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Analysis

of the affordability of switching to renewable heating for a standardised middle-income family in the EU

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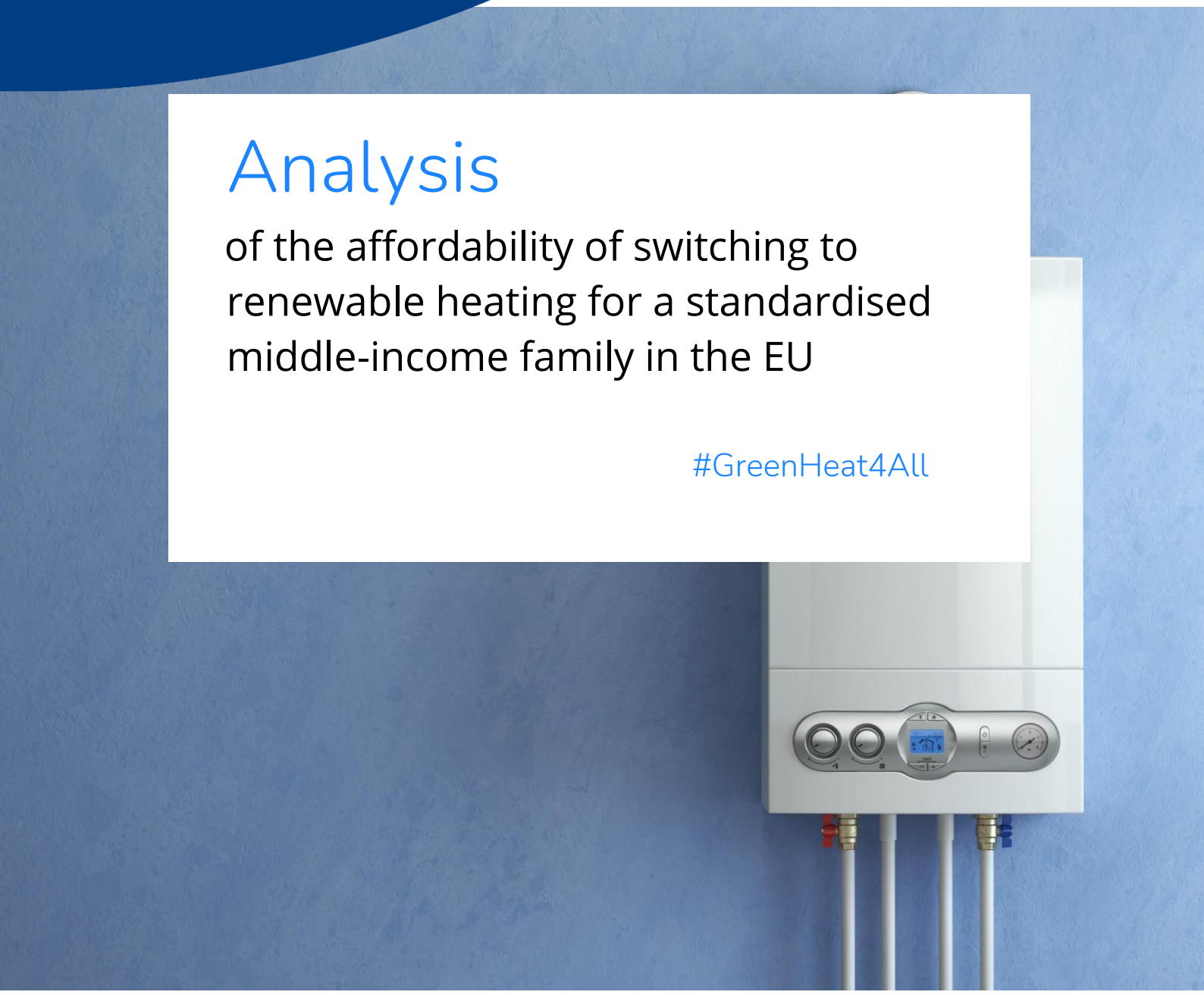

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Analysis of the affordability of switching to renewable heating for a standardised middle-income family in the EU.

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This work has used the analysis from December 2020 by **Fabio Tognetti** as a starting point and it builds on its further development published in July 2021.

Several organisations have helped with input and control of information.

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Contents

ABSTRACT

The renewable heating support schemes in EU are very different, both in the level of support and in the availability. While a few national schemes are quite generous, many of them are only open for a short time and have quite limited budgets. Other consists of a soft loan in a period where interest rates are so low that this makes no difference for most people.

The existing diversity of schemes creates huge differences from country to country for the considered standard household that intends to switch to renewable heating. Adding to that, the complex taxation on heating fuels and electricity does not always make it easy for consumers to understand when the switch is leading to a savings on heating bills.

The purpose of this report is to shine a light on the economical affordability of a switch from fossil heating to renewable, non-emitting heating for a family of four earning what is the average salary in every member state, opting for the cheapest and most suitable replacement technologies available today in their country.

We summarised the economic promotion schemes for fossil fuel and for renewable energy domestic heating systems in force in the EU-27 states as of 31 August 2021, and evaluated the emissions of the supported technologies, their affordability for the above-mentioned standard family. We then calculated the necessary additional subsidies needed to achieve a payback time of maximum 8 years.

The mapping analysis (which follows two similar ones carried out in the last year) shows that most EU governments still pay millions of euros in subsidies to have new gas boilers installed in our homes, despite evidence that this is slowing down the uptake of renewable heat and undermining Europe's 2030 climate goals.

Only seven countries in the EU have so far stopped the flood of public money going into subsidizing the installation of fossil fuel heating systems as part of their climate or fiscal plans. These include Estonia, Ireland, Lithuania, Luxembourg, Malta, Spain, and the Netherlands. Outside of the EU, they are joined by Norway - See *Table 1*.

The purpose of this report is to shine a light on the economical affordability of a switch from fossil heating to renewable, non-emitting heating for a family of four, opting for the cheapest and most suitable replacement technologies available today.

Conversely, 20 out of 27 EU governments still incentivise the purchase and/or installation of new gas boilers through various tax reductions, loans, and grants, which range between €300 and €2,500 and are supposedly aimed at greening our homes. Some tax schemes are aimed at creating jobs, but at the same time supports fossil heating. More to that, in 8 countries oil boilers are still subsidised and in Belgium, Poland and Hungary support schemes for coal heating appear to be still in place. Finally, 20 governments are supporting hybrid solutions that combine both fossil and renewable heating.

Moreover, in several countries the lower taxation that gas enjoys on average compared to the taxation imposed on electricity represents a further difficulty for the uptake of renewable heating.

On a positive note, most countries support in one way or another the installation of renewable energy for heating in the form of heat pumps and solar heating. These subsides make the shift to renewables more affordable, but to very different degrees. And still the net upfront investment is higher when installing i.e. air source heat pumps compared to gas boilers in all countries except Italy – see *Fig. 4*.

The affordability of renewable heating solutions with heat pumps and solar heating varies greatly. One measure is the net investment (total installation cost minus subsidy) compared with the average monthly income: this shows large differences from 0 monthly salary required to purchase the technology in Italy (subsidy pays in full for the installation) or one month salary in Austria to 17 monthly salaries in Bulgaria. In general, this ratio is least favourable for heat pumps in Eastern EU countries, where salaries tend to be lower. All countries where the investment is above 6 monthly salaries are in CEE. For comparison, the investment for a new, condensing gas boiler is ranging from less than one monthly salary in Austria and Belgium to 7 monthly salaries in Bulgaria.

Another relevant aspect for the affordability of the investment are the energy prices. These also vary among the EU countries and the UK with gas ranging from 3 to 11 €cent/kWh and electricity prices ranging from 9 to 25 €cent/kWh. To make a heat pump economically attractive, compared to gas (or with oil in countries where this is the standard heating fossil fuel), the electricity must not be more than 3,5 times more expensive. This ratio is exceeded in 5 countries, while in two more the ratio is very close to 3.5.

The payback time, defined as the time needed to payback the upfront cost through the savings on bills, is of key importance for most users, and at current costs, only 9 countries have acceptable pay-back times, meaning 8 years or less. If a CO_2-tax of 100 €/ton CO_2 was introduced in the EU (either with the proposed dedicated ETS scheme or alternatively through the Energy Taxation Directive) the number of countries with such acceptable pay-back would rise to 12 and the overall amount of extra incentives would be greatly reduced.

The simplest way of increasing affordability is to increase subsidies meant to overcome the upfront cost: our rough estimation for the EU countries indicates that increasing subsides to a level where all EU households could switch to renewable heating with a payback of 8 years or shorter, amounts to around 70 billion €. If a CO_2 tax of 100 €/ton CO_2 is introduced, the extra subsidy needed will fall to around 20 billion €.

The analysis of the climate emissions related to the different heating technologies in this report indicates that already today in all members states, ground-source heat pumps working on grid electricity emit considerably less GHG than gas boilers. It is also the case for all other HP types in all considered countries but two. The uptake of natural and low-GWP refrigerants in HP and renewables in the electricity mix are expected to further improve the climate performance of all heat pumps in the next years, thus offsetting their emissions in the second part of their life.

The report serves as basis for the maps of the website coolproducts.eu where figures are combined with climate emissions related to the different technologies, and incentives schemes' performances are evaluated in every country.

The situation in each country regarding subsidies and overall results is described in the countries fact sheets

European overview table

The incentives have been assessed both based on type (subsidies in cash, tax reduction, or soft loan schemes), and the incentivized technologies. The following table summarizes the result of the analysis.

Country	Coal boilers			Oil boilers, condensating			Gas boilers, condensating			Hybrid Heat Pumps			Air/Air Heat Pumps			Air/Water Heat Pumps			Water/Water + Ground Source Heat Pumps			Biomass			Solar Thermal		
	S	T	L	S	T	L	S	T	L	S	T	L	S	T	L	S	T	L	S	T	L	S	T	L	S	T	L
Austria							*		*	*			x			x			x			x			x		
Belgium		x			x	*	x	x	*	x	x		x	x	*	x	x	*	x	x	*	x	x	*	x	x	*
Bulgaria									x			x			x			x			x	*	x	x		x	x
Croatia							*																				
Cyprus							x			x			x			x			x			x			x		
Czechia							x						x			x			x			x			x		
Denmark								x			x			x		x	x		x	x						x	
Estonia																											
Finland								x			x			x		x	x		x	x		x	x			x	
France				x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Germany							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Greece				x			x			x			x	x		x	x		x	x		x	x		x	x	
Hungary	x			x			x		x	x		x	x		x	x		x	x		x	x			x		x
Ireland													x			x			x						x		
Italy					x			x		x	x		x	x		x	x		x	x		x	x		x	x	
Latvia						x			x			x			x			x			x			x			x
Lithuania														x			x			x			x			x	
Luxemburg															x	x		x	x		x	x		x	x		x
Malta																x									x		
Netherlands																x			x						x		
Norway																			x			x			x		
Poland	x			x			x	x					x	x		x	x		x	x		x	x		x	x	
Portugal									x				x		x	x		x	x		x	x		x	x		x
Romania							x			x						x			x			x			x		
Slovakia							x						x			x			x			x			x		
Slovenia							x		x				x		x	x		x	x		x	x		x	x		x
Spain													x			x			x			x			x		
Sweden					x			x			x			x			x			x			x			x	
United Kingdom							x		*	x						x		*	x		*	x		*	x		*

*Table 1. Summary of incentives (S = subsidy; T = tax reduction; L = loans; *light colour - only at local level)*

Nearly all 29 countries (EU, Norway, United Kingdom) subsidize the installation of heat pumps and solar thermal systems in some way. But at the same time most of the countries are still subsidizing investment in fossil fueled heating systems. Three countries – Poland, Hungary, and Belgium – are even subsidizing coal, though Poland has decided to end subsidizing coal by 31 December 2021.

The accessibility to the subsidies also varies substantially: for instance the Danish subsidies are only available within a limited budget that is heavily oversubscribed and many applicants are left out of the scheme. This aspect is not featured in the graph above.

The following graph summarizes the above table for the 29 countries and for all three types of incentives.

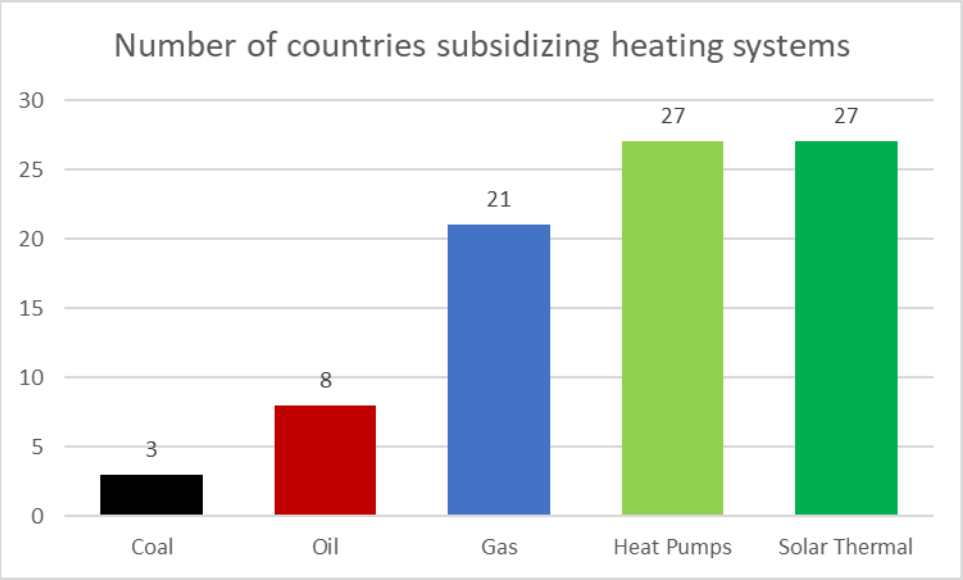


Figure 1 Number of countries (EU27, Norway, United Kingdom) that are subsidizing fossil and renewable energy systems.

CO_{2e}-emissions from Heating of an Individual House

The greenhouse gas emissions of heating a house depend to a large extent on the chosen form of heating. Comparing emissions of heating solutions shows the huge reductions possible, even when the comparison is between new, efficient oil and gas boilers and new heat pumps + solar. This is shown in the graphs below using EU average climate and CO_2 emissions from today's power production and the global warming potential of the common refrigerants for heat pumps.

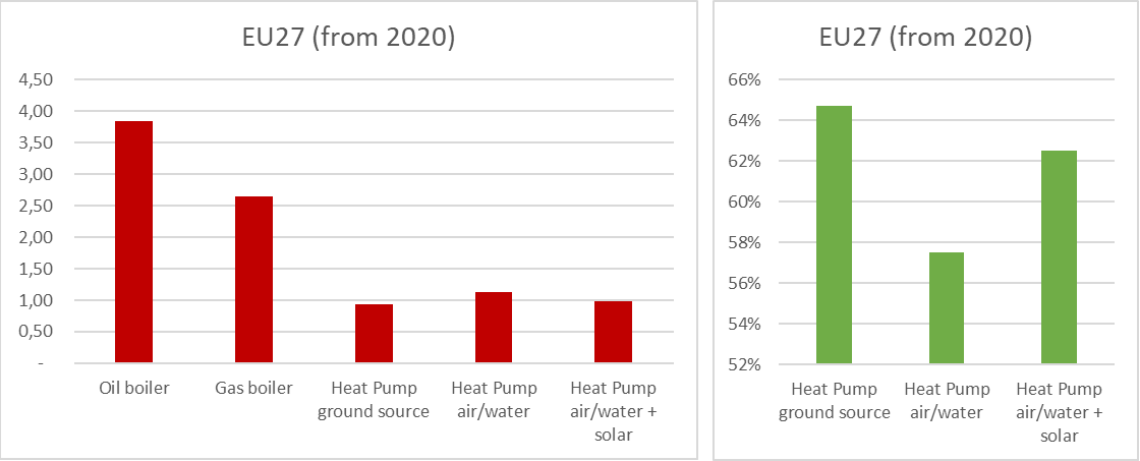


Figure 2 A (left) CO2e-emissions in ton/year/household for different heating solutions B (right) Savings on emissions when choosing to install a renewable energy heating system compared to installing a new gas boiler

There is a large variation from country to country. The annual heat consumption varies due to different climates and difference in the thermal insulation standard of the buildings. The CO_2-emissions from electricity consumption (heat pumps) also differ a lot, depending on the fuel mix and efficiency of the power generation. Only in two countries, namely Poland and Estonia, the CO_{2e}-emissions are larger when using an air source heat pump with the power (data 2019) compared to using an efficient gas boiler. This is due to the high share of coal used for power generation in these countries, but the situation there is expected to improve with the uptake of renewables in the grid and the use of natural and low-GWP refrigerants in the HP (Poland's National Energy and Climate Plans foresees an increase of RES in the H&C sector from 17.4% in 2020 to 28.4% in 2030. Estonia plans to go from 55.3% to 63%)

The next graph compares emissions based on the 2019 data.

