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Heat pumps are key to decarbonizing residential heating

The Green Deal is considered to be the EU's 'man-on-the-moon moment'. Decarbonizing the heating sector will be key to making Europe a climate-neutral economy by 2050. Heat pumps will play an essential role in combining decarbonization with sustainable economic growth. Here is why.

Keywords: heat pump, decarbonisation, renewable energy, hybrid, heating

Europe wants to become the world's first climate-neutral continent by 2050, and the EU Commission aims to reduce emissions by at least 55% by 2030.



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Decarbonizing Europe and recovering from the COVID-19 pandemic are massive challenge. In implementing the EU Green Deal, we will see the EU and its Member States promoting low carbon technologies, like heat pumps, by ensuring a fair carbon-based energy pricing and by discouraging incentives for fossil fuel heating.

Why heat pumps?

Today, the European building stock is responsible for approximately 36% of all CO₂ emissions in the Union. Taking into account that almost 50% of Union's final energy consumption is used for heating and cooling, of which 80% is used in buildings [1], the potential for decarbonizing this sector is massive.

Heat pumps make use of **renewable energies** such as thermal energy from the air, the water or the ground. These renewable energy sources are abundantly available in Europe, so they do not need to be imported.

Heat pumps are a **proven solution**, and Europe has the technology, the expertise and the investments to expand further. From single family to multi-family homes, from renovation to new housing, from small to large commercial buildings and industrial plants, heat pumps today are ready and fit for the EU Green Deal. Heat pumps are a **low carbon heating technology** as for each kWh of required heat, the carbon impact of a heat pump today is about half of a high efficiency gas boiler, with an even lower carbon footprint potential due to **increased use of renewable electricity**. For example, by 2030, the share of EU renewable electricity production is set to be at least double today's level of 32% of renewable electricity at around 65% or more [2].

In addition, heat pumps are essential to enable **balancing of the power grid**, thus supporting the further deployment of a renewable energy production, for example by acting as a thermal storage battery and a tool for flexibly balancing the energy supply and demand.

Heat pumps are a true replacement for combustion heating

As Europe's heating habits are mostly focused on hydronic heating, it looks like the hydronic heat pumps (air to water, geothermic) are the obvious suitable heat pumps to replace a combustion boiler in residential homes.

Over the years, the heat pump industry players have achieved significant improvements to allow a 100% replacement of boilers in existing homes.

Some achievements in industry's progress are:

- **Improved efficiency levels**, increasing the use of renewable energy (vs electricity): In 2007, the first generation of Daikin Altherma heat pumps was showing a COP of 4.56. The third generation of Daikin Altherma launched in 2019 reaches a COP of

5.1, concluding an increase of 12% over 12 years. As far as the Seasonal COP (SCOP) is concerned, the second generation of Daikin Altherma from 2012 displayed 3.29 in average climate 35°C conditions while Daikin Altherma 3 hits 4.56. On a European level, the EU introduced the energy label framework, first in 1992, but it is only in 2015 that all space heaters had to carry an energy label describing its efficiency up to A⁺⁺. This scale was moved up in 2019 to elevate the requirements up to A⁺⁺⁺ label.

- **Introducing solutions to reduce the sound output** of the heat pump's outdoor unit, to meet end users increased sensitivity to ambient noise and/or local government requirements in urban or densely populated areas. Solutions go from applying sound covers on existing units, offering limited sound reduction without effecting overall heat pump efficiency to dedicated outdoor units including newly developed components like fans to secure lower sound effect in operation mode.
- **Implementing state of the art connectivity technology**, from factory mounted integrated man-machine interface, allowing easy & remote commissioning of units, up to online and voice control via app, enhancing the end user efficient use & monitoring of the heat pump.
- **Creating specific design features** transforming the heat pump from machine to a white good-like indoor units up to an attractive outdoor unit.



Open caption of a modern, improved heat pump.

Hybrid solutions have been developed as an intermediate solution. In many countries hybrid heat pump solutions have been developed, with an air to water heat pump is used in combination with a combustion boiler, especially to start decarbonization in on-grid areas. Some hybrid heat pumps do manage the trade-off between both technologies by searching for the most economical or ecological condition depending on the specific operation conditions. Other hybrid heat pumps are more functioning as simple bi-valent options, where domestic hot water production is generated only by the combustion part.

A considerable benefit of hydronic heat pumps within the new build market is its **cooling feature** allowing to maximizing the reduction of CO₂ emissions, as well as benefiting of a single investment that covers the provision of total comfort in a house. Cooling becomes increasingly a requirement, partly due to climate change effect resulting in higher average temperature, and partly due to the higher insulation level of new built houses. Cooling via heat pump convectors or underfloor heating is the ideal opportunity to cool down the house. Today, hydronic heat pumps provide space heating, domestic hot water and cooling in one system. This creates an additional opportunity in efficiency to make use of one single system as opposed to the standard set up of boiler for heating and a second HVAC system used for cooling.

