

A window of opportunity for hybrid heat pumps?

A Delta Energy & Environment White Paper

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A window of opportunity for hybrid heat pumps?

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There is an emerging market in Europe for “hybrid” heating systems, combining different heat sources via an intelligent central controller to provide more flexible operation, and optimise running costs and efficiency. Delta sees a window of opportunity for hybrid systems combining an air source heat pump and a fossil-fired boiler. What is currently a niche market numbering around 10-20,000 installations in total, could in the next 2-3 years, see significant expansion and potentially 10-fold growth.

- ▶ **Hybrids will have the most impact in markets with high grid carbon, high energy prices, and a historic reliance on gas.**
- ▶ **In new build properties, the market is already emerging, and building regulations will continue to drive hybrids in many markets for several years – but in some markets hybrid products are not yet recognised in building regulations.**
- ▶ **In retrofit applications, there is a strong potential hybrid opportunity – significant CO₂ savings & running cost savings are technically possible over a gas boiler, and hybrids may also be a strong solution for high temperature heating systems – but the size of the opportunity is not yet clear.**
 - Hybrids performance in retrofit applications is not yet fully understood.
 - It is unclear how consumers will perceive hybrid products.
 - Policy incentives are not available for hybrids in some key markets.

Delta's Heat Pump Research

This Delta Whitepaper contains highlights of Delta's hybrids research, published in full in the **Delta Air Source Heat Pump Innovation Monitor** – see www.delta-ee.com. To discuss issues raised in this paper, or for more information on the Delta's heat pump research & bespoke consultancy services, please contact Lindsay Sugden (Research Manager – Heat Pumps), Lindsay.Sugden@delta-ee.com, +44 (0)131 625 1006.



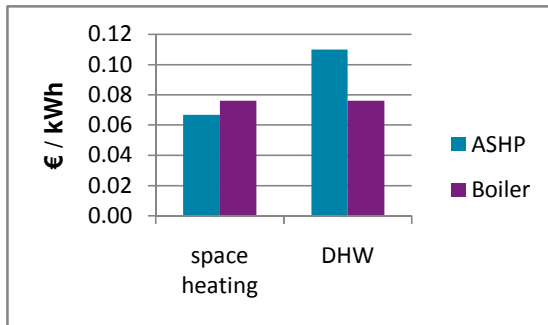
Why hybrids?

Significant running cost & CO₂ savings are possible over a boiler or an ASHP alone

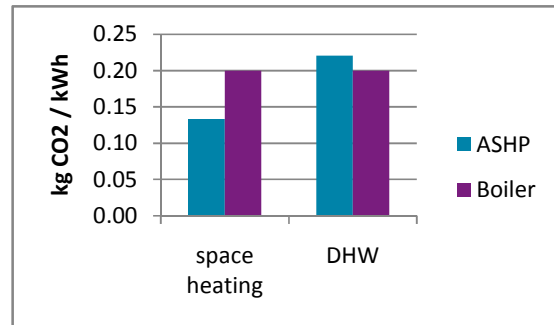
The key argument for hybrids is that, where the ASHP can focus on space heating while the boiler produces primarily hot water (and supplementary space heating on the coldest days), efficiency gains can be made. To illustrate this we model notional running costs and CO₂ emissions associated with ASHPs and boilers in Germany:

- ▶ For space heating, ASHPs have the lowest running costs / CO₂ emissions.
- ▶ For domestic hot water, boilers have the lowest running costs / CO₂ emissions

RUNNING COSTS FOR ASHP & BOILER IN GERMANY



CO₂ EMISSIONS ASSOCIATED WITH ASHP & BOILER IN GERMANY



Source: Delta Energy & Environment 2011

How do we explain these differences? Heat pumps are much better at running at lower flow temperatures (for space heating), but efficiency drops significantly when flow temperature requirements increase (for hot water production). In short, a heat pump is more efficient than a boiler for space heating, but less so for hot water production.

Most hybrid systems are set up so that the heat pump meets the majority of the space heating demand, while the boiler provides back up for space heating, and meets all of the domestic hot water demand. In this configuration, CO₂ and running cost savings can be achieved over a boiler running alone or an ASHP running alone.

