

Use of Hydrogen in Buildings



Why should hydrogen be considered an important element in meeting the decarbonisation challenges of the heating market?



Photo by [Craig Cooper](#).



The buildings sector is emissions-intensive and hard-to-abate



Second-largest consumer of energy in the EU, responsible for 40% of our energy consumption.



6% of GHG emissions from energy¹, emitting 24% more than the entire power sector.²

Efficient solutions available to decarbonise the sector, such as electric heat pumps, require renewable electricity to be available and supplied at the same time and place as the heating sector demands. It also requires a renovated building stock that can guarantee minimum energy losses. However:

- 1. Renewable energy is not always generated in the same place and time that it is consumed, increasing:**
 - * storage needs and uncertainty of supply.
 - * the costs and the time to decarbonise the sector due to necessary infrastructure upgrades (e.g., transmission and distribution power grids).
- 2. EU electricity consumption in the winter is larger than in the summer. Further increasing electricity demand in winter will exacerbate the seasonality aspect of renewable energy.**
- 3. About 65% of buildings in the EU were built before 1980³. Refurbishment of these buildings will require the following:**
 - * A high supply of craftsmen that already has a high utilisation rate, e.g., in Germany, capacity utilisation in the construction sector stands at 90%⁴. In Poland, half of the construction companies already in 2019 reported labor shortages.⁵
 - * Financing schemes to enable low-income individuals to bear the high costs of renovations.
 - * Significant time to renovate a broad part of the old building stock.

Preserving a wider range of heating & cooling choices for customers to choose their most adequate solutions is key to achieving carbon neutrality by 2050. Hydrogen can address these challenges and become an integral part of the solution.

¹ [European Commission, 2020](#).

² Hydrogen Europe based on data from [IEA, 2019](#) and [Eurobar, 2019](#).

³ [European Union, 2014](#).

⁴ [Frontier Economics, 2021](#)

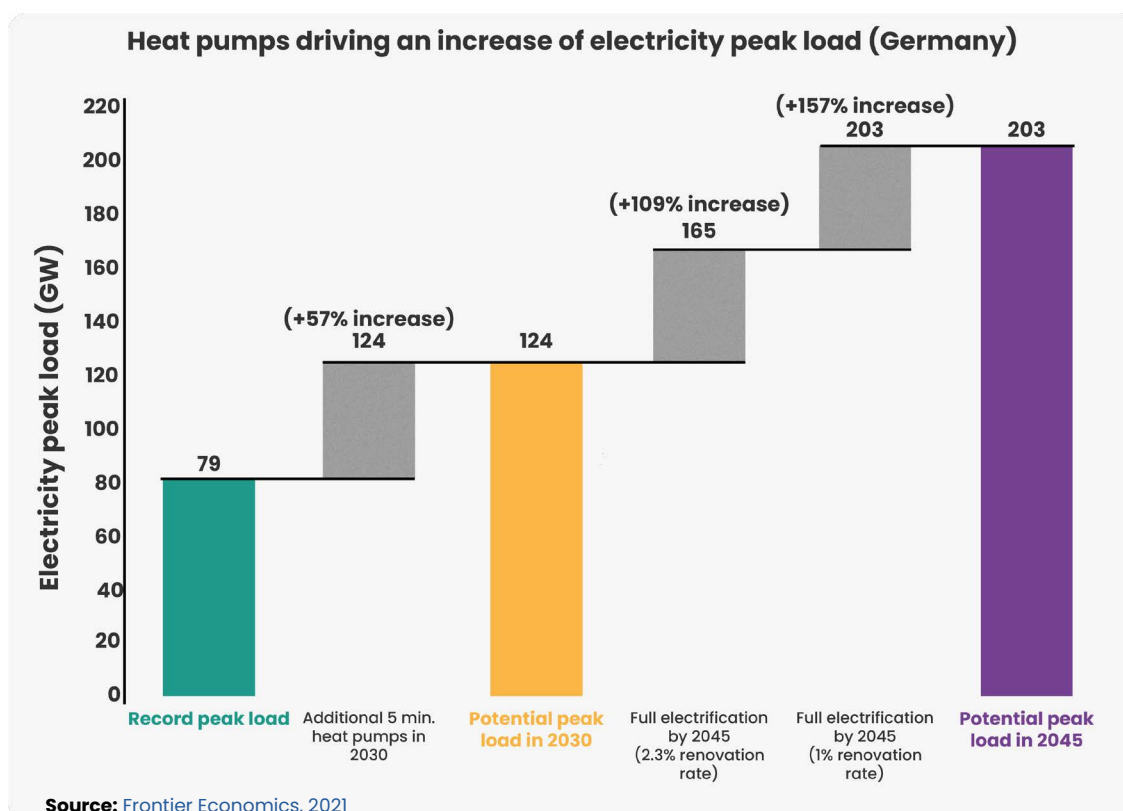
⁵ [European Commission, 2021](#)