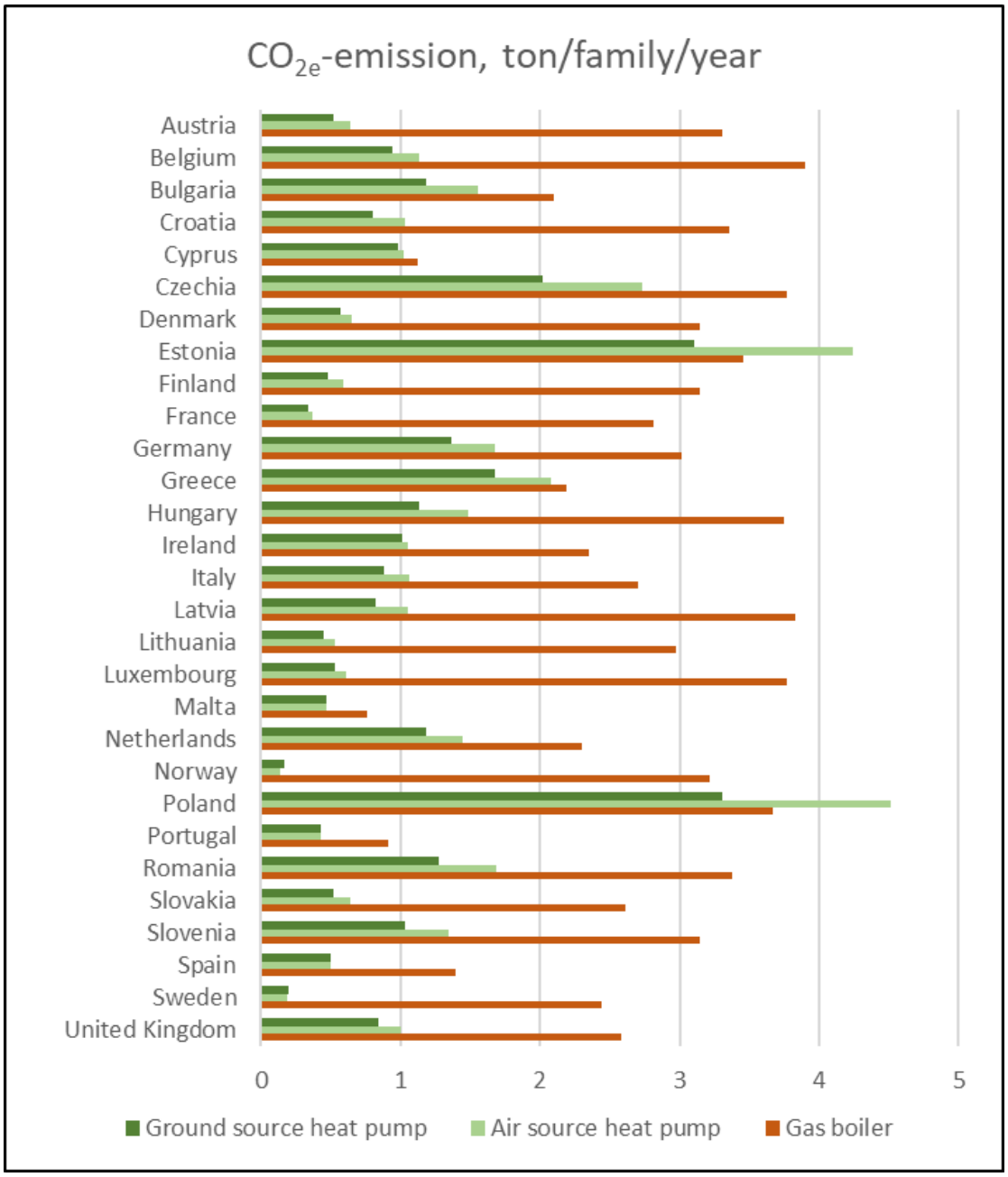


Figure 3 CO2e-emissions in ton/year/family for gas boilers and air source heat pumps.

The graphs above compare greenhouse gas emissions for space heating and hot water for a 110 m^2 house with a 4-person family based on the countries' different climate and electricity mix. In all countries considered, ground-source heat pumps are the lowest emitting technologies.

In the future, the emission differences will be larger, as emissions from electricity production are reducing fast and heat pump producers are adopting more and more refrigerants with lower GWP (in this example refrigerants lost to the atmosphere contribute around 15% of emissions of the heat pumps). See the methodology and sources for the calculation at the annex at the end of the report.

Affordability of Heating Installation – Upfront Costs

The total upfront cost remains a major obstacle to switch to renewable heating technology, especially for low- and mid-income households. The affordability of changing to renewable energy is very different between the EU countries, Norway, and the UK.

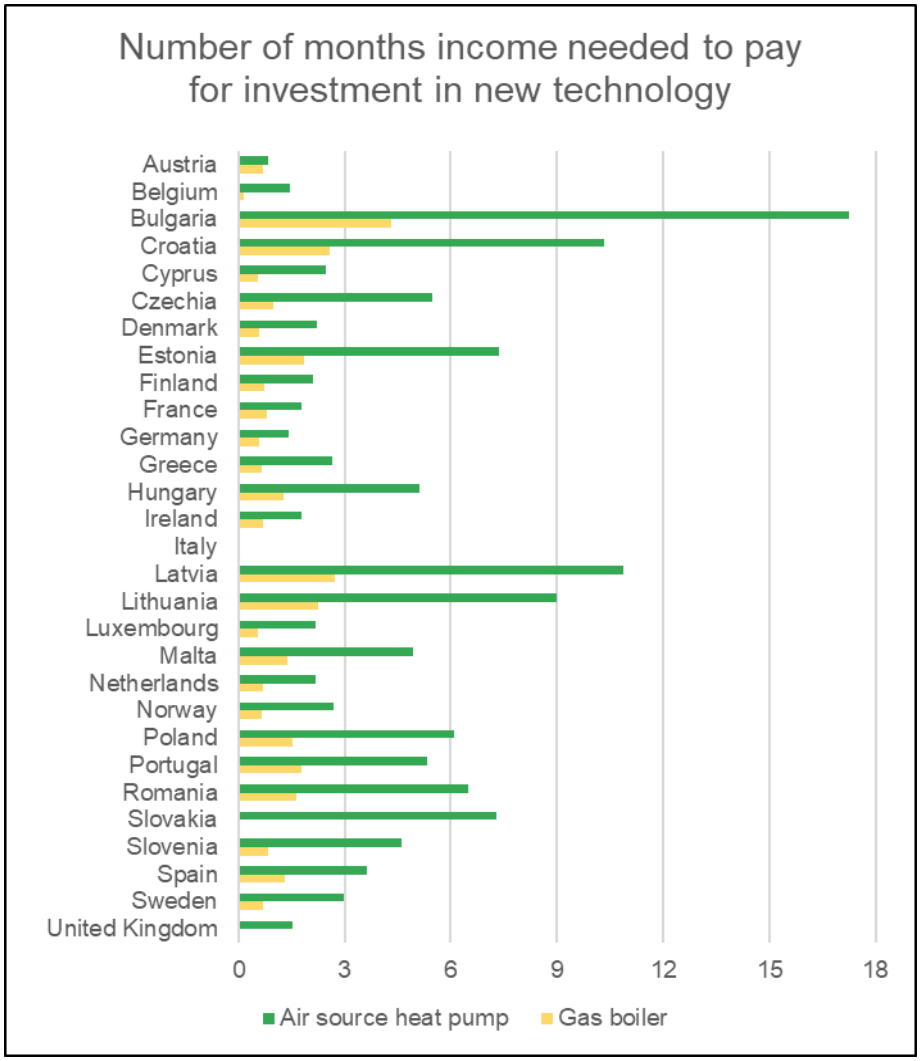


Figure 4 Number of monthly salaries needed for investment in air source heat pump and gas boiler with highest generally available subsidies. This comparison does not concern the availability of the solutions, as for instance gas heating is not available in Norway

While there are large differences within each country, in this report we just compare a standardised family – a one-earner couple with two children earning 100% of the average earning of that country,

building on Eurostat data. We compare the affordability by comparing the number of monthly salaries to pay for the net investment (purchase + installation – subsidies). This index is there to give an idea of the feasibility of the investment for the target household in the different countries.

A comparison of the investment for a fossil heating alternative (condensing gas boiler) and a renewable alternative (air source heat pump) is shown in the previous graph.

For some countries the investment is 0, as the subsidies can add up to 100%. This is the case for Italy and for Slovakia and UK regarding gas boilers.

For some countries with limited heating demand, the obvious renewable alternative we considered is not a heat pump for a water-based heating system, but an air-to-air heat pump combined with solar thermal for hot water. This is the case for Cyprus, Malta and parts of Portugal, Spain, France, Italy, and Greece.

It should be remarked though that low-income and impoverished households are not included in the model of this report, although some of the findings may apply to them as well.

Fuel costs for heating

The fuel cost is important when comparing the running costs of various heating systems. For instance, to get lower energy bills for an air-water heat pump compared to a gas boiler, on average the ratio between gas cost and electricity cost must be lower than approximately 3,5 (depending on climate and efficiency of the heat pump).

We have compared the gas and electricity tariffs based on Eurostat statistics and information from EHPA (European Heat Pump Association) about special electricity tariffs for heat pumps. For Malta, Portugal, Cyprus and Finland we have compared HPs with oil instead of gas – as this is the most common heating technology in those countries. Prices for oil are from https://www.globalpetrolprices.com/heating_oil_prices/.

The fuel tariffs considered in our model are standard tariffs for a standard household with four members living in a 110 m^2 house with the associated average heating consumption for that country.

In the graphs below are shown gas prices (oil for countries without gas) supply for heating, and electricity.

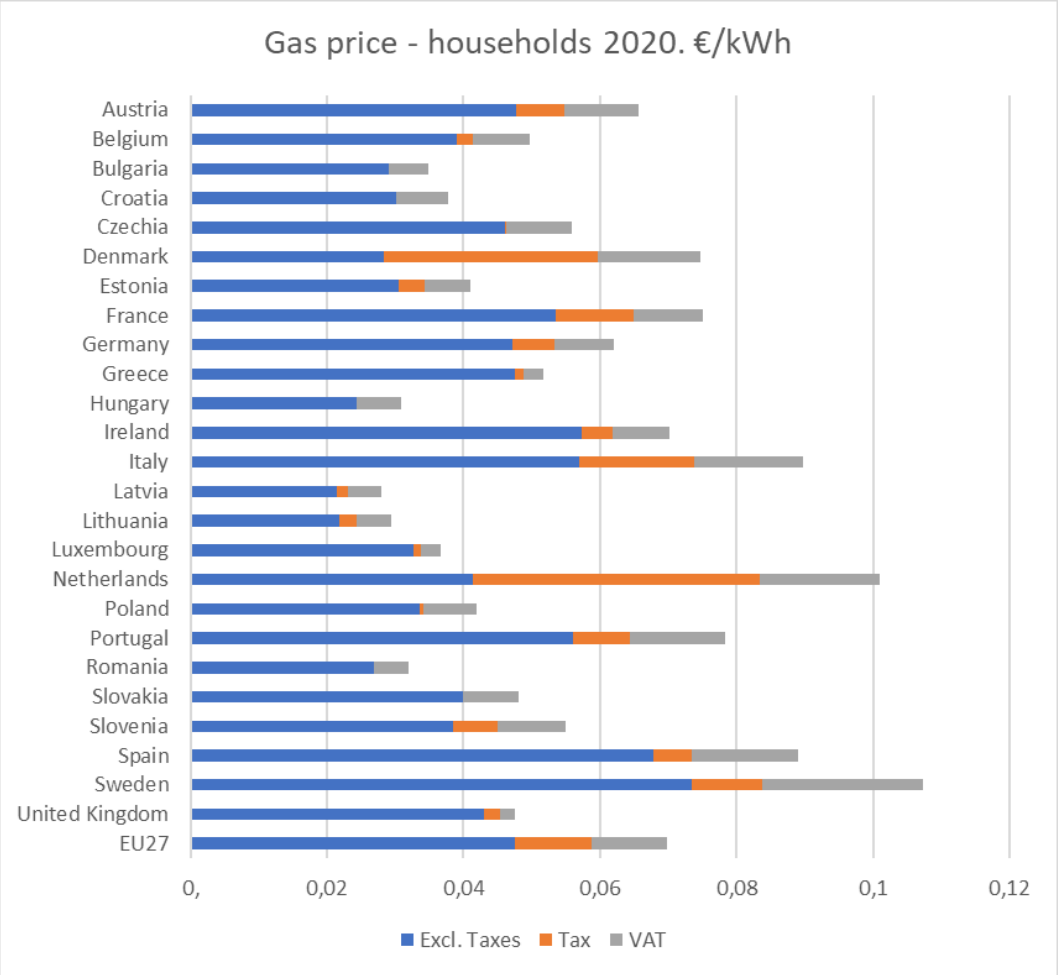


Figure 5 . Gas prices for households second semester 2020. Source: EUROSTAT

The gas price for households is between 3 and 11 eurocents per kWh in the EU countries with an average price of 7 eurocents. The price includes taxes and VAT. In some countries there is no taxation or barely any for fossil gas. The Netherlands and Denmark have the highest taxes, while Eastern European countries such as Romania, Hungary and Slovakia only apply VAT, a measure that most likely aim to include lower costs of fuels in a more general welfare framework.

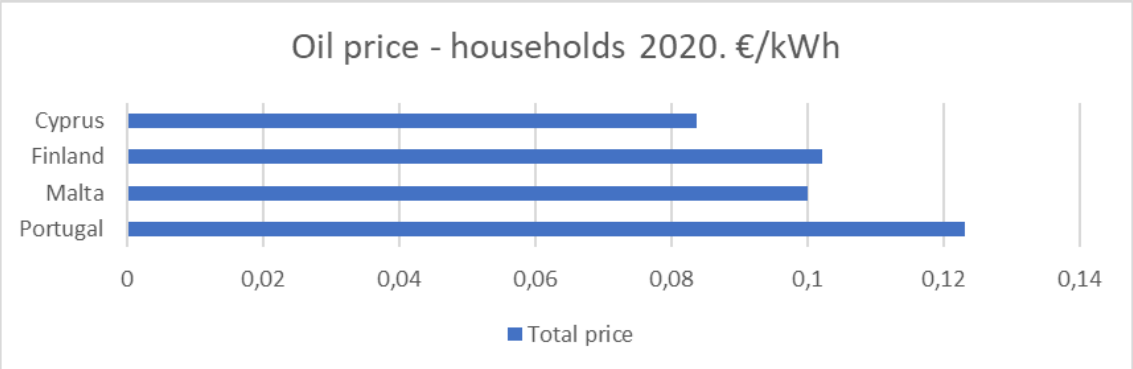


Figure 6. Oil prices for households 2020. Source: https://www.globalpetrolprices.com/heating_oil_prices/.

The oil price is 8-12 eurocents per kWh for household consumers. The price includes taxes and VAT.

It was not possible to gather information on the taxation part of the final cost. Overall, it is a little more expensive to use oil instead of gas as a fuel.

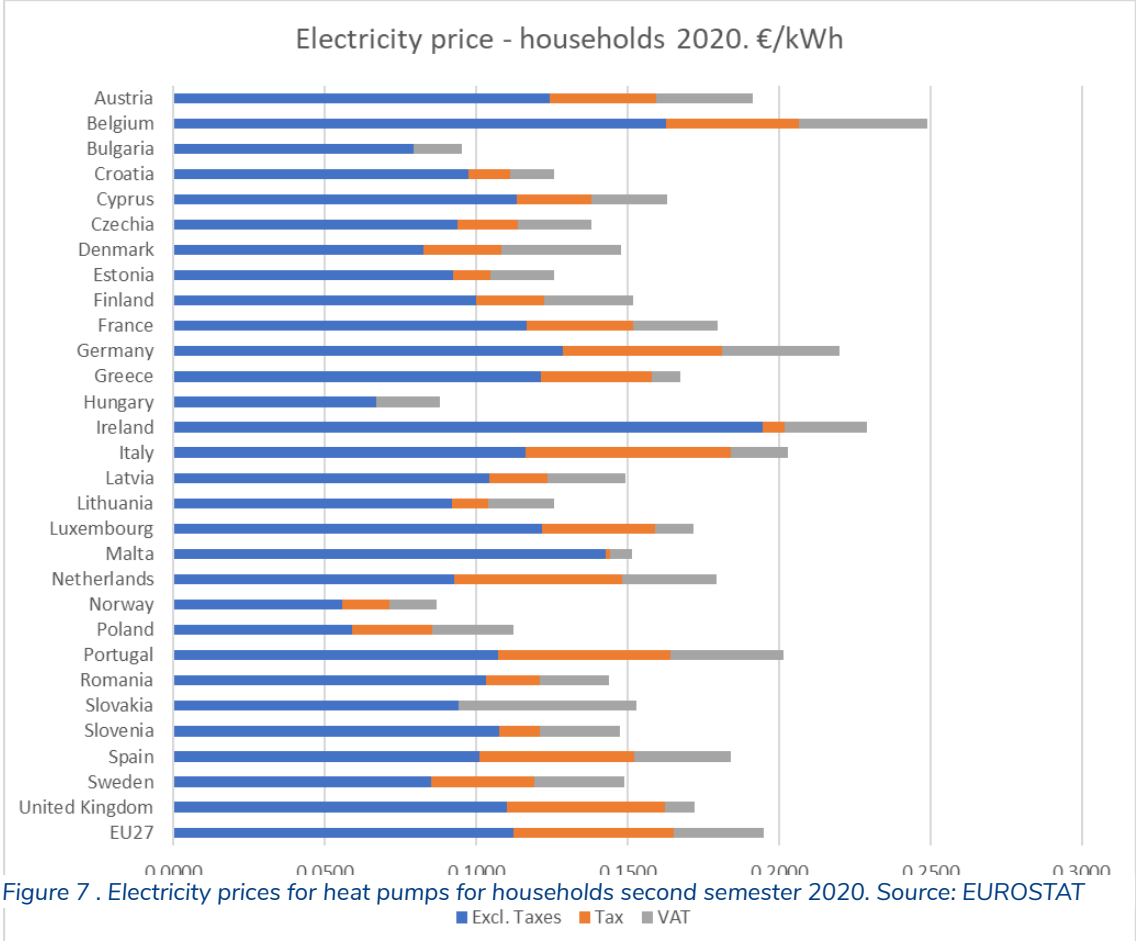


Figure 7 . Electricity prices for heat pumps for households second semester 2020. Source: EUROSTAT

The electricity price for heat pumps in households is between 9 and 25 eurocents per kWh in the EU countries with an average price of 19 eurocents. The price includes taxes and VAT. In many countries the energy tax on electricity is larger than the one on gas: it is the case, among others, of Germany and Belgium, two countries where this issue marks a sharp difference for the convenience of decarbonised heat as it will become more evident in the following pages.

