Annex 45

Hybrid Heat Pumps

Executive Summary

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Executive Summary

The goal of this annex was to develop knowledge on the technical development and the market opportunities for hybrid heat pumps.

Note: This report is intended as a first comparative overview of the opportunities for hybrid heat pumps in the participating countries. It may not accurately reflect the opinions of all participants on all topics.

A hybrid heat pump is the combination of a heat pump with a traditional fossil-fueled heater (boiler or furnace). By combining two heating technologies within a single control strategy, it is possible to flexibly choose the use of the heat pump or boiler/furnace part of the heating installation. This flexibility allows to optimize heat production according to local considerations. For instance, regarding CO_2-production, running costs, primary energy, grid congestion or load balancing. Additionally, a hybrid heating system may have lower investment costs than an all-electric heat pump and will often fit within comparably tight spaces.

Because a fossil-fueled heater is always available as a back-up, hybrid systems are an enabler for the use of heat pumps in retrofit situations.[1]

In particular, hybrid heat pumps allow:

- Flexible fuel choice
- Fit for a range of house types and buildings --> big retrofit market
- Quick upscaling possible, possibly delivering rapid and significant savings on CO2
- Decoupling renovations of buildings and heating system renewal
- Experience building with heat pumps in a 'safe' way, enabling a smoother transition to wider deployment of all electric heat pumps
- 100% renewable heating, when the boiler part is run on renewable fuel, such as hydrogen, syngas, biogas, etc.
- Far-reaching and proven smart grid applications, because of their capacity for fuel/electricity switching

For (large) commercial buildings, e.g. in industry, offices or health care, hybrid heating systems have been common practice for a long time already. The primary motivation for using hybrid systems in these buildings is typically the possibility to choose the output power of each component in such a way as to optimize the balance between investment and running costs. Hybrid systems for small-scale applications have only recently become commercially available in appreciable numbers.

Because the market development for hybrids is only starting to take off, this Annex has tried to discuss the general position of hybrids within the domestic heating sector, rather than focusing on implementation or performance details. Only a limited amount of original research has been conducted.

This final report should be considered as a first step towards defining the advantages and disadvantages of hybrid systems and their typical application areas and role in the transition towards carbon neutral heating for homes.

This final report summarizes the discussion from the working group over the past three years (2016 – 2018). During this time, the market for hybrid HPs has changed quite a bit in several of the participating countries. A growing wave of interest in hybrid HPs as an intermediate step towards renewable heating can be noticed in France, the Netherlands and the UK. Where possible, this report tries to accurately describe the latest policy and market developments.

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[1] Total system costs depend on the heating device (e.g. Boiler, HP, or both), but also on additional requirements for a DHW storage tank or possibly replacement of radiators by convectors or underfloor heating.

Key findings

Because hybrids can be applied in existing buildings, they provide a potential for significant CO^2-savings that can be tapped into immediately and on a large scale. This also allows for markets and users to get used to heat pumps, preparing for large-scale electrification of domestic heating within the next decades. In addition, it may allow to smoothly adapt/improve the electricity grid to welcome a higher share of HPs in buildings.