The value of hydrogen in a renewables-based energy system

1. Hydrogen can alleviate the electricity grid expansion requirements

Space heating requires an important amount of power that needs to be supported by a strong grid. For a heat pump to cover large or entire building heating needs, grid reinforcements must happen much faster at distribution and transmission levels. Especially during cold waves, when electric heat pumps are less efficient, electricity demand will peak, likely constraining the distribution grids. H₂-power devices such as fuel cells, boilers, and integrated hybrid heat pumps would help alleviate grid expansion and constraints, lowering costs and increasing the pace of decarbonisation of the sector.

Even if buildings' renovation rate reaches 2.3%, ensuring buildings are more energy efficient, in Germany, the grid would have to be strengthened to handle an increase of 109% in peak load to fully electrify the heating sector by 2045. If the renovation rate remains at current levels of around 1%, the peak load would increase by as much as 157%.



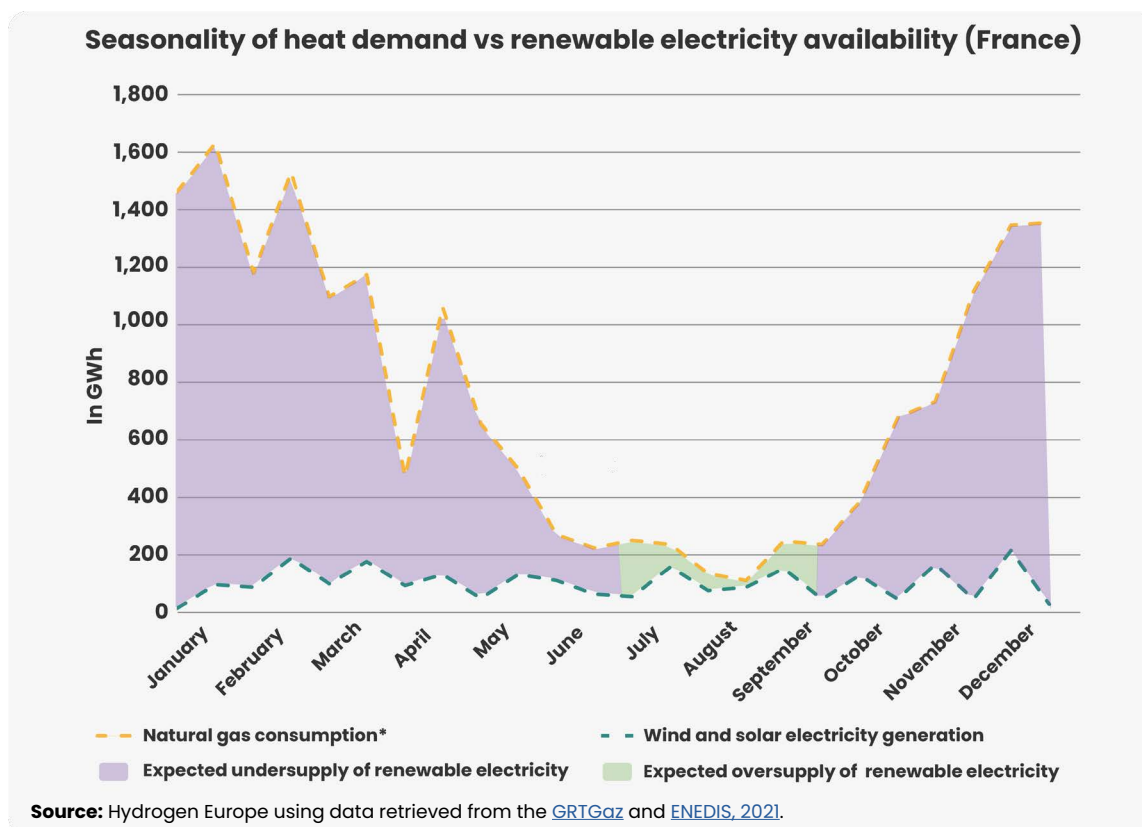
In the EU-27, if 91 million additional heat pumps are installed by 2050, the grid would have to handle a peak load of 292 GW only from heat pumps. This represents about 65% of the total average peak load of the EU-27 in 2018.

