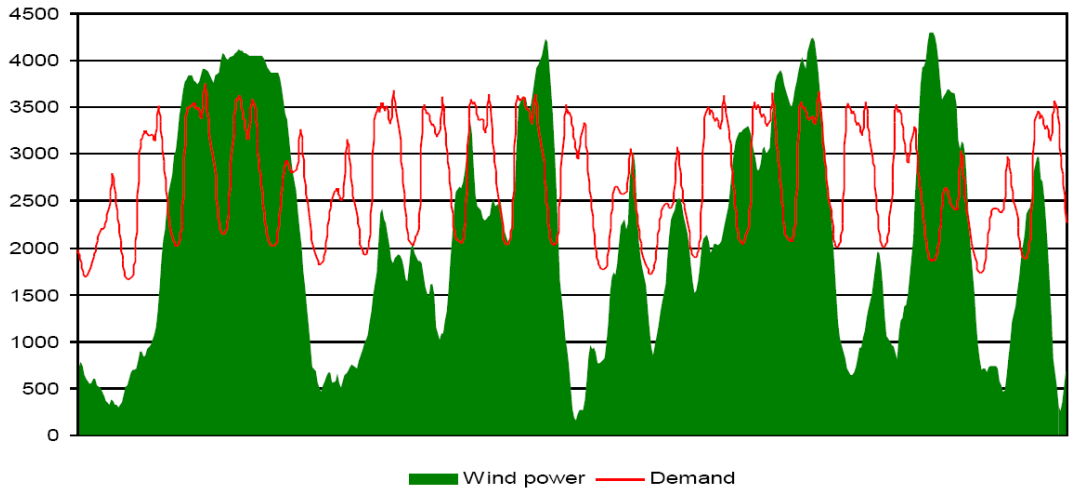
Micro-CHP

Micro-CHP is the latest in the family of CHP applications to reach the market. Its particular combination of controllable electricity and heat generation give it huge

[1] Energy Roadmap 2050 European, Commission December 2011

potential in the emerging needs of maintaining reliable electricity supply in a low carbon high renewables electricity network. Micro-CHP products are in their early market stages, with Europe at the forefront of their development and deployment. They need to benefit from a supportive policy structure if they are to fully serve Europe's energy strategy in the smart grid of 2020. The Energy Efficiency Directive (EED) can set that policy framework.

On a local scale, the penetration of electric vehicles and electric heating technologies, such as heat pumps, rely on a robust local distribution network with increased capacity, if such penetration levels rise significantly.



Source: Energinet.dk, 2011

Figure 1 comparison of electricity demand and wind power generation Denmark January 2008[2]

In addition, the increase in penetration of other sources of distributed generation, such as solar PV, will lead to greater challenges in managing unpredictability and maintaining the integrity of our local distribution networks (Figure 1).

The backdrop for these issues is an aging European energy infrastructure which is in need of significant investment up to 1 trillion EUR by 2020. If it is to cope with the future increased demand and a new energy environment this investment will have to include smart grid technologies and techniques. The smart economic solution will utilise the expertise and techniques already at our disposal to increase local electricity generation and optimise the use of the existing networks.

Role of micro-CHP in Smart Grid

Utilities, regulators and grid operators have been engaging in studies and large-scale practical demonstration projects that already conclude that micro-CHP can become a major building block of the Smart Grid. In this application micro-CHP helps to balance supply and demand, operating as a source of electricity that can be despatched remotely and modulated to meet the needs of the network and the

[2] Based on assumed wind capacity in Denmark in 2025
Source: Energinet.dk EcoGrid EU: 'A Prototype for European Smart Grids'

consumer. The output of micro-CHP units can be aggregated and used as a source of electricity output to supplement shortfalls in demand from centralised generation.

This aggregated output of micro-CHP appliances forms a Virtual Power Plant (VPP).

Definition – Virtual Power Plant

VPP refers to the ability to aggregate power production from a cluster of grid-connected distributed generation (DG) sources in order to meet demand. VPP is key component of the Smart Grid in which smart grid technology enables central control to harmonise diverse sources of energy supply and customer demand.

The configuration of such a system extracts significant value from micro-CHP which is also a tool to help balance supply and demand.

Micro and small CHP coupled with heat storage can play several "smart" roles on the new grid. In times of rapidly falling electrical output from renewables it can start to supply the local electricity network and using heat storage temporarily store the heat to supply later. This also keeps the electricity supply local hence minimising grid losses. In times of falling demand CHP can switch off supplying heat from storage. This functionality can be controlled by suitable balancing and demand response markets signalling the appropriate action. Such deployment maximises the value of the appliance for both end-user and distribution utility.

Demand response with micro-CHP

In a domestic setting Micro CHP typically operates when the occupants are in the house and in response to the occupants' requirement for space heating and hot water. In this situation Micro CHP operation coincides with periods of **peak electricity demand** which are satisfied by the operation of fossil fuel electricity generation plants.

Heat storage capacity – in the form of hot water tanks, or buffer stores – enables the decoupling of Micro CHP operation from heat demand and allows flexible operation. Micro-CHP thereby enables the **storage and despatch** of reserve electricity generation capacity at times that benefit network operation.

In a *Virtual Power Plant* in Germany the utility, Vattenfall, uses a combination of Micro CHP and heat pumps to enable a **flexible response** to variations in electricity demand and generation brought about by the integration of wind power.

There is also the opportunity that **Smart** operation of micro-CHP can enable load-shifting for end users, by decoupling end-user peak demand from traditional peaks in network demand, which are also associated with the operation of high cost peak generation plant – typically coal plants. This load-shifting from peak periods has numerous benefits:

- Demand and supply are better balanced;
- Wholesale price volatility is reduced, leading to customer price benefits;
- Distribution losses from central plant are avoided through local production and use;
- Reserve generating capacity is available to the utility network operator to meet its obligations to respond to frequency variations and maintain network integrity;

- Local electricity generation and consumption relieves pressure on the TSO network and allows better use of those assets;
- Micro CHP in a smart electricity network delivers much needed services for the utilities, DSO and by consequence TSO who can reward customers for the service they deliver to the grid.

Barriers

Barriers to micro-CHP still exist. The traditional market based on large centralised supply is slow to change. The regulatory system must also adapt to encompass a much more decentralise supply approach.
In Member States local regulation offers varying degrees of help and hindrance to enabling micro-CHP to connect to the electricity network, and in gaining reward for the electricity generated and exported by these small players in the electricity market. Micro-CHP will only develop and hence supply the services of which it is capable if new demand response and grid balancing markets open to small players. In this context metering can be a tool for extracting value and the increased penetration of smart meters will enable real-time pricing of benefits and the application of flexible tariffs, in line with the benefits delivered by micro-CHP.
Further the early stage market of micro-CHP can be encouraged and stimulated in the near term by appropriate legislative focus and measures at the Member State level.

Conclusions

Micro-CHP is a flexible and controllable player in the new smart grid low carbon electricity market offering services to the grid and the opportunity to bring a whole new group of citizens into a new relationship with the energy market. The timing of the EED with its inclusive review of the CHP Directive is ideal to ensure through an appropriate policy structure that micro-CHP emerges successfully from its early market stage, playing its part in the success of Europe's Climate and energy strategy and empowering Europe's citizens.

Sources:

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