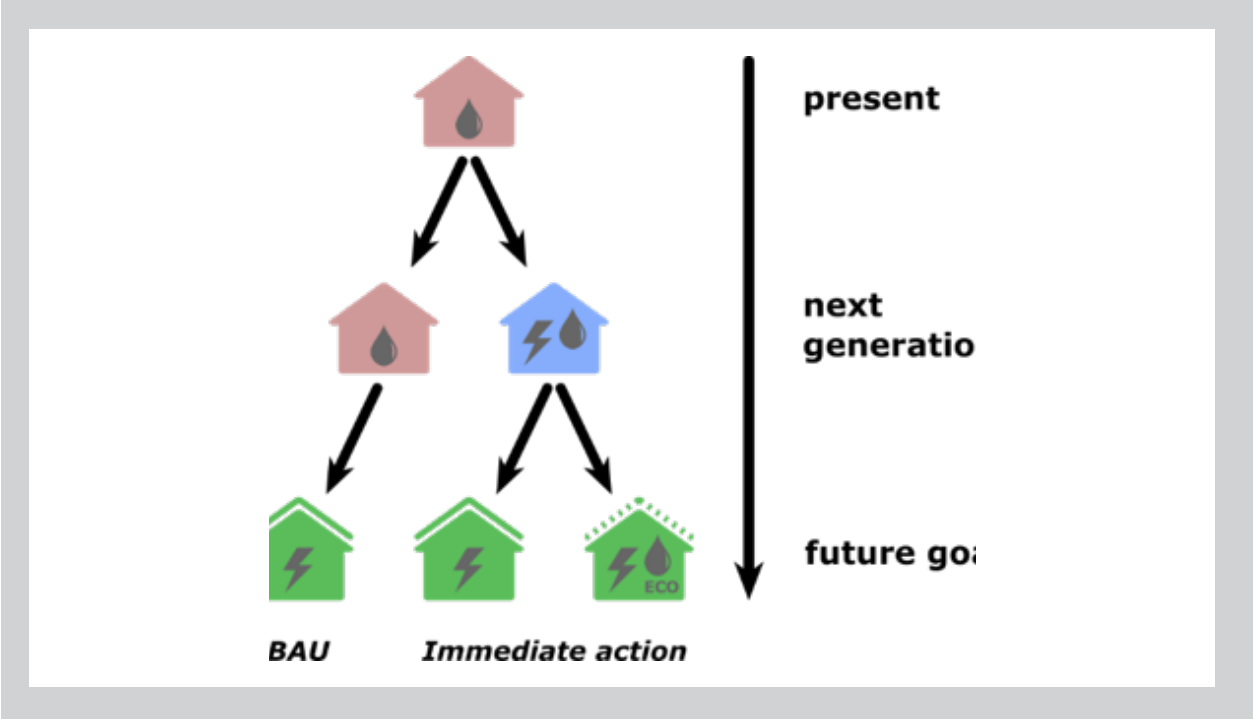

Figure 1: Traditional (left) and hybrid (middle and right) route to renewable heating.

The figure illustrates a Business as Usual route to 100% renewable heating (left), versus a hybrid route to 100% renewable heating. Hybrid systems enable quick action, but the final energy system may still contain a significant proportion of hybrid heat pumps, where the boiler part uses non-fossil fuel for the remaining peak heating demand, hot water preparation, or grid flexibility.

Hybrid heat pumps provide flexibility beyond time-shifting electricity loads. Because it is possible to switch from electricity to gas or oil, the HP electricity demand can be completely decoupled from the heating demand at any time, providing a structural solution for local grid congestion.

The figure below shows this possibility:

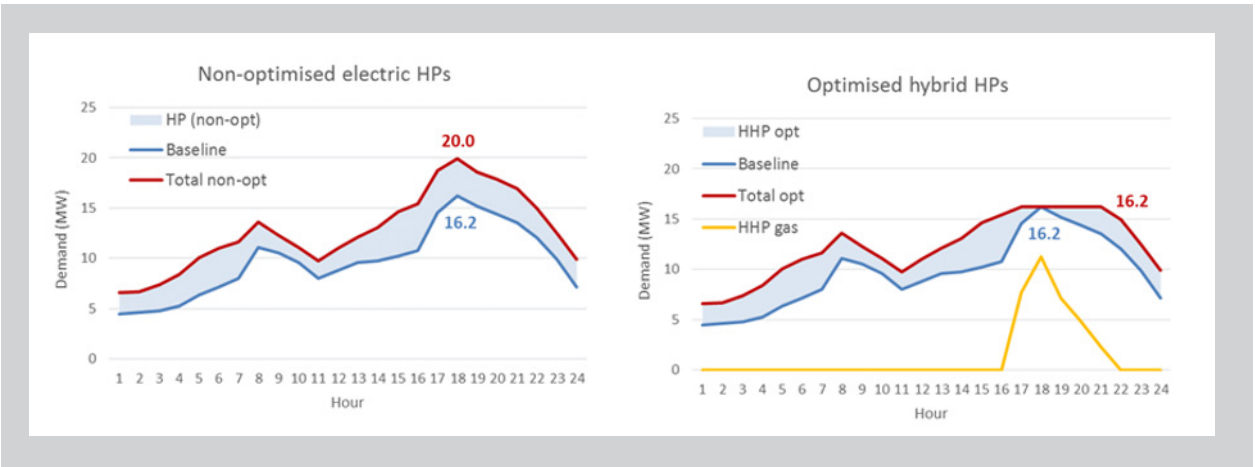

Figure 2: Illustration of the possible effect of optimizing HP performance by adding a boiler. A non-optimised HP (left) may add electricity demand at peak hours. Optimizing the HP through the use of a gas boiler can completely remove the additional load at the peak. Source: Freedom Project / PassivSystems.

Basic control strategy is a key factor in determining the operating regime for hybrid heat pumps. Hybrid systems may be used to optimize heating for an individual house but can also be used to support grid load management, renewable production profile matching and other smart grid applications.

Energy prices form a major influence on market realization potential for hybrid heat pumps. Compared with standard boilers, hybrid systems may face strong competition on both investment and operation costs. Compared to all-electric systems, hybrids tend to be more favorable in both respects, albeit not universally so.

There is a wide variety of hybrid setups and use cases across participating countries. Each country has a couple of appropriate use cases, while no single use case is relevant for all countries. The list below gives an indication of the typical use cases for hybrid HPs that may be expected in the participating countries.

