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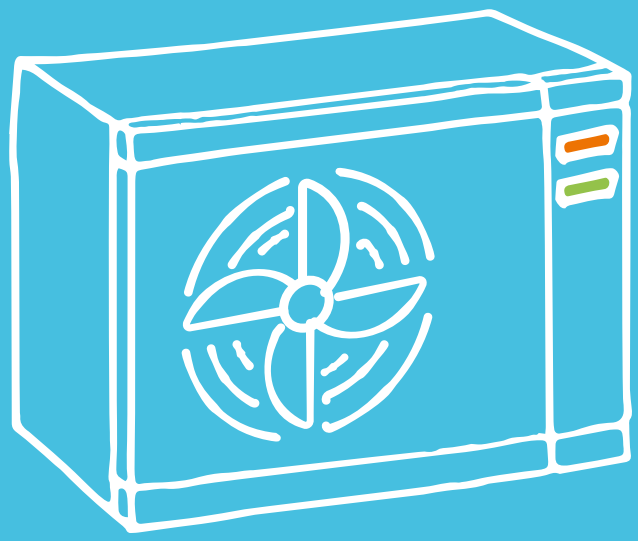

RETROFITTING HOMES WITH HEAT PUMPS: 12 STORIES ACROSS THE EU

HIGH TEMPERATURE HEAT PUMP IN EXISTING HOMES IN THE NETHERLANDS, POLAND, AND ITALY

COMFORT AUDIT 2 - BRIEFING

See the full study

Coolproducts is a coalition of European NGOs working to ensure that ecodesign and energy labelling truly work for Europeans and theenvironment. The campaign is led by the European Environmental Bureau and ECOS.

The EEB is Europe's largest network of environmental citizens' organisations. We bring together over 180 member organisations from 40 countries. We stand for sustainable development, environmental justice & participatory democracy.

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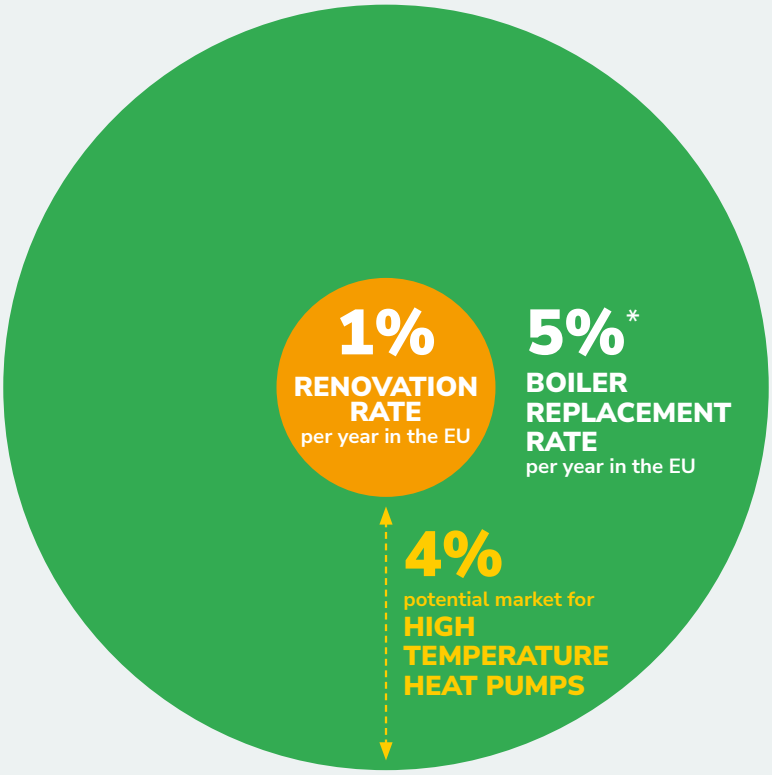
Life

European Climate Foundation

As a generation of gas boilers die out, the door to electrify European domestic heating and cooling opens. What role can the innovative high temperature heat pumps play?

Electrifying the heating sector - the bloc's second largest gas market - remains a a strategic response to European energy security, social and environmental concerns.