Energy markets – benefits of being able to switch between heat sources

Hybrids open up new market opportunities in increasingly volatile electricity markets, as operators can select a heat source. Electricity markets are becoming increasingly volatile with, for example, the increased penetration of intermittent wind power. In the future, volatility in electricity prices may be fed through to the heat pump operator – be it the end-user or the energy company. **The ability that hybrids have to switch between heat sources will create value in the future (although this can be difficult to capture today).**

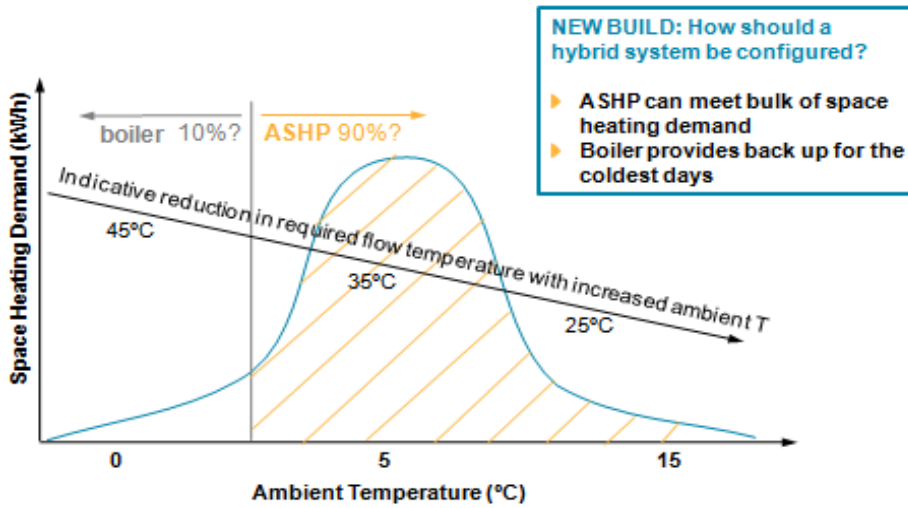
The key differentiator for the emerging hybrid technologies is the sophistication of the control system. This is a critical part of the system – defining how and when different heat sources operate – according to efficiency / running cost / end user comfort / energy market conditions.

Optimum hybrid performance comes from the right system configuration for the building type

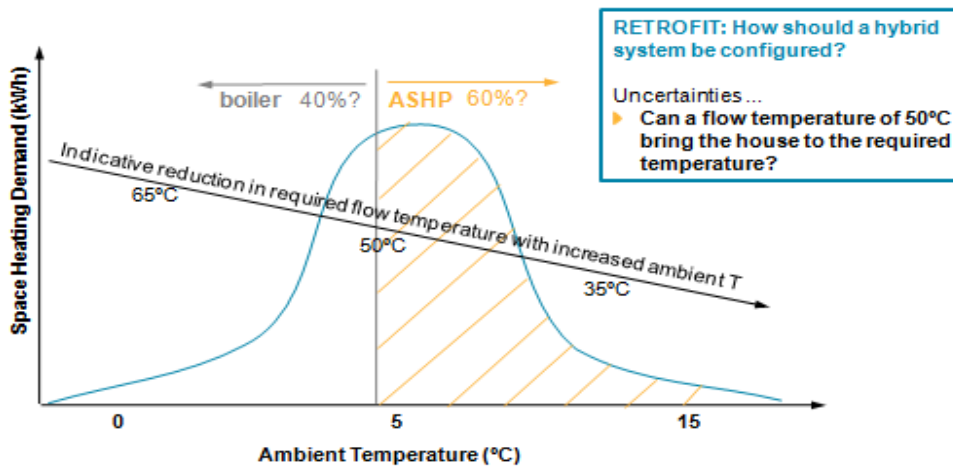
The greater the proportion of heat demand which can be efficiently met by the heat pump, the greater the potential savings (CO₂ and running cost) - using the most appropriate system configuration for the building is key to determining the achievable savings.

The ASHP can meet most of the space heating demand in new build

The majority of existing commercially available fossil hybrid systems have been targeted at and installed in new build properties. In a new build, an ASHP sized at ~5 kW is designed to meet >90% of the demand, with clear running cost and CO₂ savings being made – which is achievable given the low flow temperature requirements and low overall heat demand of a new build.



In retrofit, savings are still possible where the ASHP meets a smaller proportion of the heat demand



