Smart Grids *create new opportunities for heat pumps*

A low carbon future in Europe will require a more dynamic electricity system. A decarbonised grid - with high penetration of inflexible wind and nuclear - means that balancing generation and demand is not as straightforward as ramping up supply to meet demand. Instead, demand may be shaped to meet available generation. On the demand side, increasing electrification of heat and transport leads to demand peaks. The energy system of the future will have to deal with: supply / demand imbalances and increased congestion on the distribution grid.

New business opportunities are emerging to capture value through smart operation of heat pumps and other assets on the demand side - to help balance generation and demand, and to manage network congestion.

Ultimately, heat pumps will have to be 'smart' if they are to capture a share of this emerging market. In this article, we explore what it means for a heat pump to be 'smart', and where the value is in this emerging smart market.

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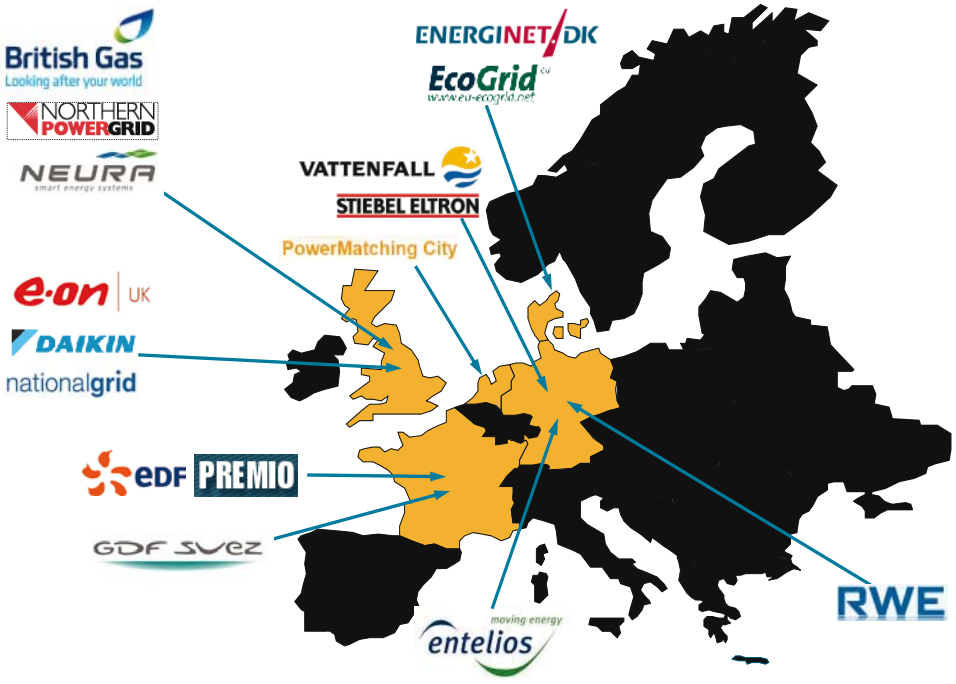

Figure 1.
A wave of smart heat pump projects as tracked by Delta-ee.

An emerging smart demand market creates opportunities for heat pumps

Ultimately, heat pumps will not be playing in a "smart heat pump" market, but in a wider smart market. There is a wave of smart projects emerging in Europe, driven by interest from a large number of energy market players. All of these companies see an opportunity to capture a share of the potential market value in smart demand. Heat pumps are one technology which could enable some of this value to be captured. There are, of course, many other ways to shape demand – for example time of use price signals, home energy management systems, and 'smart' refrigerators and washing machines. But with their relatively large electrical consumption, heat pumps offer attractive opportunities to help match supply and demand – as demonstrated by the wave of smart heat pump projects shown in **Figure 1**.

Where is the value in smart demand?

The value chain for smart demand with heat pumps is still emerging and is partly dependent on future developments in electricity regulatory frameworks. The following players can capture potential value in this future market:

- **Network operators** can benefit from the avoided cost of new grid infrastructure to support demand peaks, through smart operation of heat pumps & other assets.
- **Aggregators, energy suppliers & demand response companies** can benefit from the additional value created through controlling operating times of heat pumps and other assets according to fluctuating power prices, and trading this capacity in balancing markets and other energy markets.
- **Heat pump manufacturers** can benefit from the greater market opportunities available to them if they are 'smart-ready'.
- **New market entrants:** New market opportunities for demand response 'enabling' technologies and services from, for example, companies developing communication technologies, home/building energy management systems and offering energy services.

Delta-ee is tracking this emerging sector in Europe, and highlights projects which include the use of heat pumps in 'smart' applications. Some of these projects are already commercial, but most are pilot projects which are testing key questions related to smart control of heat pumps, such as:

- How far can demand realistically be shifted?
- How will end-users respond to 3rd party control of their heating system?
- What communication and control mechanisms are most effective?
- What business models will maximise value & provide a strong customer proposition?

Learnings from these pilot projects will be critical in developing understanding of the value potential in smart heat pumps.

Smart heat pump projects in Europe

To understand what is driving these projects, and to investigate key questions about what a smart-ready heat pump is, we focus on three projects in more detail in **Table 1**. We compare three smart heat pump projects in markets where balancing supply and demand and managing grid congestion is – or will be – a significant challenge. We compare the drivers for the projects, and assess what being 'smart-ready' means for each project.