However, boiler replacement rate in the EU is well above 5%* while the rate of renovation currently stagnates at only 1% of the building stock. This means that there is a growing group of homeowners who are at a moment to switch from their boilers to electric alternatives, but might hesitate and choose another boiler as their poorly insulated home might not reap the benefits of a conventional heat pump. This gap is where a market for high temperature heat pumps (HTHP) lies, pumps that can replace old boilers in yet-to-be-renovated buildings to achieve temperatures above 55°C. Traditionally used in industrial settings, **HTHPs might have unexplored applications in many domestic settings that are ill-fitted to conventional pumps**. They are not the only solution, though, as the most performing of the existing buildings can make use of conventional mid-temp heat pumps and others may opt for a hybrid heat pumps, thought that would entail having to bear fix costs for both the gas and the electricity bill.



*considering 20 years as the average lifespan of a boiler, we get 100%/20 years = 5% per year

Through the analysis of the existing literature and 12 interviews with HTHP users in three cold areas of Europe, this briefing aims to evaluate HTHPs' suitability, potential energy and financial savings, and their impact on occupants' quality of life. **The interviewees represent a large range of unrenovated dwellings, from individual housing, social housing, blocks of flats, and older houses in 11 different towns across colder regions in Italy, Poland and The Netherlands**. All participants relied on either gas, oil or biomass before being retrofitted with a HTHP, with the exception of one case, where a conventional heat pump was preferred. In one case, the pump is a part of a hybrid system. Nearly all heat pumps adopted in these homes are working on natural refrigerants (i.e., propane, isobutane, CO2).

12 homes

11 towns

3 countries

4 types of refrigerants

5 heat pump producers

M.P.
- Individual house
- Gora Kalwaria, Poland
- Nibe VVM 320R

P.P.
- Individual house
- Warsaw, Poland
- Nibe F1145-12

P.K.
- Individual house
- Giżycko, Poland
- Kostrezwa HPR Deluxe

P.W.
- Individual house
- Giżycko, Poland
- Kostrezwa HPR 500 Deluxe HTHP

C.B.
- Rural house
- Sieraków, Poland
- Kostrezwa HPR Deluxe HTHP

T.B.
- Rural house
- Miłki, Poland
- Kostrzewa HPR 500 HTHP

H.B.
- Individual house
- Heemskerk, Netherlands
- Vattenfall HTHP

R.A.
- Individual house
- Oga, (Alps), Italy
- Teon T30 HTHP

R.F.
- Block of flats
- Turin, Italy
- Teon HTHP

G.Z.
- Individual house
- Castello D'Agogna, Italy
- Teon T30 HTHP

F.G.
- Block of flats
- Cusago, Italy
- TEON Tina 70KW

M.H.
- Individual house
- Castelbaldo, Italy
- Viessmann
- VitoCal 252A HTHP

The EEB does not in any way intend to promote the installation of heat pumps in non-renovated buildings when the possibility of renovation exists.

The renovation rate of 3% per year should be reached as soon as possible and all renovations should achieve the highest possible energy efficiency ("deep renovations"). Only where this is not possible, i.e., where there are financial or logistical problems, should the HTHP be considered as a positive solution and a first step towards renovation.

FINDINGS

ENERGY SAVING

8/8

of respondents with data*

REPORTED LOWER ENERGY CONSUMPTION

FINANCIAL SAVINGS

8/9

of respondents with data*

REPORTED LOWER HEATING BILLS

COMFORT

12/12

REPORTED SAME OR HIGHER LEVEL OF COMFORT

Some interviewees lacked data for comparison because the heat pump had been in use for less than a year.

In our interviews, we found that consumers motivated their decision to switch to a HTHP with reasons such as increased comfort, reduced maintenance needs, increasing cost of gas and pellets, and a positive impact on the environment by reducing dependence on conventional gas systems were important.

Our interview in The Netherlands is especially interesting: **the social housing management body has decided to switch to HTHP to improve the energy efficiency of their real estate**. The tenants we interviewed live in a complex of six houses, each approximately 110 m^2 in size. All the houses were equipped with the same type of heat pump. The switch enabled them to move from a lower energy class to level B.

ENERGY SAVINGS WITH HIGH TEMPERATURE HEAT PUMPS

In our literature review, the academic papers we have revised indicate primary energy savings ranging from a minimum of 10% (in the warmer climate of Greece) to a maximum of 70% (in colder ones in the UK). In addition, for both cases, this switch offers a significant reduction in CO_2 emissions, with potential savings of more than 30% in terms of $kgCO_2/yr$.