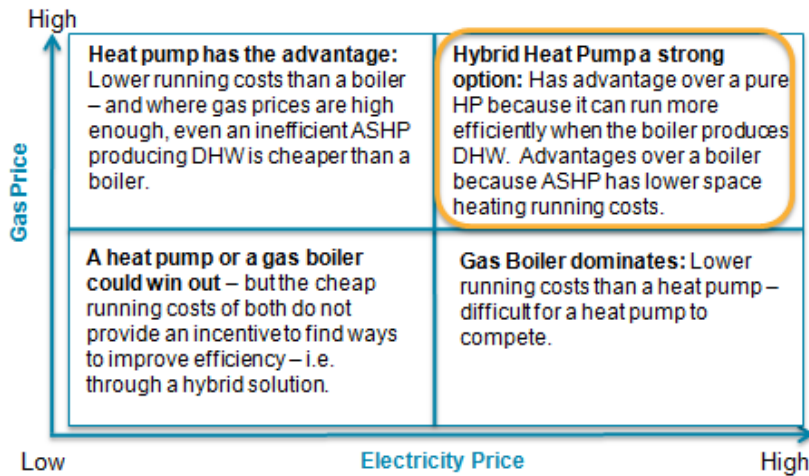
In retrofit, the higher flow temperature requirements make it harder for the ASHP to meet as much of the space heating demand as in new build – a proportion of 50-60% is more realistic in some

applications, which can still give clear savings over a boiler. The exact proportion of demand which can be met by the ASHP in retrofit (and therefore the savings) will of course vary depending on the specific characteristics of the building. There are also uncertainties about hybrid performance in practice, as highlighted above, given the relative lack of field-tested hybrid systems in retrofit properties to date.

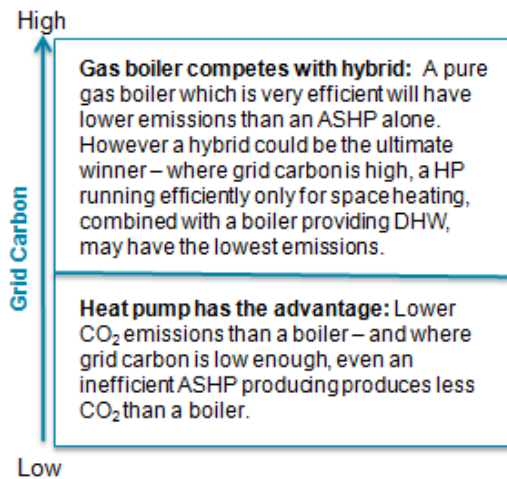
Where will hybrids be best suited?

Markets: Hybrids are attractive in markets where gas and electricity prices are high

The economic case for hybrids in different types of market is a function of energy price and the performance of the heat pump in space heating and water heating modes. As explained below, where both gas and electricity prices are high, there is a stronger argument for hybrids. Delta's analysis shows potential annual running cost savings over a gas boiler in markets such as Germany and the UK in the order of a few €100s. In Germany we see comparable savings to be made with a hybrid over a pure ASHP.



Biggest CO₂ savings can be made with hybrids in markets with high grid carbon



The case for hybrids in terms of CO₂ emission reduction potential is strongest where grid carbon levels are fairly high – for example in Germany and the UK. Delta has calculated annual CO₂ savings of around 100 kg / year in the UK relative to a pure ASHP, and over 500 kg / year relative to a gas boiler. In contrast, in France, where grid carbon is very low, an ASHP running alone has by far the greatest CO₂ savings.

Applications: Policy will drive the new build market for hybrids, but retrofit is uncertain

In new build, the treatment of hybrids within building regulations will be critical in determining the market opportunity. Currently available hybrid products have been designed for, and are being targeted at the new build sector in response to increasing strict building regulations – which are already driving hybrids in some markets. In other markets, there are still uncertainties around how to calculate the CO₂ savings possible through hybrids – but with more provision of real hybrid performance data, Delta sees this as a short-term challenge which will be overcome.

Uncertainties remain about the level of policy push for hybrids in retrofit. Implementation of planning laws for replacement heating systems could drive large growth if hybrids qualify. Currently it is not clear if hybrids will qualify for wider financial incentives such as the MAP subsidy in Germany or the RHI in the UK, which could place them at a disadvantage over pure renewable solutions.

Consumer perception of hybrids is an unknown. In markets with a traditional reliance on fossil boilers, installing a new hybrid heating system which still contains a fossil boiler could help build consumer confidence in the technology. However, there is also the possibility that consumers may not respond so positively to a system that uses fossil fuel, compared to a pure heat pump.

About Delta Energy & Environment

Delta is an energy consultancy specialising in the technologies, market and policies on the 'customer side of the meter'. Delta provides market insight & forecasts; techno-economic analysis; competitor analysis; and strategy and tactics. Delta's clients comprise:

- ▶ Energy companies
- ▶ Manufacturers
- ▶ Finance sector
- ▶ Policy makers

Delta's provides:

- ▶ Research services (such as air source heat pumps, micro-CHP, GB Microgeneration Market Research Service)
- ▶ Multi-client studies
- ▶ Consultancy
- ▶ Specialist Summits

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