Source: Hydrogen Europe with data retrieved from EHI, 2022 and ENTSO-E and ENTSG, 2022.

2. Hydrogen facilitates the storage of renewable energy to account for seasonality, securing supply for the entire heating sector

Especially in winter, due to a reduction of solar radiation and wind to produce renewable energy and the seasonality of demand in the heating sector, hydrogen can store renewable energy and avoid further adding to the already existing imbalance between electricity consumption in winter and summer.

Although heating demand significantly increased during the winter in 2021 in France, actual electricity generation from wind and solar sources did not see a similar increase. Instead, generation remained relatively stable throughout the year.



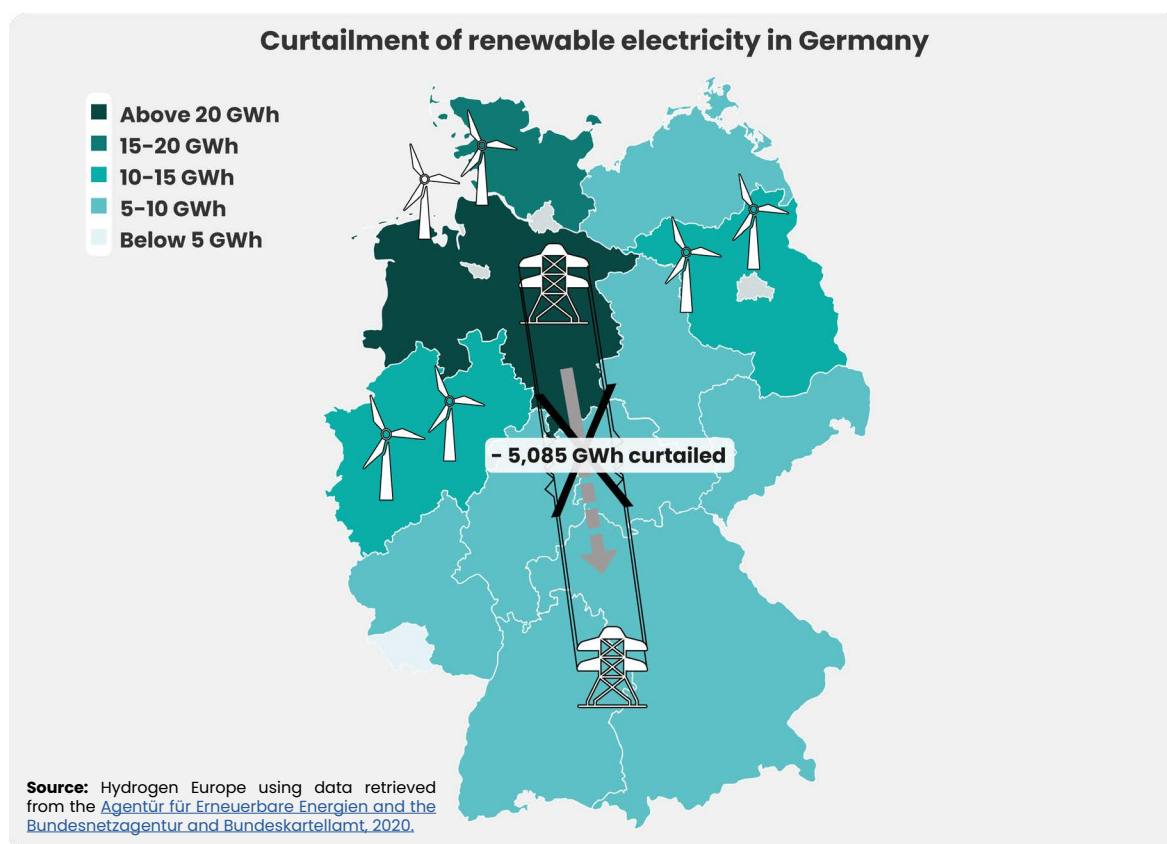
*Natural gas consumption refers to gas consumption on public networks (e.g., excluding industrial customers), and it is used to estimate heat demand. The figure shows natural gas consumption and wind and solar electricity generation in France on the 1st and 15th day of each month in 2021.

A “one-size-fits-all” approach will not work. Countries have different climates and different heating challenges. Hydrogen works well in very cold climate and poorly insulated buildings. It can be easily adopted by adapting existing gas infrastructure. At distribution level, pipelines do not need to be retrofitted, with investments only needed for adapting boilers and other appliances.