Being smart-ready will be a must-have to maximise the growth potential of heat pump markets

As seen above, there is growing recognition amongst utilities and other energy market players that smart-ready heat pumps could represent significant market value through their application in smart demand projects. Currently in the form of pilot projects and demonstrations, this could open up new value opportunities for heat pumps (**Figure 2**). Only 'smart-ready' heat pumps will be able to exploit these opportunities. The heat pump value proposition will grow towards 2020. Energy cost savings will be larger in the future as energy prices rise (depending what electric heat pumps are displacing). But the future value proposition is increased further because of the additional value associated with smart use of heat pumps in matching supply & demand – additional value which will only be captured with smart-ready heat pumps.

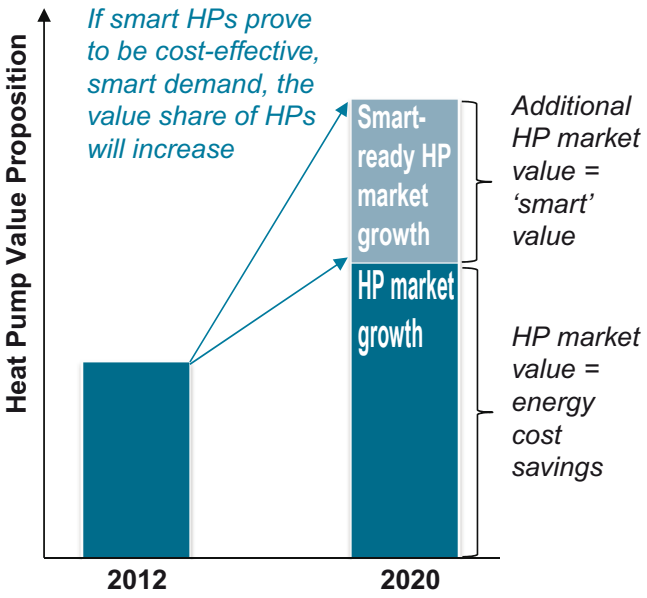

Figure 2. How will being smart-ready grow heat pump market value?

Table 1. Comparison of smart heat pump projects in Denmark, the UK and Germany.

	Denmark	UK	Germany
Companies	**Energinet.dk** (TSO)	**British Gas** (Energy supplier), **Northern Power Grid** (DNO)	**Entelios** (Demand Response company)
Project type & status	Demonstration project	Pilot which may be rolled out commercially	Commercial business
Project description	Assessing the control & communication mechanisms necessary for shifting HP operation in response to energy price signals, testing how far demand can be shifted, and assessing consumer response.	Trialling the application of smart grid solutions on the distribution grid – including HPs and other microgeneration, and assessing the consumer behaviour and network impacts.	Controlling the operation of technologies providing flexible load & energy storage (e.g. air-cond/HPs) in response to TSO signals, and selling into power markets.
End-user	Residential	Residential & small commercial	Commercial/industrial
Market context	Wind capacity is set to grow from 3 GW today to 6 GW by 2025, meeting 50% of Danish electricity demand. This will create major challenges managing supply & demand.	The UK electricity networks will need significant upgrading to accommodate the growth in wind and the projected electrification of heat & transport. Smart demand could minimise investment costs in the grid upgrade.	The increasing penetration of wind in Germany, and increased volatility of electricity prices associated with this, creates large opportunities for demand response.
Primary driver	Managing distribution grid congestion & matching supply/ demand	Managing distribution grid congestion	Matching supply/ demand
Requirements for the heat pumps involved in the project			
Communication capability of HP	2-way	2-way	2-way
Communications interface	wifi	tbc	LAN
Level of intelligence built in to the HP	None required – controls retrofitted (but retrofitting is not cost-effective for a commercial project)	Ability to accept utility signal and communicate how much consumption has been reduced	Ability to integrate with Building Energy Management system is critical
How fast should the HP respond?	As quickly as possible	As quickly as possible – certainly within 1 hour	Within 1-5 minutes of receiving the signal
How long will the HP need to shut down for?	Typically up to 2 hours	Ideally up to 4 hours	Typically up to 2 hours, but longer if possible

Being smart-ready requires built-in control & communication capabilities

As seen from analysing existing smart projects in Europe, the market has yet to decide exactly how smart a heat pump must be, and uncertainties remain – for example, currently there is no clear preference for communications interface. But there are some clear messages about what capabilities will be critical:

- **2-way communication** – to accept utility signals and be able to respond back with information on how much capacity it has available, or how long it has shut down for.
- **The ability to accept dynamic control and influence on operation** - responding to signals as fast as possible, and being able to shut down for as long as possible while minimising the impact on the end-user.

Heat pumps which can differentiate themselves in this way will be more attractive to energy market players engaging in smart markets, so ultimately will take a greater share of the heat pump (and smart) market.

Delta-ee's Heat Pump Research

For more information on the Delta-ee Heat Pump Innovation Monitor or Delta's wider heat pump research, please visit www.delta-ee.com or contact Lindsay.Sugden@delta-ee.com, +44 (0)131 625 1006.

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