Results from our interviews also corroborate these findings: One Italian interviewee, G.Z., **achieved a double-fold energy saving by shedding both electricity and gas usage, showcasing the substantial benefits of the HTHP technology**. Before adopting the HTHP, they used 1,885 cubic metres of gas and 4115 kWh of electricity. After installing the HTHP, their total electricity consumption increased to 5,731 kWh, as gas went to zero. However, they installed photovoltaic (PV) panels and sold the surplus energy, resulting in a net energy consumption of 3,328 kWh.

Another Italian family, R.A., switched to an HTHP from an annual energy usage of about 11,300 kWh, which included 1,000 litres of heating oil (approx. 10,000 kWh) and 1,300 kWh of electricity for hot water and other needs. After removing the oil boiler, their energy consumption dropped to around 4,400 kWh, with 3,500 kWh from the heat pump. R.A. also installed PV panels, generating about 8,000 kWh, with 2,000 kWh used onsite and the rest fed back into the grid.

Three interviewees in Poland reported using 3,000-5,000 kg of pellets per year for their previous heating systems, which equates to around 14,400-24,000 kWh per year. However, after installing a heat pump, their energy consumption significantly decreased. C.B. now reports an annual consumption of 3,600 kWh, while P.K. reports a consumption of 7,000 kWh.

The results illustrate the tangible energy savings achieved in Italy, The Netherlands and Poland and confirm the effectiveness of high-temperature heat pumps in improving energy consumption patterns.

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FINANCIAL SAVINGS WITH HIGH TEMPERATURE HEAT PUMPS

With the volatile and climbing costs of fossil fuels, financial considerations play a significant role for those contemplating a shift from gas or oil boilers to heat pumps. For many, the concerns remain that heat pumps may result in higher bills for similar heating levels, which can be discouraging when considering the accompanying renovation, installation, and maintenance expenses. These assumptions often dissuade people from choosing heat pumps over traditional boilers, unless incentivised by policies.

However, through our literature review and interviews, we have found that the heightened of energy efficiency brought by HPs can translate to financial savings with the right mix of energy policy condition and saving measures.

The interviewees consistently reported reduced heating expenses as the primary financial benefit, with some variations in purchase and installation costs based on country. **8 out of 9 interviewees with data reported to have lower running costs after the switch, thought three of them believe that without PV panels this might not be the case.**

For example, R.F. in Italy mentioned a decrease in expenditure from EUR 11,000 to EUR 6,000 per apartment building, almost halving the costs. In Poland, P.P. reported a 60% decrease in expenses, from PLN 7268 PLN (approx. EUR 1660) to PLN 3630 (approx. EUR 830).

8 out of 9 interviewees reported to have lower running costs after the switch, though three of them believe that without PV panels this might not be the case.

In Poland, half of the interviewees reported lower costs and higher savings than before the switch. It is important to note that 4 out of 5 Polish interviewees had installed or were using photovoltaics alongside the heat pump. This is to offset the fact that electricity prices in Poland are higher than biomass. C.B. acknowledges that the photovoltaic panels generate enough energy to fully offset the costs. Without them, expenses would be around PLN 4000 (approx. EUR 900).

H.B., in the Netherlands, mentioned higher electricity bills but does not provide information on the savings of no longer paying for gas heating. They have installed solar panels and are waiting for a battery to reduce costs.

It's important to remark that most interviewees enjoyed national subsidies, such as Italy's Superbonus, to facilitate the transition to heat pumps. Notably, the condominium of R.F. in Italy achieved a 50% cost reduction using the 'conto termico 2023 GSE' which includes subsidy combined with a bank loan that covers 50% of investment costs over 10 years from purchase.

Among the interviewees in Poland, the three did not mention state aid, while among the remaining two, P.P benefited from a City Council subsidy covering 30% of costs, while M.P. relied on tax write-offs. Affordability is challenged in Poland, where the heat pump cost around PLN 50,000 (approx. EUR 11,000). This amount can pose a significant financial challenge for families with limited incomes and undermine the operational savings, stressing once more the importance of policies to lower the installation costs.

COMFORT

Comfort was the most critical element for our analysis, since a common criticism of heat pumps is that they cannot provide the same level of comfort as gas or oil in existing buildings. **All our interviewees have reported feeling as or more comfortable after installing a HTHP for heating**. This is due to improved heating in the home and reduced maintenance and control requirements. Indeed, for those coming from biomass, the reduced burden of charging the boiler with pellet is part of the perceived improved comfort.

R.A. stated that their comfort level increased after installing a HTHP, as the indoor temperature is now more consistent. The time required to reach the comfortable temperature (18°C) has decreased, going from 24 to only 12 hours.