In United Kingdom households investing in heat pumps can receive a feed in tariff of 0,1092 £/kWh or nearly 13 eurocents per kWh heat produced for the first seven years. With this subsidy, the feed-in tariffs payments are higher than electricity costs during these seven years. It is an alternative to the upfront subsidies given in other countries.

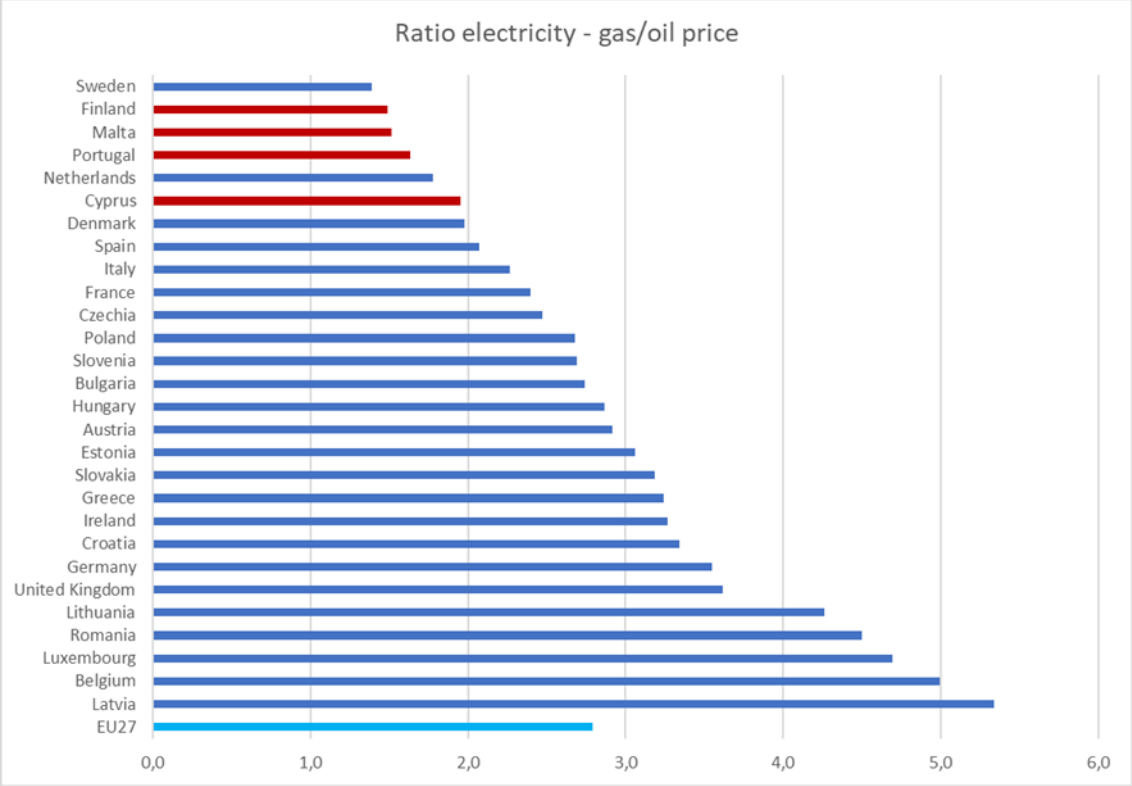


Figure 8 The price ratio between gas (blue bar) or oil (red bar) and electricity for heat pumps for household consumers.

The price ratio between electricity and gas is larger than 3,5 in five countries – Latvia, Belgium, Luxemburg, Romania, Lithuania. This favours new gas boilers above heat pumps because the fuel bills will be lower for gas in most cases.

The price ratio is approximately 3,5 in United Kingdom and Germany, but in United Kingdom this balance is changed by the feed-in tariff that lasts for the first 7 years.

Annual fuel bills

We have compared the annual heating bills with a heat pump or either an oil or a gas boiler. The calculations refer to newly installed technologies. We have used the standard tariffs from the previous paragraph, except for United Kingdom where we included the heat pump feed-in tariff, making the effective tariff negative. The energy consumption for heat and hot water is for a standard household with four members living in a 110 m^2 house with the average heating consumption of the country.

In Finland, Cyprus, Malta and Portugal the benchmark is made for oil boilers, while in all other countries it is made for gas boilers.

When choosing the decarbonisation technology, **we went for the cheapest and most suitable replacement solution for each country;** hence the heat pump calculation is based on the electricity consumption using an air-water heat pump in most countries, but for Germany and Luxembourg the calculation is based on a ground-source heat pump, because the net investment in ground source heat-pumps there is cheaper for a household when public grants are included.

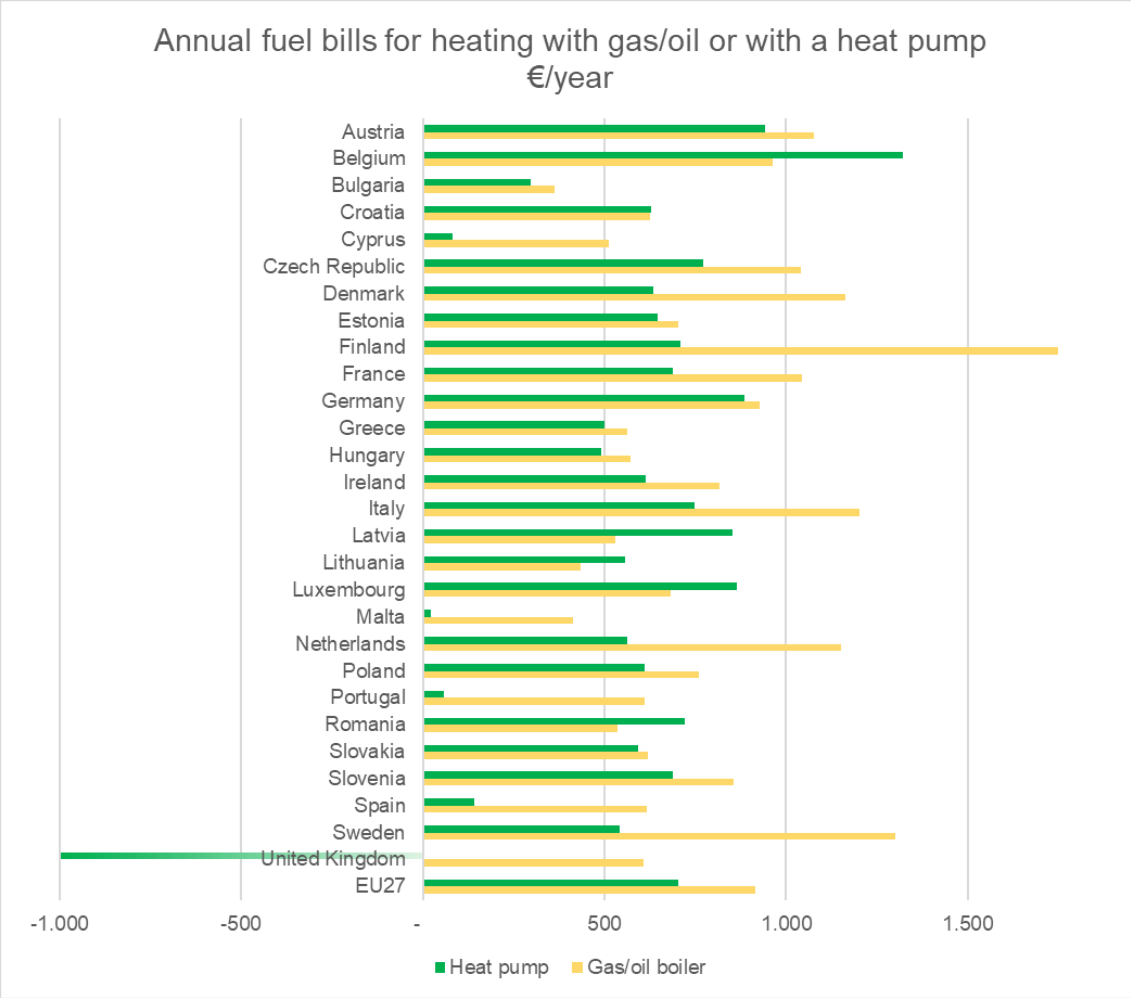


Figure 9 Annual fuel bills for a standard household, when heating with gas/oil or a heat pump. The calculations are for newly installed technologies.

Finally, in Malta, Cyprus, Spain, and Portugal, where climate is warmer, the calculation is based on an air-to-air heat pump for heating and hot water is produced by solar heating.

In Belgium, Latvia, Lithuania, Luxembourg, and Romania switching to renewable heating results in higher yearly running costs at present conditions. This means that the investment in a heat pump cannot be paid back by the savings on bills unless these conditions change (taxes and levies).

In the four warm countries (Malta, Cyprus, Spain, and Portugal) it is much cheaper to use air-air heat pump combined with solar thermal than fossil fuels for heating. In Finland, Sweden, Denmark, Netherlands, Italy and France it is also considerably cheaper to use heat pumps for heating.

In the United Kingdom the fuel costs are negative for a heat pump for the first seven years, when the household can receive a feed in tariff for heat production of the heat pump. After seven years, the fuel costs for the heat pump will be the same as for a new gas boiler, at current prices.

Payback time and necessary subsidies to reach affordability

We have calculated the simple payback time for switching from an old gas or oil boiler to heat pump (+ solar heating in Cyprus, Malta, Spain, and Portugal). The following table shows a calculation made both at current fuel prices (left) and introducing a scenario where a carbon pricing of € 100/tCO_2 applies (right).

Country	Technology	Payback time, years	
		Current	w CO2 tax
Italy	gas → air source HP	0	0
Portugal	oil → air-air HP + solar	1	1
Spain	gas → air-air HP + solar	4	3
Finland	oil → air source HP	5	3
Cyprus	oil → air-air HP + solar	5	4
United Kingdom	gas → air source HP	6	5
Malta	oil → air-air HP + solar	6	5
Austria	gas → air source HP	8	4
France	gas → air source HP	8	5
Sweden	gas → air source HP	9	7
Netherlands	gas → air source HP	9	7
Denmark	gas → air source HP	10	7
Czech Republic	gas → air source HP	13	9
Germany	gas → ground source HP	16	8
Ireland	gas → air source HP	16	10
Slovenia	gas → air source HP	18	10
Greece	gas → air source HP	21	12
Poland	gas → air source HP	21	15
Hungary	gas → air source HP	23	9
Slovakia	gas → air source HP	42	16
Estonia	gas → air source HP	45	27
Bulgaria	gas → air source HP	66	32
Croatia	gas → air source HP	68	20
Luxembourg	gas → ground source HP	never	15
Belgium	gas → air source HP	never	17
Romania	gas → air source HP	never	20
Lithuania	gas → air source HP	never	31
Latvia	gas → air source HP	never	46

Table 2 Simple payback time for switching from fossil heating to renewable heating

In the calculation the investment cost includes already existing subsidies for purchasing the new heating system. The annual saving is the result of lower heating bills after switching to the new

technology. We are not including any other running costs, such as maintenance or local safety certifications (assuming they are equal for all technologies).

In this calculation, a financial cost of 2% annual interest rate for a loan for the investment cost is included.

The results indicate that bills are lower in most countries and in nine countries (Spain, Malta, Cyprus, Portugal, Italy, France, Austria, Finland, and United Kingdom) the payback time is already within 8 years, a timespan considered reasonable for a technology that is meant to last 20 years on average.

In most member states, though, the payback exceeds 8 years, with some outstanding countries where the payback time exceeds the lifespan of the product (Greece, Poland, Hungary, Slovakia, Estonia, Bulgaria, and Croatia) or will never happen due to higher running costs (Belgium, Latvia, Lithuania, Luxembourg, and Romania).

If a carbon price of € 100/tCO_2 is introduced on both fuel and electricity (for electricity: existing 30 € with EU-ETS + additional 70 €), the payback time will be lower and the payback time will also be within 8 years in Denmark, Sweden, the Netherlands, and Germany; and there will be savings on the fuel bills in all countries.

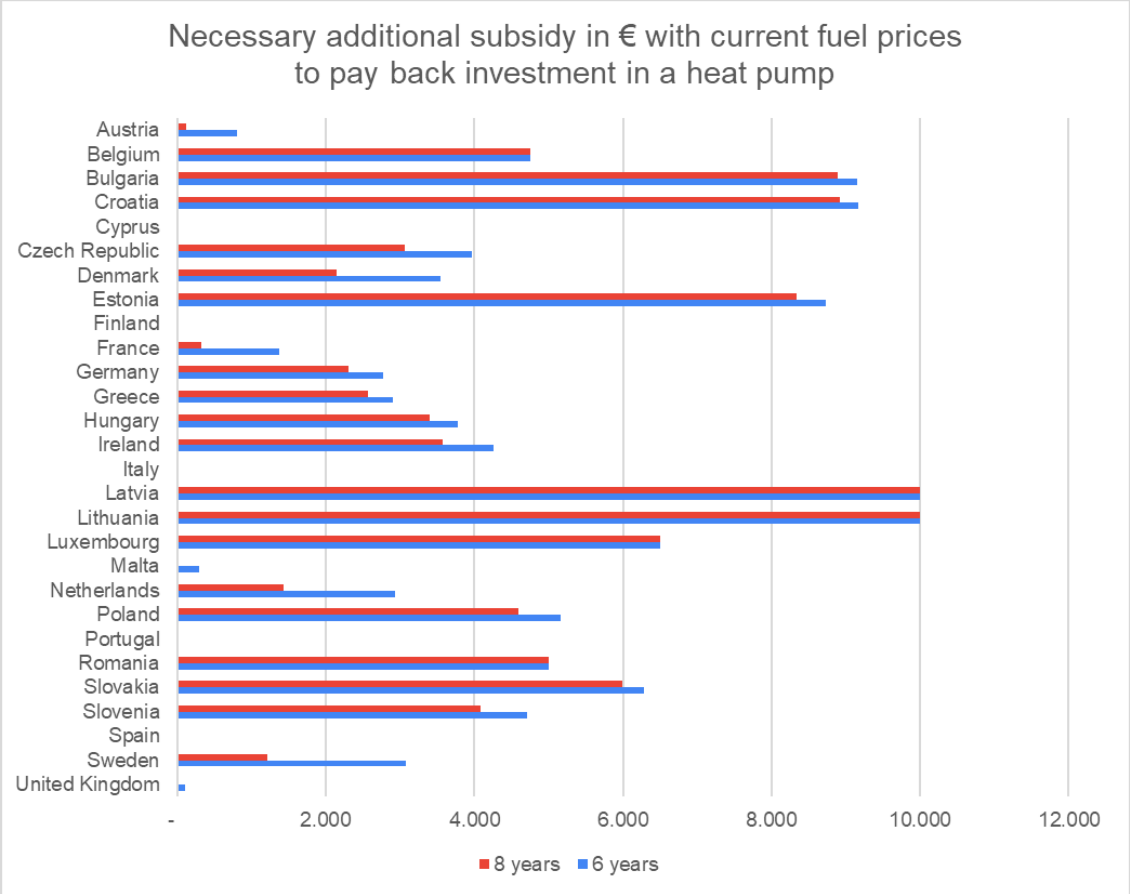


Figure 10 Necessary additional subsidy to payback the investment in a new heat pump with current fuel prices. See table 2, for the chosen heat pump technology

In most countries, there is a need for additional subsidies for a standard household to be able to pay back the investment in either 6 or 8 years with the savings on fuel bills.

In countries with high electricity costs the needed extra incentive is the highest; and it is nearly the same for a payback time of 6 or 8 years, because the savings on fuel bills only plays a secondary role

in the investment. In Finland, Spain, Portugal, Cyprus, and Italy there is no need for extra incentives. For Malta and United Kingdom there is only a need for extra incentives if we want to shrink the payback time to 6 years.