Hybrids do have a place in the market, especially in a transition period during which end users are made familiar with the heat pump technology. By using smart control technology hybrids can also offer flexible switching between energy carriers (gas, electricity); which is reinforced by the use of storage tanks for the use of domestic hot water. While a hybrid heat pump provides sufficient day to day comfort, we believe that CO₂ emission can be further reduced when combined with storage tanks.

In the long run, the full electric hydronic heat pump seems to offer a clear benefit over the hybrid alternatives, from a carbon footprint viewpoint, as electricity becomes greener, while securing full residential comfort is fully guaranteed.

A source of economic growth

Investing in heat pumps also boosts EU economic growth as these products are widely developed and manufactured in Europe.

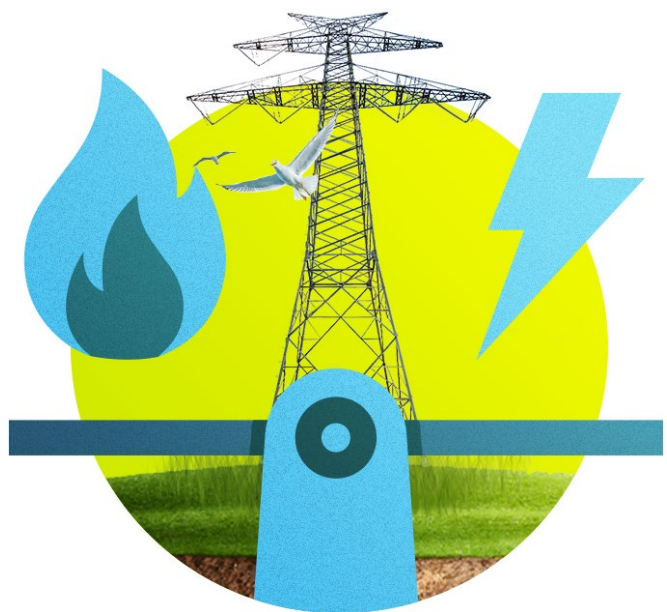
Every euro invested in heat pump technology is a euro invested in **local job creation**. The heat pump industry as a whole currently employs 225,000 people in Europe [3]. New and further investments in renewable heating will pay dividends for the European economy as well as for our environment.

Swedish success story

Making use of heat pumps to accelerate decarbonisation is possible. For example, Sweden started an ambitious policy in the 1980s to replace fossil fuel boilers with heat pumps. Today, heat pumps are the standard for heating Swedish homes. This push to make heat pumps the standard technology for residential heating helped reduce total greenhouse gas emissions by 33.7% between 1990 and 2018 [4]. Other European countries are starting to follow suit. Recently, countries including France, Germany, Italy and the Netherlands have launched similar heat pump promotion and boiler replacement schemes.

End carbon-based incentives

It is however crucial that, following the EU Green Deal initiative, policy makers in the EU member states take action to make this transition happen. I see they can act on two levels to achieve decarbonization.



GREEN DEAL: decarbonizing the grid and increasing the energy efficiency.

First, EU member states could **commit to ending the use of fossil fuels**. The most polluting heating systems must be phased out. Austria no longer allows oil-based boilers to be installed in new homes as of January 2020. This is an excellent initiative. Policy makers could avoid incentives for fossil fuels. Even today, direct or indirect incentives benefit oil or gas-based boilers, due to different taxation of heat pumps compared with boilers for instance.

Secondly, **renewable technologies also need a level playing field**. The gap between electricity and gas prices in many member states is too high to make a heat pump an economically attractive investment for EU citizens [5]. Incentives can bridge that gap for a certain period, but in the long run, the cost of energy should reflect the carbon intensity more. Carbon pricing can contribute to further emissions reduction by extending the EU Emission Trading System (ETS) to all emissions of fossil fuel combustion in buildings and revising the Energy Taxation directive [6].

Motivating consumers

Consumers who are looking to replace their fossil fuel systems need to be motivated to take a closer look at heat pumps. The industry innovates relentlessly to make heat pumps attractive through a mix of product

features, pricing, design, and installer- and end user friendliness [7].

The industry can put more effort in explaining the benefits of heat pumps so that end users become more aware of them.

Governments draw consumers' attention to heat pumps through incentives for residential renovations, but also other means could make opting for heat pumps beneficial, such as reflecting the use of renewable energy in the building's total energy score. This sends a strong signal and invites consumers to do a detailed calculation of total cost of ownership and ecological advantages [8]. At this point, the benefits of heat pumps will become evident to consumers.

Heat pumps should become accessible to all Europeans

In the short term, government incentives can help accelerate the transition to carbon-neutral heating and make heat pumps accessible to all Europeans, but in the longer-term accurate energy prices and a correct indication of the energy and carbon performance of a building need to be the end user motivations to invest in heat pump technology. ■

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- [8] Daikin for instance provides a solution selection tool to installers and consumer called Stand by me, <https://standbyme.daikin.eu/>