Situation	Problem/driver	Hybrid provides…	Applies to…
Collective heating / multi-family houses	Renewable energy with best business case.	Optimal balance between investment (€/$) and CO_2-savings.	NL, DE, IT
Houses with PV-installations	Maximize use of self-produced renewable electricity.	Hybrid systems can be optimized for hot water production during PV peak production.	DE, BE
Existing houses on gas grid or oil-fired boilers	CO_2-savings hard to achieve without renovation.	Immediate savings, without the need for building renovation. No “lock-in”: future renovation will still provide extra savings on fossil fuels.	NL, BE, DE, CA, FR
Small houses	No space for hot water storage tank.	With hybrid, HP can provide at least baseload, boiler can still cover hot water.	NL, UK, BE
“Hard-to-treat” houses	Limited technical/architectural options for building-related measures. E.g. in monuments and old buildings.	Elegant way to provide at least a minimum amount of CO_2-saving, without necessitating (deep) renovation.	NL, UK, DE
Houses with LPG- or oil-fired boilers	Boiler fuel is expensive.	Immediate savings on fuel use.	BE, IT, DE, FR
Weak electricity grid or “end-of-the-line” grid connections.	Capacity of electricity grid too small for all-electric heat pump.	Maximal use of renewable energy with minimal peaks in grid load.	UK, CA, IT, FR
New built houses	Renewable targets / building regulation.	Desired amount of renewable energy or energy performance.	FR
Add HP to planned AC installation	Heating reference (furnace) is low-cost, AC installation needed	By choosing a reversible HP, with cooling as primary function, part of the heat demand can become low-CO_2 for a limited investment	CA
Enabler for large-scale grid management	Several grid-load issues: e.g. renewable production, electrical vehicles, mass-deployment of HPs, etc.	Electricity demand from hybrid systems can be switched off at will, providing plenty of smart grid potential.	Future development

Hybrid heat pumps may serve as a gateway to low-carbon heating.

Through the use of hybrids, it is possible to immediately realize a partial transition of the heating system towards 100% renewable, even if the building itself has not yet been renovated. Depending on the availability of renewable fuels (e.g. hydrogen, syngas, biogas), hybrid HPs may become a permanent part of the energy system.

Barriers to market growth

Hybrid heat pumps have a significant potential to accelerate the transition to low-carbon heating and facilitate the wide-spread introduction of all-electric heat pumps. To achieve this potential, a number of barriers must be removed.

ACKNOWLEDGE HYBRID HPS AS A VALUABLE OPTION FOR TRANSITION TO 100% RENEWABLE HEATING

Any successful policy regarding hybrid systems needs at least acknowledgement of their existence and possible usefulness in the energy transition. At the most basic level, it should be ensured that hybrid systems are covered – just like other renewable heating options – in

- Building regulations
- Incentives for renewable heating
- Product regulations such as ErP
- Testing standards
- Information campaigns

IN SOME CASES, HYBRIDS MAY BE THE ONLY OPTION TO REALIZE AT LEAST A PARTLY RENEWABLE HEATING SOURCE FOR DOMESTIC HOUSING

In specific cases, it will be impossible to introduce low-temperature heating into houses. These houses may be heated using collective systems or district heating using specialized heat pumps, geothermal energy or fossil-free boilers. However, such projects may be prohibitively expensive. For these cases, hybrid systems (eventually combined with fossil-free fuel) may prove to be the only viable solution in the long run.

HYBRID HPS MAY SERVE AS A TRANSITION TECHNOLOGY, BUT ALSO AS A USEFUL INTRODUCTION FOR CUSTOMERS TO GAIN EXPERIENCE WITH HEAT PUMP SYSTEMS

Although hybrid systems provide their own set of advantages, both as a long-term solution and as a transition technology, an important spin-off for other types of HPs can be expected.

Because hybrid technology offers a fail-safe way to introduce HPs in existing homes, important experience can be gained for wider HP deployment. Consumers and installers alike will have the opportunity to develop best practices for HP applications. Because hybrid HPs have a wide application range, they may help to greatly speed up the market growth for all types of heat pump systems.

MAKE PLANS TO STIMULATE THE USE OF HYBRID HPS AND IDENTIFY COUNTRY-SPECIFIC USE-CASES AND MARKET DRIVERS

Typical use cases for hybrid systems differ greatly according to local circumstances (see section 3.5). Therefore, it is necessary to explore the application areas for hybrid HPs at a country level and develop appropriate stimulation measures and regulatory frameworks where necessary.

In particular, the role of hybrid HPs as an enabler and kick-starter in the transition to 100% renewable heating should be acknowledged. The potential for CO_2- and cost savings, targets for market growth and number of installed units should be made explicit.

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