If a carbon price of € 100 per ton CO_2 is introduced, the saving on fuel bills will be higher for those switching to renewable heating. Thus, the need for additional subsidies for a standard household to be able to pay back the investment in 6 or 8 years will be lower.

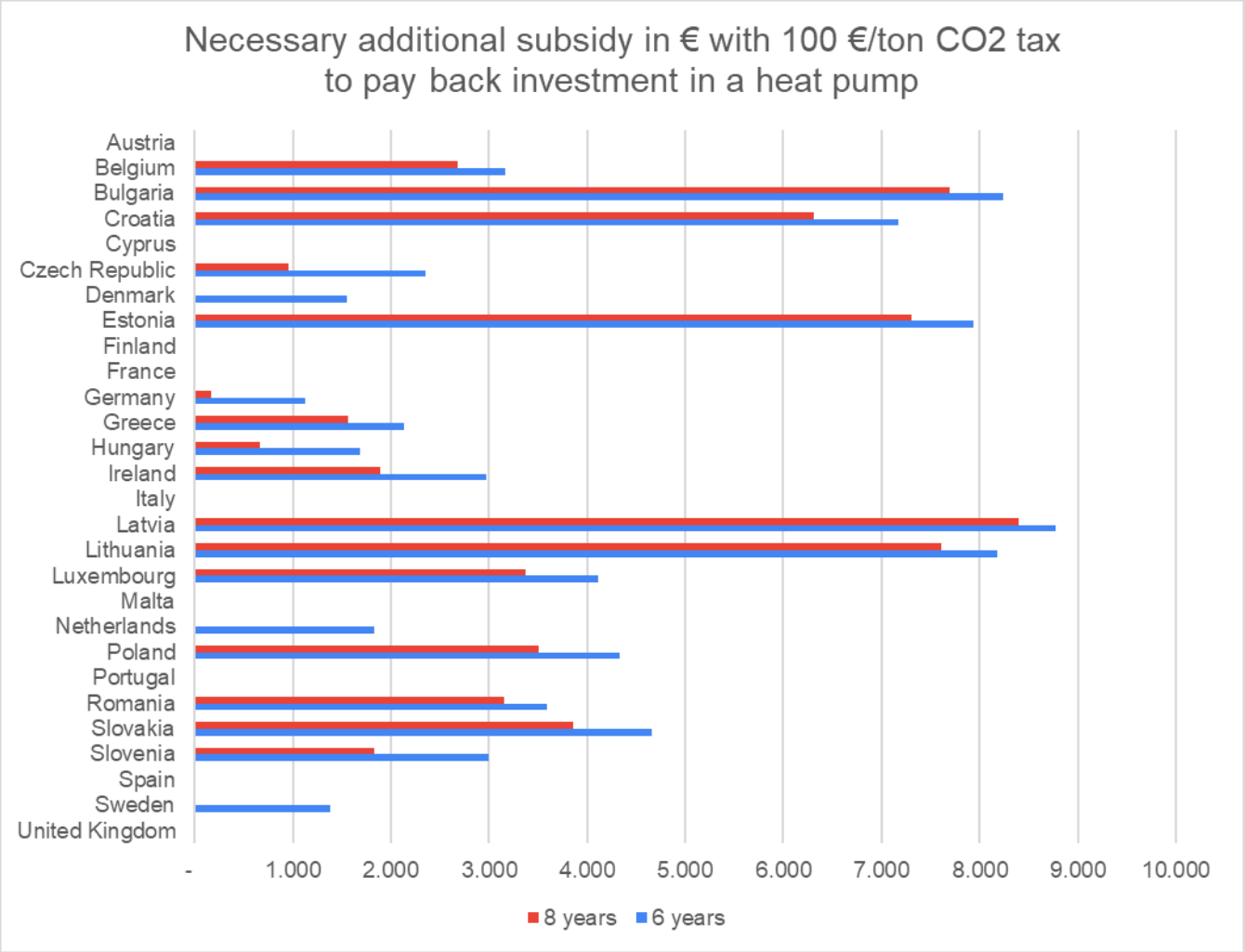


Figure 11 Necessary additional subsidy to payback the investment in a new heat pump if a CO2-tax of 100 € per ton CO2 is introduced. See table 2, for the chosen heat pump technology

The situation is the most difficult in the Baltic and Eastern European countries where the electricity mix is at present largely based on fossil fuels, hence the application of a CO_2 tax would not create a substantial difference in running costs that would allow for a payback of the renewable technology. In these countries while we wait for the change in electricity mix to happen, a decisive factor would be to lower the upfront costs substantially, in order to allow for a reasonable payback time.

Costs at European level

Building on the existing installed stock of gas boilers (oil boilers in Cyprus, Finland, and Malta), we have made a rough estimation of the total extra incentives needed per country to have a payback time of maximum 8 years for a standard household in the country -see Annex for details.

National costs for additional subsidies in million €				
Country	Technology	Gas/oil boilers (est. 2017)	Current fuel prices	with CO2-tax 100€/ton CO2
Austria	gas → air source HP	719.000	100	-
Belgium	gas → air source HP	1.615.000	7.700	4.300
Bulgaria	gas → air source HP	11.000	100	100
Croatia	gas → air source HP	250.000	2.200	1.600
Cyprus	oil → air-air HP + solar	132.000	-	-
Czech Republic	gas → air source HP	982.000	3.000	900
Denmark	gas → air source HP	338.000	700	-
Estonia	gas → air source HP	6.000	100	-
Finland	oil → air source HP	203.000	-	-
France	gas → air source HP	10.062.000	3.200	-
Germany	gas → ground source HP	10.933.000	25.300	1.900
Greece	gas → air source HP	76.000	200	100
Hungary	gas → air source HP	1.388.000	4.700	900
Ireland	gas → air source HP	395.000	1.400	700
Italy	gas → air source HP	13.419.000	-	-
Latvia	gas → air source HP	30.000	300	300
Lithuania	gas → air source HP	not available		
Luxembourg	gas → ground source HP	64.000	400	200
Malta	oil → air-air HP + solar	69.000	-	-
Netherlands	gas → air source HP	5.498.000	7.900	-
Poland	gas → air source HP	727.000	3.300	2.500
Portugal	oil → air-air HP + solar	not available		
Romania	gas → air source HP	1.261.000	6.300	4.000
Slovakia	gas → air source HP	558.000	3.300	2.100
Slovenia	gas → air source HP	not available		
Spain	gas → air-air HP + solar	4.641.000	-	-
Sweden	gas → air source HP	10.000	-	-
United Kingdom	gas → air source HP	22.879.000	-	-
Total EU27			**70.200**	**19.600**

Table 3 The 4th column indicates the total need for extra incentives per country to achieve a payback <8y

In the 27 EU countries there is an estimated total need of 70 billion € in additional subsidies. Should a CO_2 tax be introduced the needed amount would be reduced to 20 billion €.

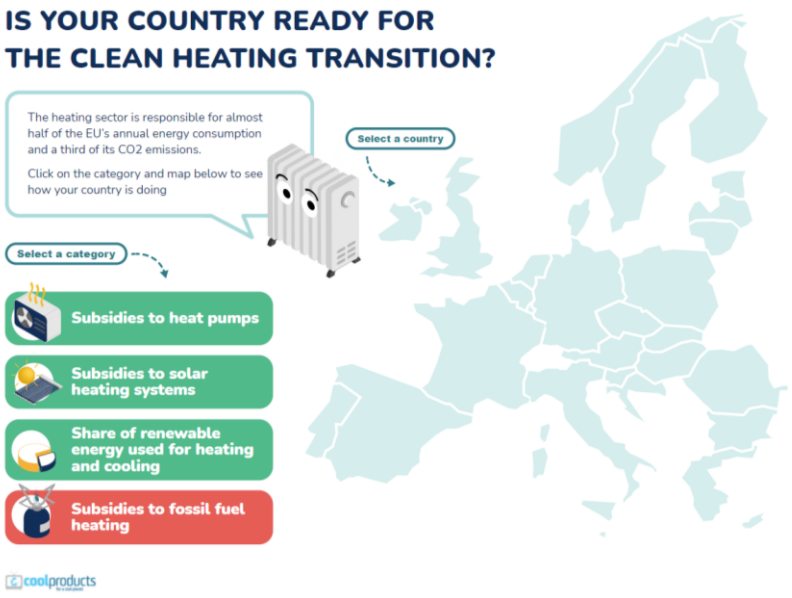
In addition to the gas boilers, there are also oil boilers in most countries. The household oil consumption in EU+UK compares roughly to 30% of the household gas consumption. Although the

extra subsidy needed to replace oil boilers is substantially lower that the one for gas (due to higher savings on running costs) dedicated funds will have to be added to replace this stock too.

Incentives, emissions and affordability by country

Information about each country's subsidies schemes and repayment time with own capital can also be found in the interactive heating map on the Coolproducts website.

On the website you can also find updates and more studies related to heating policies, e.g. a new analysis of Member States' ambition to phase out fossil-fuel heating, July 2021,



Colouring of titles

The titles of the paragraphs dedicated to the Countries is coloured green if in that Country there are **only** incentives for renewable sources. They are coloured red if there are also incentives for fossil fuels. Similarly, the titles of the paragraphs dedicated to the single schemes are coloured green if the scheme promotes **only** RES and in red if it promotes fossil fuels.

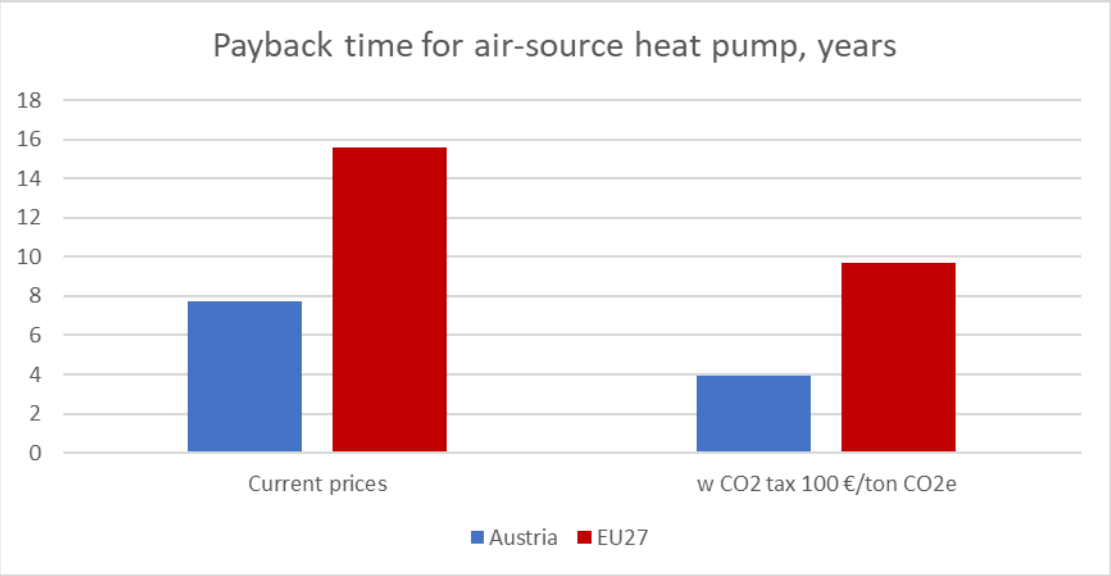
AUSTRIA

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler		0 €	2.500 €	1080 €/year
Air-water heat pump	Grant	3.500 €	6.500 €	940 €/year
Solar thermal system	Grant	1.300 €	3.700 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

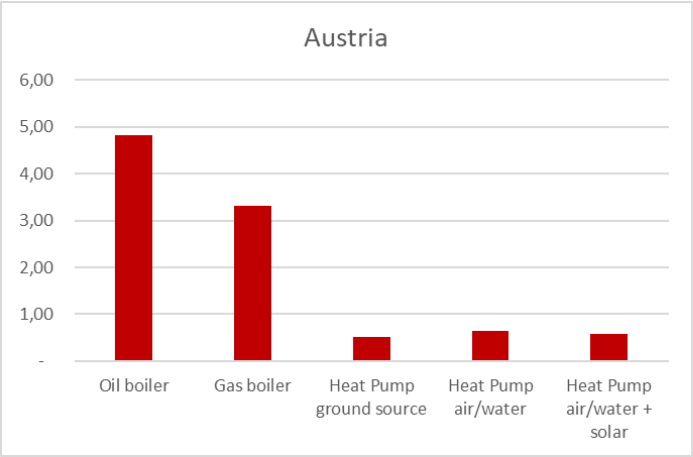
The payback time refers to the net investment after subsidies (upfront cost).

In Austria an additional subsidy of 125 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Austria amounts to about 90 million €.

If a carbon price of € 100 per ton CO_2 was introduced, there would be no need for an additional subsidy.

CO2e emissions from heating of an individual house



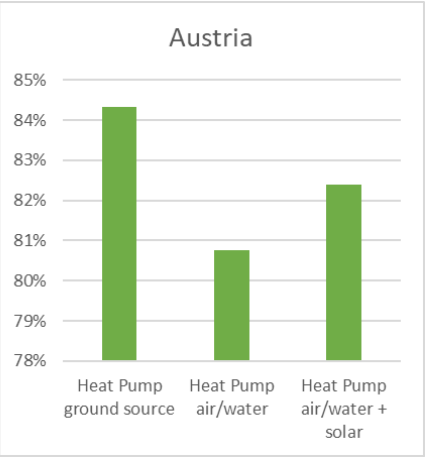


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

The Austrian government has set 2025 as the phase out date for gas boilers in new buildings. From 2035 oil heating will be banned in all buildings.

Support Schemes for households' heating

Campaign Out of Oil and Gas (Raus aus Öl und Gas)

Type. Central government grant scheme for RES.
Description. *Raus aus Öl und Gas* campaign promotes the replacement of fossil fuel-fired heating systems with sustainable heating systems through a one-off grant (which also covers planning costs with a maximum of 10% of all eligible costs). The interventions promoted are the connection to a district heating system or, where not possible, the transition to centralized wood heating or to a heat pump. The scheme ends December 21, 2022.
Amount: 5.000 euros for single-family buildings, 5.000-10.000 euros for multi-storey buildings + 1,500 euros pr. living unit (for heat pumps with a refrigerant with a GWP between 1.500 and 2.000, the calculated financing is reduced by 20%.). The maximum amount cannot exceed 35% of the eligible costs.

Source:
https://www.umweltfoerderung.at/privatpersonen/raus-aus-oel-efh-f-private-20212022.html

Promotion of Wood Heating (Förderung von Holzheizungen) - CLOSED

Type. Central government grant scheme for RES.
Description. The campaign financed newly installed pellet and wood chip central heating systems that replace an existing wood heating system, as well as pellet stoves. The financing scheme is exclusively for individuals. The programme is closed.
Amount: the contribution is paid in the form of a non-repayable lump sum: 800 euros for a pellet or wood chip central heating system that replaces an old wood heating system built before 2006, 500 euros for a pellet stove.

Source: https://www.klimafonds.gv.at/ausschreibungen/#private
https://www.klimafonds.gv.at/wp-content/uploads/sites/6/Leitfaden_Holzheizungen_2020.pdf

Promotion of Solar Thermal (Förderung von Solaranlagen)

Type. Central government grant scheme for RES.
Description. The campaign finances newly Solar thermal. The financing is exclusively for private individuals. The call expires March 21, 2022, or when funds are used.
Amount: The contribution is paid in the form of a non-refundable lump sum and amounts to 700 euros

Source:
https://www.klimafonds.gv.at/wp-content/uploads/sites/16/Leitfaden_Solaranlagen_2020_2021.pdf
https://www.klimafonds.gv.at/call/solaranlagen-2020-21/

Local incentives in Austria

In Austria there are a huge number of local incentives at regional or municipality level. The incentives are generally grants. The Austrian heat pump association has made a list of all national and local subsidies for heat pumps (and other RES systems). A private website provides a handy updated calculator that takes into account the various local incentives in Austria. Below is a list of many of the local programs.

Source: https://www.waermepumpe-austria.at/foerderungen
https://www.hoval.at/de_AT/Foerder-Rechner

Burgenland: Alternative Energy Systems (Alternativenergieanlagen)

Type. Local government grant scheme for RES heating systems.
Description. The local government subsidizes heat pumps, solar thermal systems, biomass heating and connection to district heating. There is no support for gas heating, but support for hybrid heat pumps. The programme cannot be combined with other local or federal programs. The program is eligible for one- and two-family houses.

Amount. The support is maximum 30%. Solar thermal for hot water 700-1.100 €; combined solar themal systems 1.200-1.800 €; air, ground and water source heat pumps 1.400-2.500 €; biomass heating 1.400-2.200 €; hot water heat pumps 300-600 €; hybrid heat pumps 700-1.600 €.

Source:
https://www.burgenland.at/themen/energie/foerderungen/alternativenergieanlagen/allgemeine-informationen/

Kärnten: Out of Fossil Fuels (Impulsprogramm „Raus aus Fossilen Brennstoffen“ 2021)

Type. Local government grant scheme for RES heating systems.
Description. The local government subsidizes substitution of fossil fuel heating systems with connection to district heating with minimum 80% renewable energy; biomass boilers; heat pumps for central heating. The program is eligible for one- and two-family houses. Can be combined with federal grants.