3. Hydrogen allows the transportation of renewable energy from generation to consumption centers to account for geographical unbalances

Unfortunately, not all regions in Europe can easily access cost competitive renewable electricity. Germany is struggling to transport excess onshore wind from the north to the south. Landlock countries, such as the Czech Republic and Slovakia have limited renewable resources and limited access to the large resources in the north seas. A large degree of electrification of the heating sector would only exacerbate this problem.

In 2019 wind onshore electricity generation in the North was significantly higher than in the South of Germany, and about 5,100 GWh had to be curtailed.

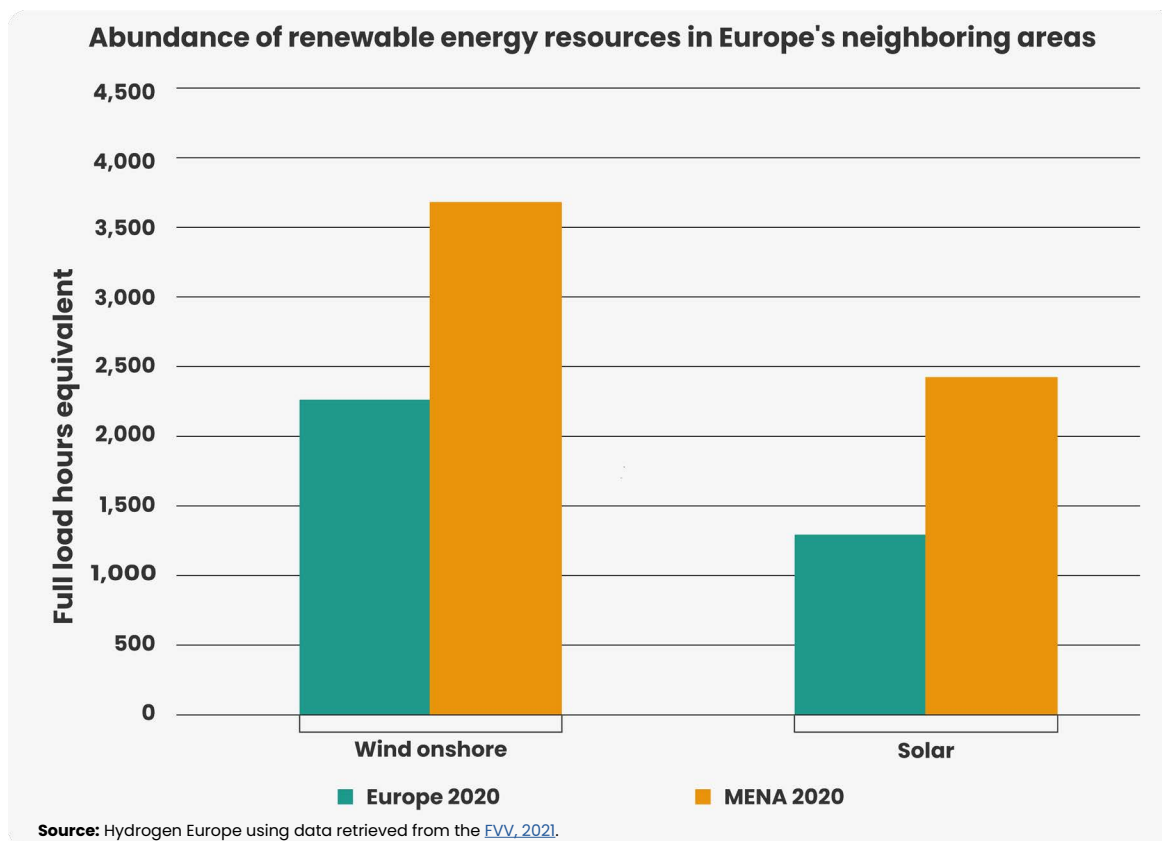


Buildings close to hydrogen valleys will benefit from infrastructure investments that will be made for industrial and transport uses. Therefore, even in areas without natural gas infrastructure, hydrogen can easily be introduced into buildings in the short term.

Photo by [Barbara Horn](#).

4. Hydrogen enables imports of cheaper renewable energy from countries with large renewable resources, lowering costs and boosting system efficiency


Yearly RES utilisation rates from wind and solar are higher in the Middle East and North of Africa (MENA) than in Europe, maximising RES generation in the MENA region.




Hydrogen can ease the race to modernise buildings, alleviating the craftsman sector bottlenecks, reducing the burden on individuals to bear the costs of full renovations, and accelerating decarbonisation.





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