Interviewee R.F. highlighted their satisfaction with the improved and comprehensive management of the heating system, coupled with the advantage of reduced maintenance requirements. This is particularly true for Polish interviewees who switched from biomass heating. **One interviewee, C.B., notes that while thermal comfort remains the same, the overall comfort related to daily life has become 'incomparably greater' due to the elimination of the need to add fuel to the stove.**

P.P., who retrofitted their home with a mid-temperature heat pump enjoys the consistent room temperature ensured by the heat pump, as opposed to uncomfortable temperature spikes when using a gas boiler.

From our desk analysis, other studies on high temperature heat pumps indicate that both in the north (UK) and south (Greece) of Europe, HTHP can deliver the same comfort than gas boilers, though in some cases, integration with storage (heat or electric) is suggested. In the Greek study, another factor of comfort was mentioned linked to dust: the chosen technology proved to be lifting less dust than conventional low-temperature heat pumps with floor heating.

One interviewee, C.B., notes that while thermal comfort remains the same, the overall comfort related to daily life has become 'incomparably greater' due to the elimination of the need to add fuel to the stove.

CHALLENGES

After conducting research across the three analysed studies, it became evident that the primary challenges in the domestic sector lie in the realm of installation and purchase costs rather than technology itself. Additionally, public acceptance issues such as unwarranted fear, misperceptions, misinformation, and past experiences regarding heat pump reliability might pose obstacles to broader awareness and acceptance of HTHPs.

Possibly because most had access to incentives, our interviews differ from the results of the desk analysis: here homeowners did not face many challenges when discovering, installing, and financing an HTHP system. The tone of the replies was overall positive: interviewees did not mention any significant obstacles they encountered; instead, they were to express their satisfaction with their decision.

Although most interviewees did not express concerns about time constraints **(two-third had it installed in less than a week)**, a few noted that the installation process was connected to other projects or where the length of the permitting procedure and subsidies had a negative impact on installation timelines.

Two interviewees highlighted how the high cost of electricity in Poland might be a challenge or even an obstacle to installing heat pumps. One of the two respondents noted that in his case, the HTHP brought his heating costs to roughly 20% higher than those of pellet stoves. Both planned on installing PV panels to reduce overall utility expenses.

Discomfort linked to noise from the HTHP, a common critic to heat pumps, was mentioned in only one interview due to an improper installation. The problem was quickly resolved.

It's worth stressing that **none of the 12 interviews regretted the choice of installing a HP or planned to revert it.**

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CONCLUSION

The European Union's focus on decarbonising heating and cooling has made self-reliant, reliable and sustainable solutions more urgent. High temperature heat pumps have shown itself to be a worthy alternative to fossil fuel heating in homes that require higher temperatures than conventional heat pumps. Both our literature analysis and interviews have shown that replacing traditional boilers with HTHPs can result in significant energy savings, lower bills, at no sacrifice of comfort.

Despite the common perception that heat pumps are consuming more energy due to higher electricity consumption, our research suggests that HTHPs are highly energy efficient, and can result in up to 70% lower energy consumption when taking in consideration the massive energy use of fossil fuel and biomass heating systems.

Although the energy savings are evident, lower bills depend on the mix of local policies concerning installation subsidies to electricity pricing compared to fuels. In some Polish households cost savings can only be achieved when coupled with photovoltaics and/or storage due to comparatively high electricity pricing.

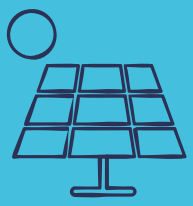
When it comes to comfort, both the analysed studies and interviews show the success of HTHPs in various climates, addressing challenges such as heating comfort and maintenance needs, which in cases of biomass are perceived as an important improvement of comfort.

POLICY RECOMMENDATIONS

Taking into consideration the benefits and current challenges faced by HTHP users, the following are our policy suggestions:

1.

Ensure a dedicated electricity tariff enjoying the lowest possible taxation is present in every Member State: many interviewees report that their investment would not be paying back without the support of self-produced electricity and/or storages to offset peak consumption. These solutions might not be available in all buildings.



2.

Whenever possible, promote solar and storage alongside HTHP, particularly in renovation, as this improves the payback time of the investment and guarantees lower running costs compared to fossil solutions.

3.

Promote dedicated training and awareness raising on these technologies in the existing heating workforce and future professionals: the technical expertise has been mentioned as a key factor for the adoption of HTHP in several interviews.

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