Amount. The support is maximum 35%. Maximum 6.000 € per house. There is a bonus of 1.000 € for low-income families.

Source. https://portal.ktn.gv.at/Forms/Download/BW269

Kärnten: Thermal Solar Systems (Thermische Solaranlagen)

Type. Local government grant scheme for RES heating systems.
Description. The local government subsidizes solar heating systems. The program is eligible for one and two family houses. Can be combined with federal grants.

Amount. The support is maximum 50% of eligible costs. Maximum 150 €/m2 solar collector.

Source. https://portal.ktn.gv.at/Forms/Download/BW265

Niederösterreich: NÖ Out of Oil - bonus (NÖ Raus aus Öl - Bonus)

Type. Local government grant scheme for RES heating systems.
Description. The local government subsidizes substitution of fossil fuel heating systems and inefficient biomass heating with connection to district heating with minimum 80% renewable energy; biomass boilers; and heat pumps for central heating (air-water heat pump, liquid-water heat pump). The program is eligible for single-family and terraced houses. Can be combined with federal grants.

Amount. The support is maximum 20%. Maximum 3.000 € when substituting a fossil heating and 1.000 € when substituting biomass heating.

Source. https://www.noe.gv.at/noe/Sanieren-Renovieren/wbf_heizkesseltausch.html

Oberösterreich: Support for first-time installation of RES heating systems

Type. Local government grant scheme for RES heating systems.
Description. The local government subsidizes substitution of fossil fuel heating systems with connection to district heating with minimum 80% renewable energy and heat pumps for central heating. Installation of solar thermal systems are also supported. The program is eligible for houses with maximum 3 living units. Can be combined with federal grants.

Amount. Max. 50% of eligible costs. Air-water heat pump: 100 €/kW, max. 1.700 €; geothermal and water-water heat pump 170 €/kW, max. 2.800 € (for less efficient systems 100 €/kW, max. 1.700 €); an additional 1.000 € bonus is available, when a stationary fossil fuel tank is disposed of. Solar thermal: 4-10 m^2 1.750 €; 11-19 m^2 175€/m^2; more than 20 m^2 3.500 €.

Source. https://www.land-oberoesterreich.gv.at/190718.htm

Linz: Heat Pumps (Thermische Solaranlagen)

Type. Local town grant scheme for RES heating systems.

Description. Linz town subsidizes efficient heat pumps for heating and/or hot water production.

Amount. For heating systems, the basis grant is 1.300 € for a heat pump with SCOP = 3,8. For higher SCOP +75 € for each 0,1; for lower SCOP -100 € for each 0,1. Maximum grant 2.050 €. No support when SCOP < 3,0. For heat pumps only for hot water supply the grant is 360 €.

Source.
https://www.linz.at/serviceguide/viewchapter.php?chapter_id=122019#foerderungsrichtlinien

Salzburg: Funding for deep boreholes, geothermal collectors or well systems for heat pumps (Förderung Tiefenbohrung, Erdkollektor oder Brunnenanlage für Wärmepumpen)

Type. Local grant scheme for RES heating systems.
Description. The Local government subsidizes costs for deep boreholes, geothermal collectors or well systems for heat pumps. Can be combined with federal grant.

Amount. 3.000 €. Max. 35% of eligible costs.

Source.
https://www.linz.at/serviceguide/viewchapter.php?chapter_id=122019#foerderungsrichtlinien

Styria: Heating exchange and solar thermal systems (Heizungstausch und solarthermische Anlagen)

Type. Local grant scheme for RES heating systems.
Description. The Local government subsidizes substitution of fossil fuel heating systems and direct electricity heating with biomass heating or heat pumps. Solar thermal systems are also supported.

Amount. Geothermal and groundwater heat pump 3.600 €. Air-water heat pump 1.000 €. Solar thermal heating sytems 150 €/m^2 up to 10 m^2 collector area, further collectors 100 €/m^2; for one and two family houses max. 2.000 € without heating integration and max. 3.000 € with heating integration. Max. 30% of eligible costs.

Source. https://www.wohnbau.steiermark.at/cms/beitrag/12600591/159881717/

Tyrol: Funding for highly efficient heat pumps (Förderung von hocheffizienten Wärmepumpen)

Type. Local grant scheme for RES heating systems.
Description. The Local government subsidizes efficient heat pumps in new houses and existing houses with low heating demand (max. 47,6 kWh/m^2/year).

Amount. Geothermal and groundwater heat pump 3.000 €. Air-water heat pump 700 €.

Source. https://www.tirol.gv.at/buergerservice/e-government/formulare/ansuchen-zur-foerderung-von-hocheffizienten-waermepumpen/

Vorarlberg: Energy Funding 2021/22 (Energieförderung 2021/2022)

Type. Local grant scheme for RES heating systems.
Description. The Local government subsidizes heat pumps, biomass, and solar thermal systems (minimum covering 60% of energy demand for hot water or minimum covering 30% of total heat demand). Installation of geothermal and groundwater heat pumps as well as air-water heat pumps with heat recovery from ventilation systems are subsidized.

Amount. Heat pumps: one- and two-family houses 2.000 € (+ bonus 2.000 € when substituting fossil heating or direct electricity heating); buildings with more than 2 living units: 1.000 € per building + 400 € per living unit (+ bonus 4.000 € when substituting fossil heating or direct electricity heating); max. 30% of eligible costs. Solar thermal systems for hot water: one- and two-family houses 2.000 €; buildings with more than 2 living units: 1.000 € per building + 400 € per living unit; max. 50% of eligible costs.

Source. https://vorarlberg.at/-/energiefoerderungsrichtlinie-2018-2019?article_id=134303

https://www.energieinstitut.at/buerger/foerderungen/energiefoerderung/foerderung-waermepumpen/

There are also subsidies available from some of the municipalities in Vorarlberg.

Wien: Heat Pump, Solar Thermal Systems Funding (Wärmepumpe, Solarthermische Anlagen - Förderung)

Type. Local grant scheme for RES heating systems.
Description. The Local government subsidizes water-water, brine-water, air-water heat pumps (only existing buildings), solar thermal systems for water heating (min. 5 m^2 collectors, 300 litre water storage). and solar thermal systems for water and space heating (min. 10 m^2 collectors, 800 litre water storage).

Amount. Air-water heat pump ≤ 15 kW: 2.500 €. Water-water heat pump ≤ 15 kW: 6.000 €. Brine-water with deep probe ≤ 15 kW: 7.500 €. Brine-water without deep probe ≤ 15 kW: 4.500 €. For the most efficient systems the amounts are increased by 1.500 €. Max. 30% of eligible costs. Solar thermal for hot water: 1.000 € + 70 €/m^2 collector, max. 25% of eligible costs. Solar thermal for hot water and space heating: 1.000 € + 100 €/m^2 collector, max. 35% of eligible costs.

Source.
https://www.wien.gv.at/amtshelfer/bauen-wohnen/wohnbautechnik/foerderungen/waermepumpefoerderung.html
https://www.wien.gv.at/amtshelfer/bauen-wohnen/wohnbautechnik/foerderungen/solarthermiefoerderung.html

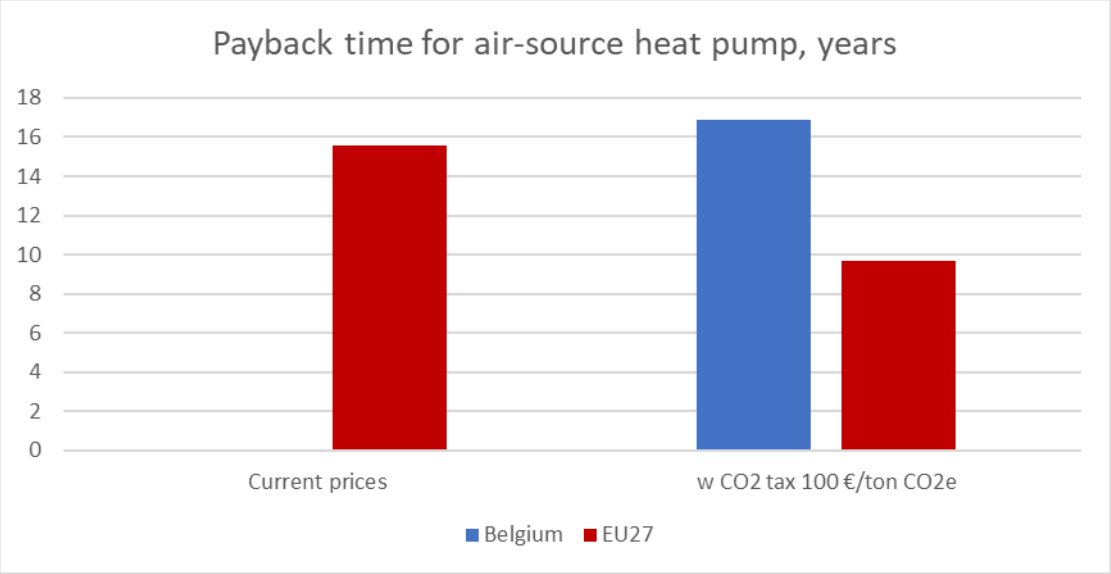
BELGIUM

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Grant, tax reduction	2.000 €	500 €	960 €/year
Air-water heat pump	Grant, VAT reduction	5.200 €	4.800 €	1320 €/year
Solar thermal system	Grant, VAT reduction	3.600 €	1.400 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

Since fuel costs are cheaper for a gas boiler than a heat pump, the investment will never be paid back.

In Belgium an additional subsidy of 4.800 € is needed for the considered average household, since the household cannot pay back the investment by fuel savings with current prices.

The total additional cost to substitute all gas boilers in Belgium amounts to about 7.700 million €.

If a carbon price of € 100 per ton CO2 was introduced an additional subsidy of 2.680 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Belgium would amount to about 4.300 million €.

CO2e emissions from heating of an individual house

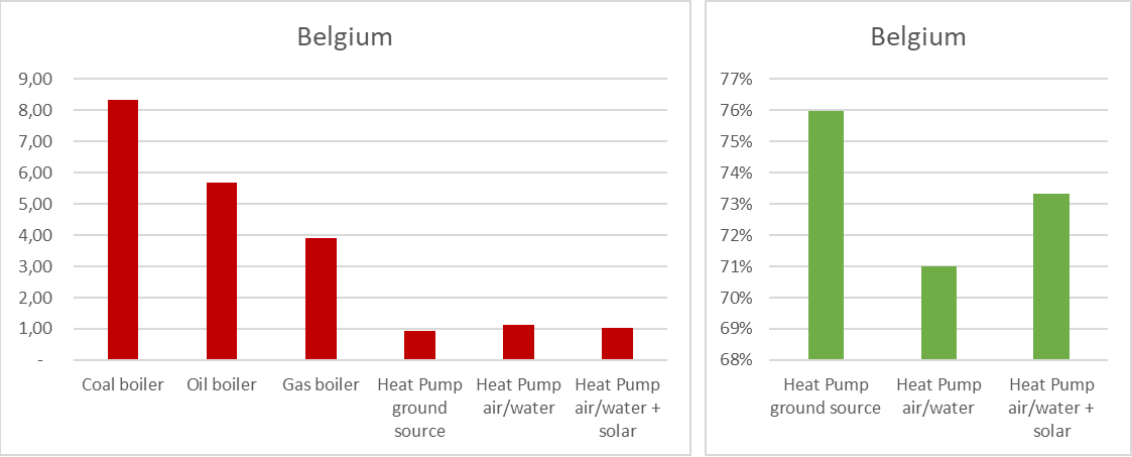


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

In 2021 the Flemish government has introduced a ban for oil in heating in all new buildings. In existing buildings, replacement is not allowed if the area is serviced by the gas grid. Gas heating is banned for apartments blocks unless used in combination with renewables. In Brussels capital region the oil ban will take place from 2025. In Wallonia in 2035.

Support Schemes for households' heating

Belgium: Energie Positive

Type. Central government grant scheme for fossil heating systems.
Description. Gas.be grants a premium for the replacement of a natural gas boiler installed in Belgium before 1 January 2000 with a new gas appliance (condensing boiler, gas heat pump, condensing hot air generator, hybrid gas heat pump, gas micro cogeneration).
Amount: 500 euros for a new natural gas boiler with a maximum nominal power of 70 kW (condensing boiler, gas heat pump, condensing hot air generator, hybrid gas heat pump, gas micro cogeneration), 5 euros extra per kW are granted with a ceiling of 2.500 euros per appliance (corresponding to 470 kW); 200 euros for a new natural gas hot water appliance for the immediate production of hot water or for its storage; 150 euros for a new appliance for individual space heating (stove, convector or built-in fire) with natural gas.

Source: https://prime.gas.be/nl/algemene-voorwaarden

Belgium: V.A.T. reduction

Type. Central government tax reduction scheme for fossils and RES heating systems.
Description. The reduced V.A.T. at 6% can be obtained in the case of renovation of a house for insulation, installation of solar boilers, photovoltaic solar panels, replacement of the central heating boilers.
Amount. VAT reduced at 6%. Standard VAT rate is 21%.

Source: https://financien.belgium.be/nl/particulieren/woning/verbouwen

Brussels: Primes énergie

Type. Local grant scheme for fossils and RES heating systems.
Description. *Primes énergie* promotes the installation of efficient boiler up to 40 kW, hot air generator or gas air heater; thermal regulation; heat pump for heating; water heater heat pump; collective chimney lining; solar water heater.
Amount: for condensation gas boilers 700/800/1200 EUR; for heat pumps for heating € 4.250/4500/4.750 (the amount of the premium is capped at 50% of the eligible costs of the invoice); for heat pump for hot water 1.400/1500/1.600 €; for solar thermal up to 4 m² from 2.500/3000/3.500 € (bonus of 200 € / m² of surface beyond 4 m²). The amount is depending on income group /A/B/C. Higher grants for low-income groups. In 2021 there is a bonus of 300/350/500 EUR when replacing old oil boilers and 600/700/1000 EUR when replacing old oil or coal stoves.

Source: https://environnement.brussels/thematiques/batiment-et-energie/primes-et-incitants/les-primes-energie-2021

https://leefmilieu.brussels/themas/gebouwen-en-energie/premies-en-stimuli/energiepremies-2021

Flanders: Property tax discount for major energetic renovations (Korting onroerende voorheffing voor ingrijpende energetische renovaties)

Type. Local tax reduction scheme for fossils and RES heating systems.
Description. A tax rebate can be obtained in case of energy renovation of buildings, with the total replacement of the heating and the insulation (of at least 75% of the building surfaces). Only valid if energy level max E60 (100 kWh/m2/year) is reached.
Amount: 100% discount on property tax for 5 years.

Source: https://www.energiesparen.be/korting-onroerende-voorheffing-voor-ingrijpende-energetische-renovaties?language=en

Wallonia: Renopack

Type. Local soft loan scheme for fossils and RES heating systems.
Description. Renopack is a 0% interest rate loan to carry out renovations. Houseowners with an annual income up to 97,700 EUR are eligible. It also covers energy efficiency measures, such as Installation of a condensing boiler, biomass boiler, biomass stove, heat pump, solar thermal.

Amount: 1,000 – 60,000 EUR.

Source: https://www.wallonie.be/fr/demarches/beneficier-du-renopack

Wallonia: Primes Habitation

Type. Local grant scheme for RES heating systems.
Description. Primes Habitacion is a subsidy for home energy improvement, which also covers various types of interventions on the heating system (see below).
Amount: the basic amount of the premium depends on the income and the composition of the household (5 income groups), with a maximum of 70% of invoices: heat pump for domestic hot water 500-3.000 €; heat pump for heating or combined 1.000-6.000 €; biomass boilers 1.000-6.000 €; solar water heaters 750-4.500 €; biomass stoves 250-1.500 €; combined biomass boilers or stoves with solar water heaters in one operation 150% of the respective base premiums.

Source: https://energie.wallonie.be/fr/primes-habitation-a-partir-du-1er-juin-2019.html?IDC=9792

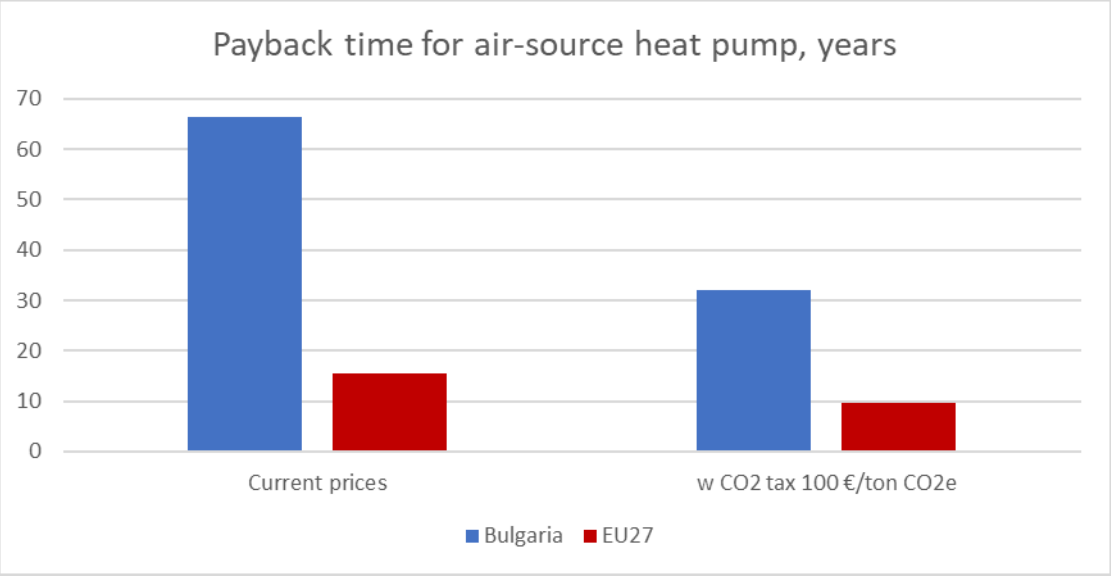
BULGARIA

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	(Loan)	0 €	2.500 €	360 €/year
Air-water heat pump	(Loan)	0 €	10.000 €	300 €/year
Solar thermal system	(Loan)	0 €	5.000 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In Bulgaria an additional subsidy of 8.890 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Bulgaria amounts to about 100 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 7.700 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Bulgaria would amount to about 80 million €.

CO2e emissions from heating of an individual house

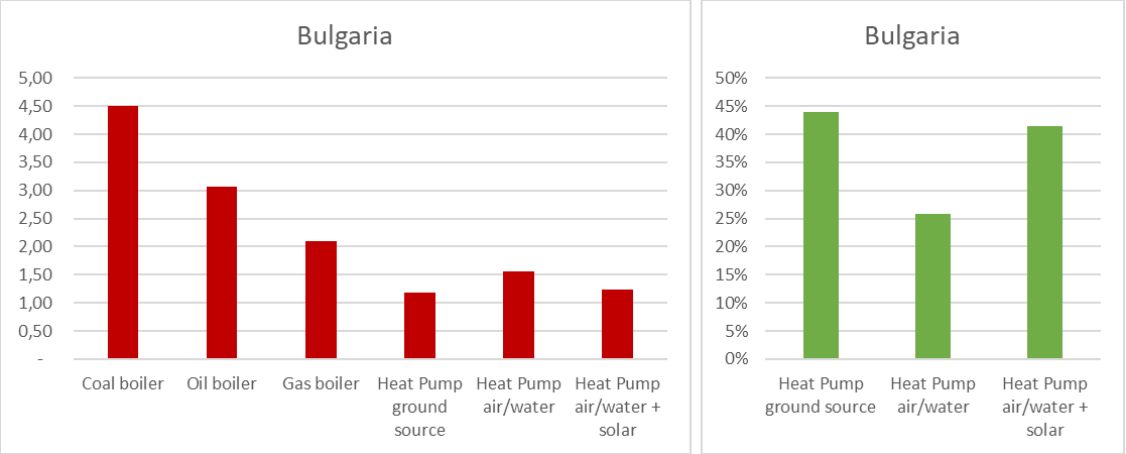


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

Energy Efficiency and Renewable Sources Fund (фонд Енергийна ефективност и възобновяеми източници)

Type. Central government soft loan scheme for fossils and RES heating systems.
Description. The Energy Efficiency and Renewable Sources Fund finances loans for rehabilitation and energy improvement of buildings in all sectors. Improvements to the heat source and distribution systems are included: new high-efficiency boilers and burners; automatic boiler control systems; separate domestic hot water heaters for summer usage; substantial efficiency-driven modernization of existing boilers; boiler heat recovery devices; small cogeneration systems; high efficiency fossil fuel or electric-powered heat pumps; projects with utilization of renewable energy sources (RES) etc.

Source: https://www.bgeef.com/en/energy-efficiency-measures/

Property tax reduction

Type. Central government tax reduction scheme for RES heating systems.
Description. The improvement of renewable energy in buildings is promoted through a tax rebate for building owners. This incentive scheme provides that a building that has been granted a class A or B energy performance certificate can be exempted from property tax for a longer period of time (between 3 and 10 years) if renewable energy technologies are used in the building.

Source: http://www.res-legal.eu/search-by-country/bulgaria/single/s/res-hc/t/promotion/aid/tax-regulation-mechanism-3/lastp/111/

Project "Bulgarian Municipalities Working Together to Improve Air Quality" (LIFE-IP Clean Air)

Type. Local level grant scheme for fossils and RES heating systems.
Description. LIFE-IP Clean Air supports the implementation of the Air Quality Programs of the Sofia Municipality, Burgas Municipality, Ruse Municipality, Stara Zagora Municipality, Veliko Tarnovo Municipality and Montana Municipality. The main objective of the project is the improvement of air quality in the participating municipalities. The core instrument to achieve the objective is design and

implementation of a scheme for transition to alternative forms of household heating. The scheme supports transition from heating with wood and coal to heating with pellets or gas. The new heating system is covered 100% by the grant, but the house owner has to cover costs of necessary internal installations in order to be compatible with the chosen equipment. Project budget 16.7 mill EUR, 2018-2024.

Source: http://lifeipcleanair.eu/en/index.html

DESIREE Gas (Demand Side Residential Energy Efficiency Through Gas Distribution Companies In Bulgaria) - CLOSED

Type. Central government grant scheme for fossil heating systems (Closed due to budget exhaustion in February 2020. Programme ended June 2020.)
Description. The Ministry of Energy of Bulgaria (ME), in the framework of the National Programme for Accelerated Gasification ("National Programme for Gasification"), uses grant support provided by the KIDSF (Kozloduy International Decommissioning Support Fund, managed by the European Bank for Reconstruction and Development), for the provision of incentives to households to connect to gas distribution networks. The assistance for the residential sector is delivered through a Demand Side Residential Energy Efficiency (DESIREE) Financing Facility, operating via the Gas Distribution Companies in Bulgaria.
Amount. 30% of the costs up to € 1.200.

Source: https://desireegas.bg/en/
https://biomasa-energy.com/blog/%D0%BF%D1%80%D0%BE%D0%B3%D1%80%D0%B0%D0%BC%D0%B0-desire%D0%B5-gas/

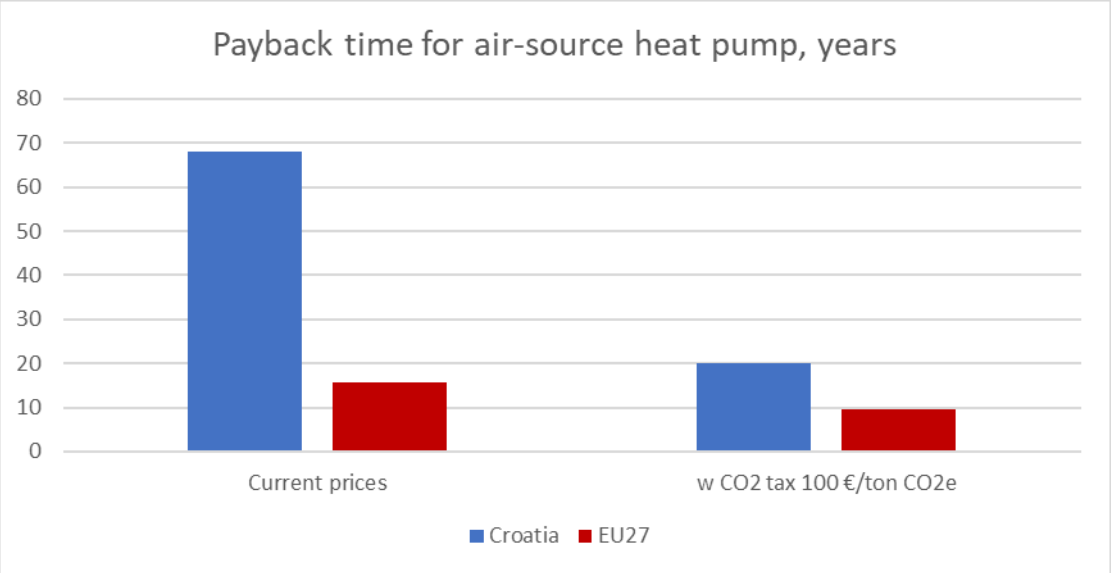
CROATIA

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler		0 €	2.500 €	630 €/year
Air-water heat pump		0 €	10.000 €	630 €/year
Solar thermal system		0 €	5.000 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

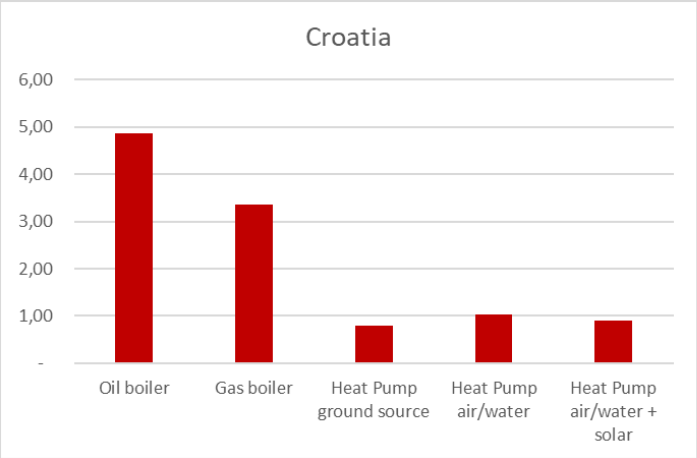
In Croatia an additional subsidy of 8.910 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Croatia amounts to about 2.200 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 6.310 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Croatia would amount to about 1.600 million €.

CO2e emissions from heating of an individual house



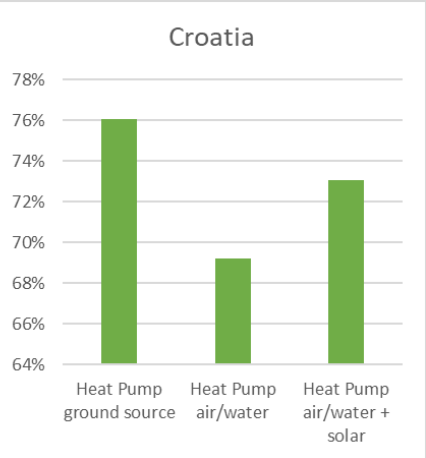


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

Program for Energy Renovation of Family Houses – TEMPORARILY CLOSED

Type. Central government grant scheme for RES heating systems.
Description. The Program for Energy Renovation of Family Houses, implemented by the Fund for Environmental Protection and Energy Efficiency was **temporarily closed** on September 1, 2020, after the total amount of requested grants was exceeded in relation to the total available amount of planned financial resources.
Amount. The program co-financed up to 60% the increasing of the thermal protection of the houses including the installations of RES (solar heat converter systems, wood chip / pellet systems, air-water, water-water or ground heat pumps) and even water and photovoltaic systems for electricity generation for own consumption.

Source:
https://www.fzoeu.hr/hr/energetska_ucinkovitost/enu_u_zgradarstvu/energetska_obnova_obiteljskih_kuca/

***Public Call for co-financing the use of renewable energy sources for the production of heat or heat and cooling energy in households, for own consumption (Javni poziv za sufinanciranje korištenja obnovljivih izvora energije za proizvodnju toplinske ili toplinske i rashladne energije u kućanstvima, za vlastitu potrošnju)* - CLOSED**

Type. Central government grant scheme for RES heating systems. The programme ended by December 31, 2020.
Description. On September 7, 2020, the Fund for Environmental Protection and Energy Efficiency announced a public tender for the co-financing of the use of renewable energy sources for the production of heat or thermal and cooling energy of households, for self-consumption. The available funds amount to HRK 30.000.000. The call assigns funds to individuals for the installation of one or more new systems for the use of renewable energy sources for the production of thermal or thermal and cooling energy: biomass plants; heat pumps; thermal solar panels. The interventions concern houses of energy class A, B and C in continental Croatia and A and B in coastal Croatia.
Amount. The Fund will allocate funds for donations to users up to HRK 75.000 per application, for justified costs of procurement and installation of one or more systems (including VAT): up to 80%, but

not more than HRK 75.000 in the area of special state interest and in the first group of islands; up to 60%, but not more than HRK 56.250 in a hilly and mountainous area and on another group of islands; up to 40%, but not more than HRK 37.500 in other areas of the Republic of Croatia.

Source: https://www.menea.hr/natjecaji/javni-poziv-za-sufinanciranje-koristenja-obnovljivih-izvora-energije-za-proizvodnju-toplinske-ili-toplinske-i-rashladne-energije-u-kucanstvima-za-vlastitu-potrosnju/

Program for co-financing the purchase of condensing boilers for houses and apartments affected by the earthquake (Program sufinanciranja kupnje kondenzacijskih bojlera za kuće i stanove pogođene potresom)

Type. Local grant scheme for fossil heating systems.
Description. The program finances the installation of condensing boilers following the earthquake that hit the Zagreb area on 22 March 2020, partially or totally destroying numerous buildings in Zagreb and Krapina-Zagorje. The programme has been reopened 21 July 2021. It covers buildings damaged in earthquakes in Zagreb area, Krapina-Zagorje, Sisak-Moslavina and Karlovac region.
Amount. A single family can receive a grant of up to 80%, with a ceiling of HRK 8.000.

Source: https://www.fzoeu.hr/hr/sufinanciranje-kondenzacijskih-bojlera/7691

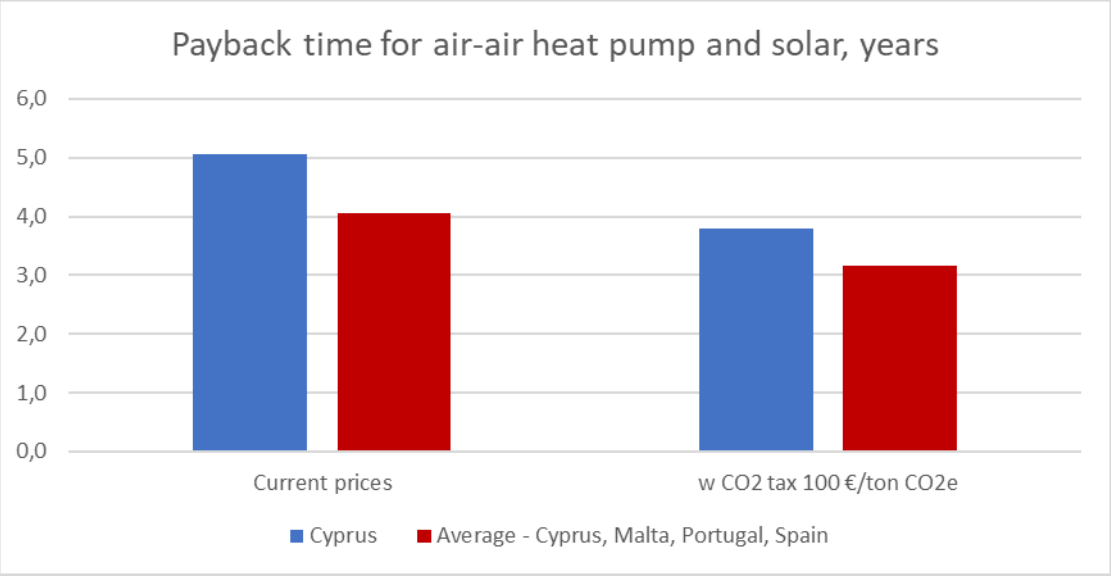
CYPRUS

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Oil boiler		0 €	3.500 €	510 €/year
Air-air heat pump	Grant	500 €	1.000 €	80 €/year
Solar thermal system	Grant	1.200 €	1.500 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies

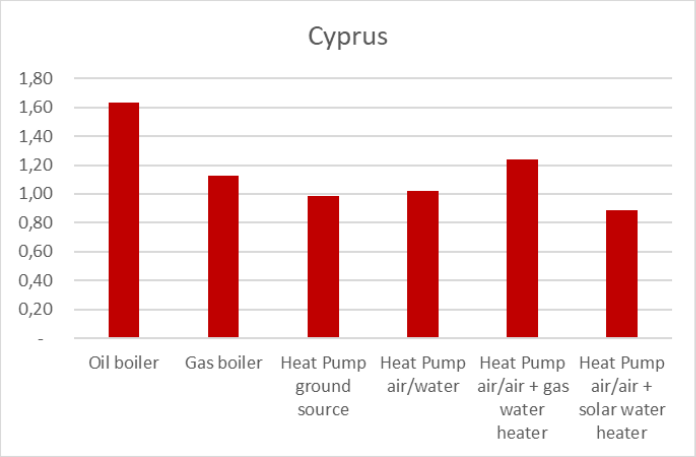


The simple payback time for substituting an old oil boiler with a new air-air heat pump and solar thermal. For Spain it is an old gas boiler that is substituted.

The payback time refers to the net investment after subsidies (upfront cost).

In Cyprus there is no need for an additional subsidy for the considered average household to pay back the investment in 8 years.

CO2e emissions from heating of an individual house



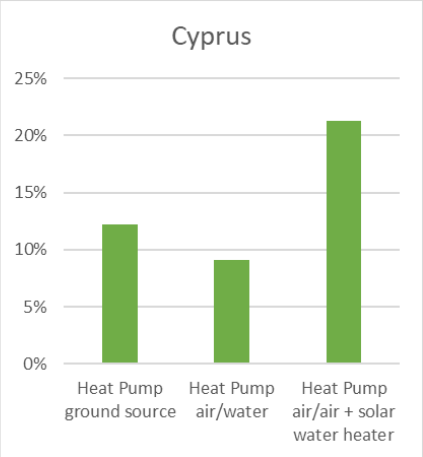


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

RES and Energy Conservation Fund, Sponsorship plan for the installation/replacement of solar systems for the production of hot water for residential use (*ΣΧΕΔΙΟ ΧΟΡΗΓΙΩΝ ΓΙΑ ΕΓΚΑΤΑΣΤΑΣΗ / ΑΝΤΙΚΑΤΑΣΤΑΣΗ ΗΛΙΑΚΩΝ ΣΥΣΤΗΜΑΤΩΝ ΠΑΡΑΓΩΓΗΣ ΖΕΣΤΟΥ ΝΕΡΟΥ ΧΡΗΣΗΣ ΣΕ ΚΑΤΟΙΚΙΕΣ* – 2021 closed for applications

Type. Central government grant scheme for RES heating systems.
Description. The program finances solar thermal with a subsidy. September 1, 2021 was last day for application.
Amount: € 350 for complete water heating systems (boiler + panels) whose solar panels have the keymark solar certification; € 175 for only solar panels with keymark solar certification. For mountainous areas the subsidy amount is double.

Source: https://www.resecfund.org.cy/iliaka_2021

Save-Upgrade Houses (*ΕΞΟΙΚΟΝΟΜΩ –ΑΝΑΒΑΘΜΙΖΩΣΤΙΣ ΚΑΤΟΙΚΙΕΣ*)

Type. Central government grant scheme for fossil and RES heating systems.
Description. The scheme aims at large-scale energy requalification of existing buildings or real estate units used as residences, which belong to natural persons living permanently in areas under the control of the Republic of Cyprus. The scheme encourages: insulation of roofs, floors, walls; installation of efficient windows, efficient gas boilers; heat pumps, solar thermal (also solar cooling); biomass boilers; efficient lamps; micro-cogenerators; etc. The overall budget of the scheme amounts to € 16.5 million. Closing date for the call is December 12, 2021; or when the budget is used. The call is part of programme running 2021-2027.
Amount: The amount of the subsidies is equal to 60% oflatvia the expenses (80% in the case of low-income families). Maximum amounts: solar heating $1,200; all heat pumps €5,500; high performance gas boiler €2,000; autonomous air-conditioning €500 for up to 4KW in cooling and €900 for the ones having higher than 4KW in cooling. For cooling the label must be A+++ and for heating. The maximum amount cannot exceed € 22,000 for each building (€ 32,000 if you make house category A energy efficient, insulate house, get 25% of energy from RES and put limits on energy needs for heating).

Source: 1 2 3

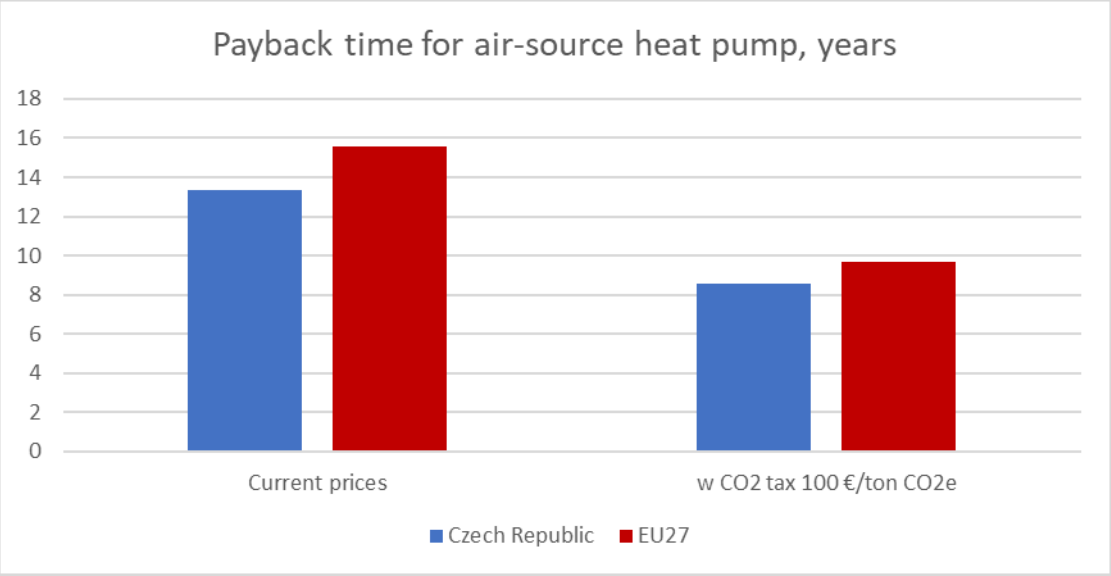
CZECH REPUBLIC

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Grant	1.250 €	1.250 €	1040 €/year
Air-water heat pump	Grant	3.100 €	6.900 €	780 €/year
Solar thermal system	Grant	1.800 €	3.200 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In Czech Republic an additional subsidy of 3.070 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Czech Republic amounts to about € 3Bn.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 960 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Czech Republic would amount to about 900 million €.

CO2e emissions from heating of an individual house

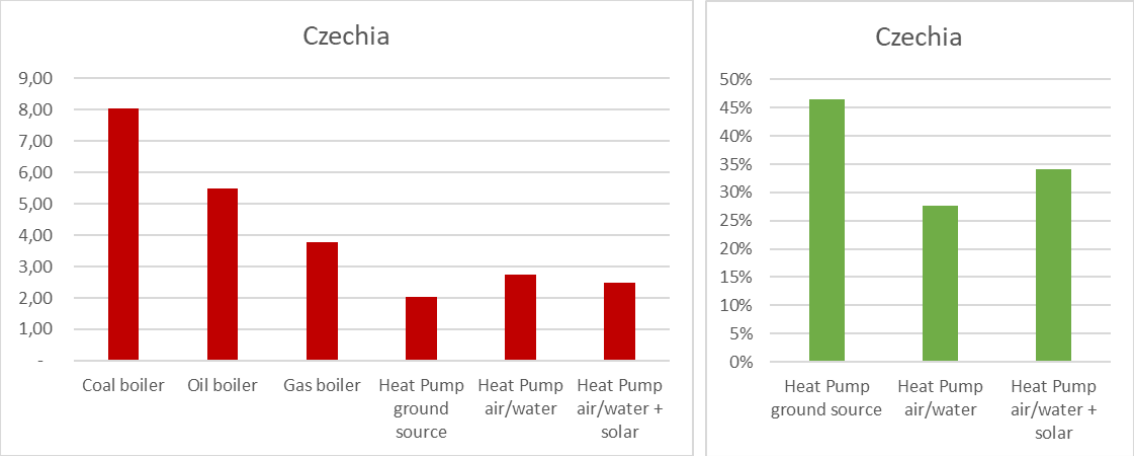


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

The New Green Savings Programme (Nová zelená úsporám)

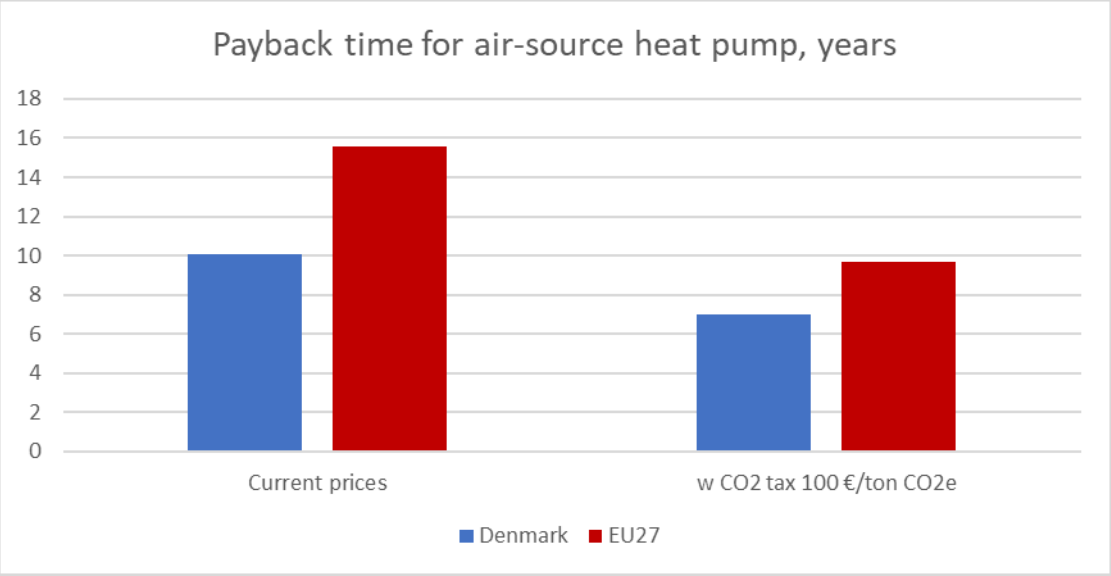
Type. Central government grant scheme for fossil and RES heating systems.
Description. The New Green Savings Programme of the Ministry of the Environment supports the reduction of the energy intensity of residential buildings (complex or partial thermal insulation), construction of houses with very low energy intensity, environmentally friendly and efficient use of energy sources and renewable sources of energy (RES). Eligible applicants are owners or builders of family houses and apartment buildings, both individuals and legal entities. The programme incentives solar thermal and photovoltaic systems, controlled ventilation system with heat recovery from the exhaust air (recovery), use of heat from wastewater, replacement of electric heating with a heat pump system, replacement of local stoves (e.g. stoves used as the main source of heat for heating). Also condensing boilers are incentivized.
Amount. 50% of the eligible costs (in some cases higher support for low-income families). The maximum amount is: solar thermal systems for hot water CZK 45.000, for hot water and heating CZK 60.000; biomass boiler with automatic fuel supply CZK 80.000; biomass stoves with automatic fuel supply CZK 30.000; biomass stoves with hot water heat exchanger and automatic fuel supply CZK 45.000; air-water, water-water and ground-source heat pump CZK 80.000 (incl. preparation for water system CZK 100.000); air-air heat pump CZK 50.000; heat pump for hot water CZK 45.000; photovoltaics for hot water CZK 45.000; gas condensing boiler CZK 35.000; connection to the heat supply system CZK 40.000. There is a bonus for some combinations with insulation.
Sources: https://www.sfzp.cz/en/administered-programmes/new-green-savings-programme/
https://2030.novazelenausporam.cz/

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Tax deduction	300 €	2.200 €	1160 €/year
Air-water heat pump	Grant	1.900 €	8.100 €	630 €/year
Solar thermal system	Tax deduction	500 €	4.500 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In Denmark an additional subsidy of 2.140 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Denmark amounts to about 700 million €.

If a carbon price of € 100 per ton CO_2 was introduced, there would be no need for an additional subsidy.

CO2e emissions from heating of an individual house

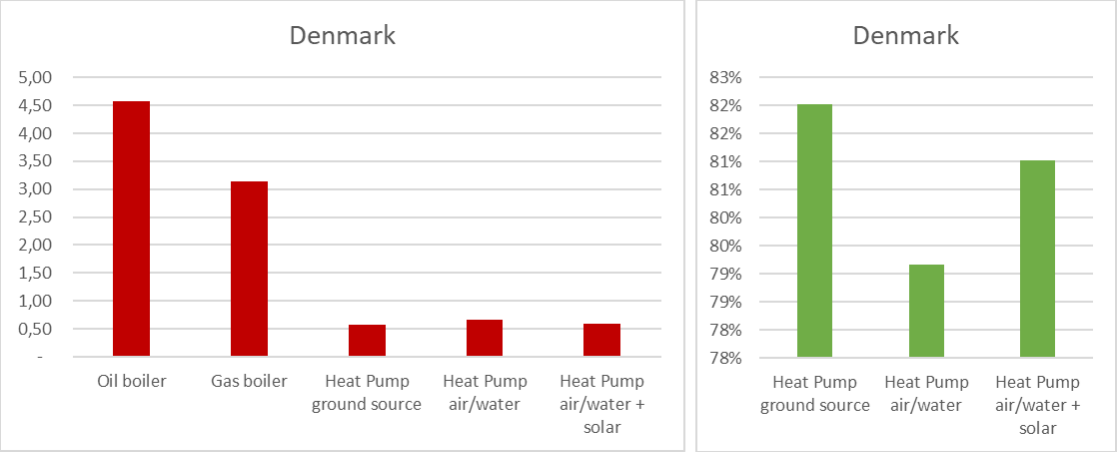


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

The Danish government has banned oil boilers in new buildings in 2013.

Support Schemes for households' heating

The Building Pool - Grants for energy savings and energy efficiency improvements in buildings for year-round housing (Bygningspuljen)

Type. Central government grant scheme for RES heating systems.
Description. The Danish Energy Agency administers this scheme, that provides subsidies for energy savings and energy efficiency improvements for year-round homeowners, including private homeowners, owner associations, cooperative housing associations, public housing associations (on some conditions), dormitories, landlords, etc. The subsidies concern various types of interventions including thermal insulation, windows and conversion of the primary heat source (from oil boiler, gas boiler, biomass boiler or direct electric heat) to heat pump (only air/water or ground source class A^{++} or A^{+++} heat pump, and only if the home is not located in a district heating area). All subsidies are calculated on basis of fixed subsidy rates, set by the Danish Energy Agency, using estimated average market prices. The subsidy does not exceed 20% of the market price for the energy improvement measure itself and is only available as long as the budget last. In addition, a weighting is made to give larger subsidy to better energy solution. The grant also depends on the size of the house. The scheme is running for 2020 to 2026 with several calls every year. The scheme has changed so only buildings with energy label E, F and G can receive support, except for change to heat pump and the maximum support has been lowered, so more house owners can be supported. The scheme is heavily oversubscribed, so in spring 2021 only around ¼ of applicants were granted support. The latest call was in September 2021.
Amount. For heat pumps the grant is 15% of the market price for an A^{++} heat pump and 20% of the market price for an A^{+++} heat pump. installed in a 140 m^2 building. Ground/water heat pump DKK 14.000 for an A^{++} heat pump and DKK 23.000 for an A^{+++} heat pump installed in a 140 m^2 building. For example: for an A+++ air/water HP installed in a 140 m2 house the subsidy is DKK 19.000 (approx. € 2.500); and for an A++ air/water heat pump DKK 14.000 (approx. € 1.900).

Sources: https://ens.dk/service/tilskuds-stoetteordninger/bygningspuljen

Home-job-scheme (Bolig-job-ordningen)

Type. Central government tax reduction scheme for fossils and RES heating systems.

Description. A tax deduction can be obtained for certain work on the home (craftsperson deduction), as well as for some services (service deduction), e.g. cleaning. The tax deduction includes work on energy efficiency measures, e.g. thermal insulation, windows, PV-systems, installation of heat pumps and solar thermal systems. Repair or replacement of gas boilers is also supported. Oil and biomass boilers are not supported. Only salary costs are supported (not equipment). The tax deduction scheme cannot be combined with The Building Pool grants.

Amount. Maximum DKK 25.000 can be deducted per person annually for work on the house (in 2021. The maximum was increased due to corona). The saving is 26% of the deducted value.

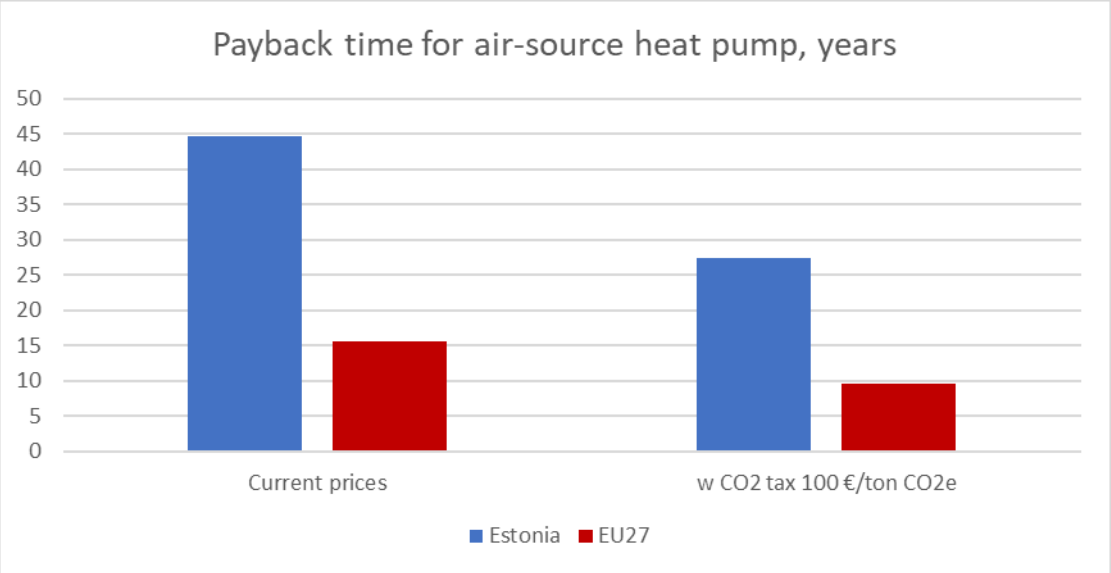
Source. https://skat.dk/skat.aspx?oid=2234759

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler		0 €	2.500 €	700 €/year
Air-water heat pump		0 €	10.000 €	650 €/year
Solar thermal system		0 €	5.000 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

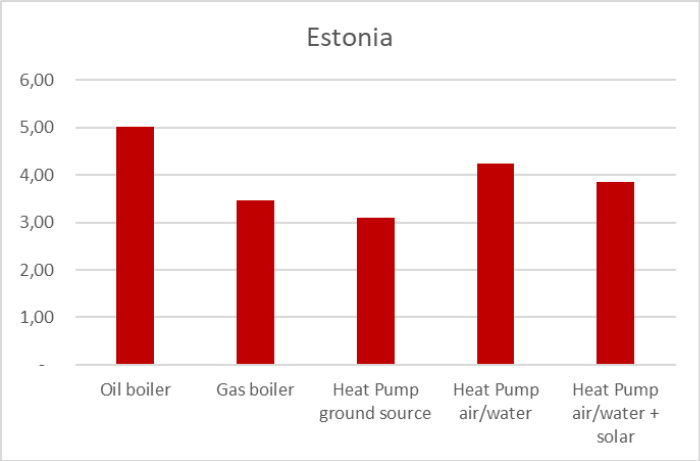
In Estonia an additional subsidy of 8.340 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Estonia amounts to about 50 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 7.300 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Estonia still would amount to about 40 million €.

CO2e emissions from heating of an individual house



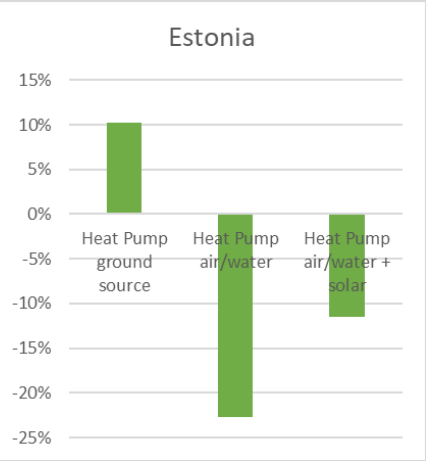


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Estonia's power generation has a high share of coal thus the CO2-emission is high. As a result, using air-water heat pumps has a higher CO2-emission than efficient gas boilers.

Support Schemes for households' heating

Reconstruction grant for small residences (Väikeelamute rekonstrueerimistoetus) - SUSPENDED

Type. Central government grant scheme for fossil and RES heating systems. Is closed for applications.
Description. The program promotes various energy efficiency interventions, including: replacement or refurbishment of the heating system and related works; construction, replacement or reconstruction of a ventilation system and related works; the acquisition and installation of renewable energy production equipment together with the necessary equipment for energy conversion and storage of energy production and related works (for *renewable energy production installation* the Regulation means an installation that generates heat or electricity by means of the sun); purchase and installation of equipment for the use of waste heat from waste water and related works. Among the incentivised heating systems there are also gas boilers.
Amount: between 30% and 50% and up to 20.000-50.000 euros depending on the Estonian regions and the type of the house. The lower values apply to small residences.

Source: https://www.riigiteataja.ee/akt/103062020014
https://kredex.ee/en/services/housing/private-home-renovation-support

Renovation grant 2020 (Rekonstrueerimistoetus 2020) - CLOSED

Type. Central government grant scheme for RES heating systems.
Description. Programme aimed to promote comprehensive reconstructions of apartment buildings. The grant is round-based and applications are approved within the volume of the funds allocated to the region.

Source: https://kredex.ee/en/services/elamistingimuste-parandamiseks/renovation-grant-2020

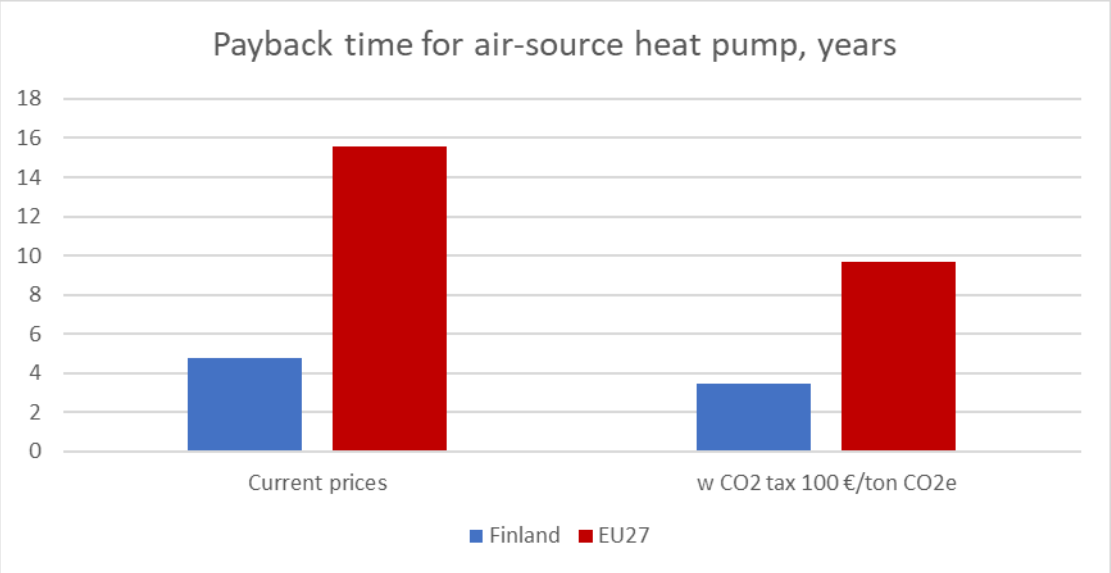
FINLAND

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Oil boiler	Tax reduction	300 €	3.200 €	1750 €/year
Air-water heat pump	Grant	4.000 €	6.000 €	710 €/year
Solar thermal system	Tax reduction	700 €	4.300 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old oil boiler with a new air-water heat pump.
(The EU data refers to the substitution of an old gas boiler with a new air-water heat pump).

The payback time refers to the net investment after subsidies (upfront cost).

In Finland there is no need for an additional subsidy for the considered average household to pay back the investment in 8 years.

CO2e emissions from heating of an individual house

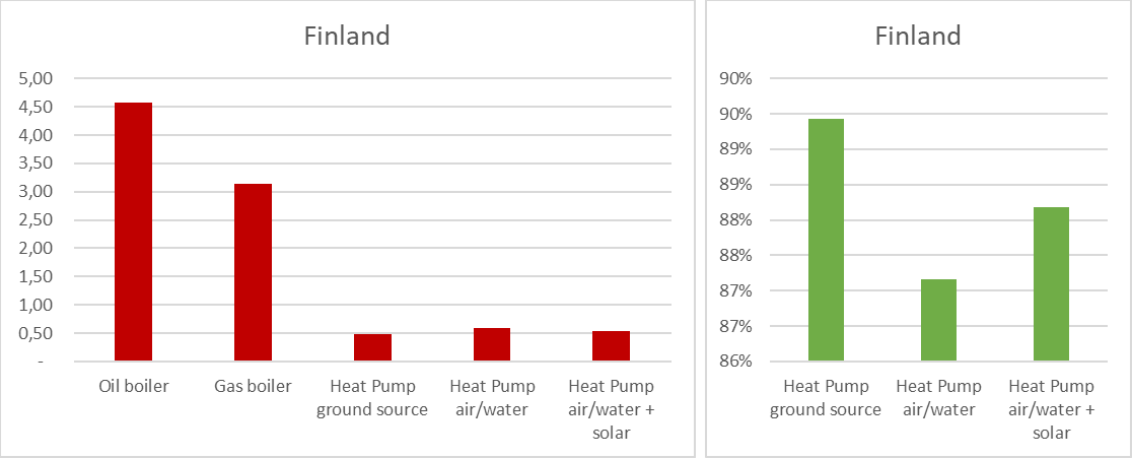


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to oil

The comparison is made with oil because Finland has very little gas heating. The Finnish government has set 2035 as the phase out date for oil in heating.

Support Schemes for households' heating

Avustus pientalon öljylämmityksestä luopumiseksi (Grant for giving up oil heating in a detached house)

Type. Central government grant scheme for RES heating systems.
Description. The grant is for owners of detached single or double residential houses used all year. The grant supports cost of removing oil heating system and replacement with a new non-fossil heating system or district heating. The grant scheme runs until resources are used.

Amount. The subsidy is €4,000 for conversion to district heating, air-water heat pumps and ground source heat pumps. For other non-fossil heating systems it is €2,500.

Source: https://www.ely-keskus.fi/oljylammityksen-vaihtajalle

Tax credit for household expenses

Type. Central government tax reduction scheme for fossils and RES heating systems.

Description. Tax credit for household work and renovation, e.g. upgrading, improvement and repair of heating systems; as well as installation of heat pumps and solar thermal. The deduction only covers cost for work (salaries) and not equipment.

Amount. The deduction is 40% of the costs minus 100 EUR, with an annual maximum of € 2,250/person. No reduction if a subsidy is granted for part of the costs.

Source. https://www.vero.fi/en/individuals/tax-cards-and-tax-returns/income-and-deductions/Tax-credit-for-household-expenses/

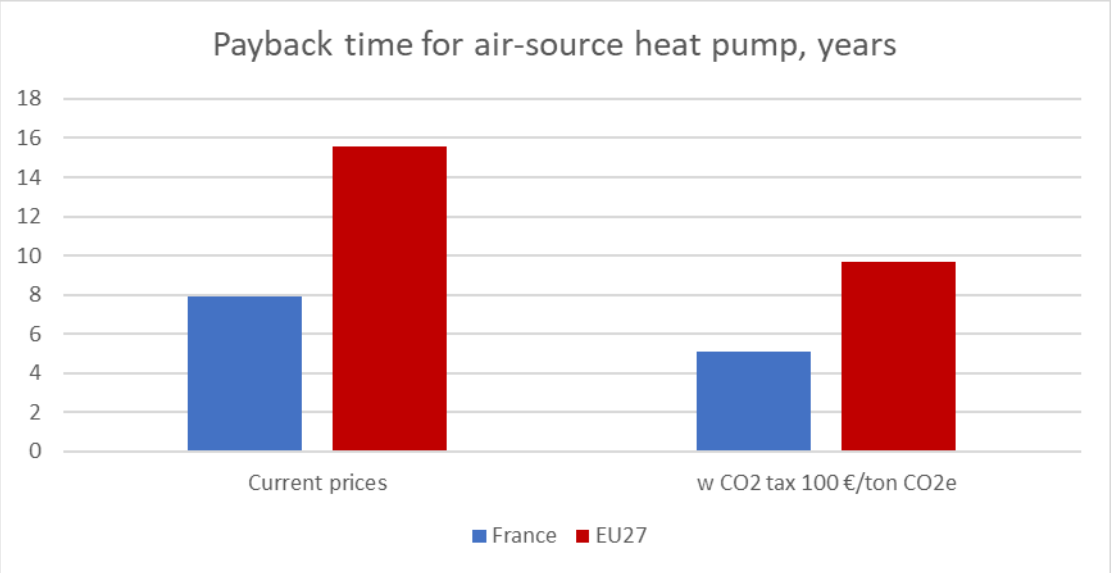
FRANCE

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	VAT reduction	300 €	2.200 €	1040 €/year
Air-water heat pump	Grant, VAT reduction	5.200 €	4.800 €	690 €/year
Solar thermal system	Grant, VAT reduction	4.600 €	400 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In France an additional subsidy of 320 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in France amounts to about 3.200 million €.

If a carbon price of € 100 per ton CO_2 was introduced, there would be no need for an additional subsidy.

CO2e emissions from heating of an individual house

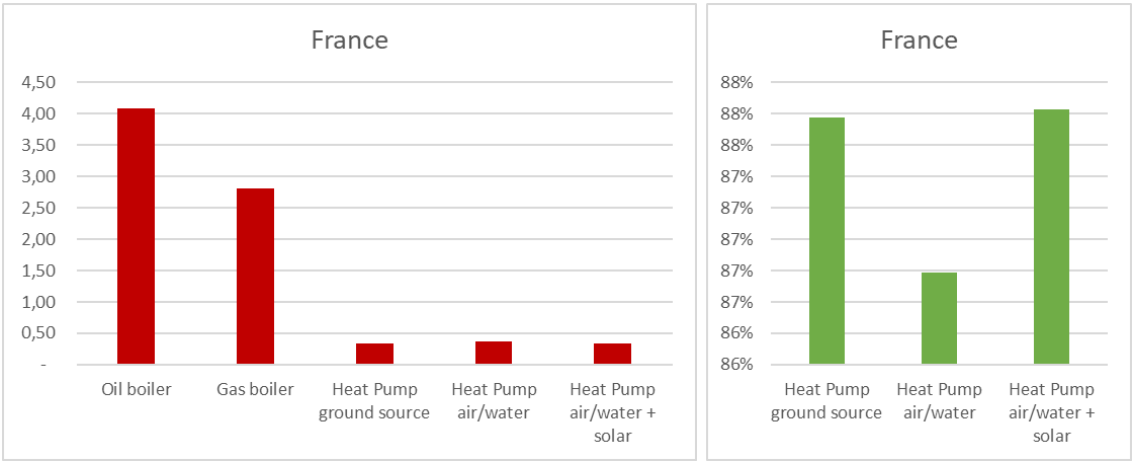


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

The French government has introduced a de facto ban on gas boilers by 2022 and a progressive phase-out between 2022 and 2025 in collective housing.

Support Schemes for households' heating

Information on programmes for the public https://www.faire.gouv.fr/aides-de-financement

Éco-prêt à taux zéro (éco-PTZ)

Type. Central government soft loan scheme for fossil and RES heating systems.
Description. The zero-interest eco-loan (eco-PTZ) allows to finance the energy renovation of the houses. Promoted interventions: thermal insulation; installation, adjustment or replacement of heating systems or production of domestic hot water; installation of heating systems using a renewable energy source; installation of equipment for production of domestic hot water using a renewable energy source. Also condensing gas boilers are included. The programme runs till the end of 2021.
Amount: The maximum amount is between € 7,000 and € 30,000 depending on the works

Source: https://www.service-public.fr/particuliers/vosdroits/F19905

Aide de l'Anah: travaux d'amélioration de l'habitat

Type. Central government grant scheme for fossil and RES heating systems.
Description. Various types of efficiency measures for old buildings. The programme is supporting low-income households.
Amount. Subsidies up to 50% for lowest income families. Maximum subsidy EUR 15,000.
Source: https://www.service-public.fr/particuliers/vosdroits/F1328
https://www.faire.gouv.fr/aides-de-financement/programme-anah

Prime "Coup de pouce économies énergie": chauffage

Type. Central government grant scheme for fossil and RES heating systems.
Description. This energy bonus allows to pay the costs of replacing the heating system. This award can be claimed until December 31, 2025. After June 30, 2021, the subsidy for gas is only available

when efficient RES heating systems is not possible. Can be combined with Eco-PTZ and Ma Prime Rénov.
Amount: Installation of an efficient biomass boiler € 4,000 for low-income families and 2,500 for non-low-income families; Installation of an air/water or water/water or hybrid heat pump € 4,000 or 2,500; Installation of a combined solar system € 4,000 or 2,500; connection to a heating network supplied by renewable energies (ENR & R) 700 € or 450; installation of a very high energy performance gas boiler € 1,200 or 600; installation of a high-performance wood-burning appliance 800 € or 500.

Source: https://www.service-public.fr/particuliers/vosdroits/F34421
https://www.ecologie.gouv.fr/sites/default/files/Evolutions%20li%C3%A9es%20aux%20Coups%20de%20Pouce%20-%20mai%202021.pdf

Prime "Coup de pouce thermostat avec régulation performante"

Type. Central government grant scheme for fossil and RES heating systems.
Description. The Prime promotes the installation of thermostats. The award can be claimed until 31.12.21.
Amount: 150 €.

Source: https://www.service-public.fr/particuliers/vosdroits/F35338

Prime de transition énergétique "Ma Prime Rénov"

Type. Central government grant scheme for fossil and RES heating systems.
Description. The energy transition bonus called *Ma Prime Rénov* can be granted to any owner to finance the works and/or the energy renovation costs of his main residence. The programme promotes various interventions related to heating: gas condensation boilers; biomass boilers; solar thermal; geothermal or solar thermal heat pumps; air/water heat pumps; water heater heat pumps; connection equipment, or connection fees and costs, to a heating or cooling network; removing an oil tank. From January 2021 it was extended to all houseowners and from July 1, 2021, it also supports flat owners.
Amount. The overall amount of the premium is capped at € 20.000 per home, over a period of 5 years. The amount depends on the family income, the following is for individual houses. Gas boiler with very high energy performance € 800-1.200; automatically fed wood boiler €8.000-10.000; manual feed wood boiler € 6.500-8.000; combined solar thermal systems €8.000-10.000; solar thermal for hot water € 3.000-4.000; geothermal or solar thermal heat pump € 8.000-10.000; air/water heat pump €3.000-4.000; water heater heat pump € 800-1.200. Households are divided into four income groups. For the highest income (over €60.336 for a 4-person family), there is only a reward for deep renovation projects (min. 55% energy savings). Lower subsidy than above mentioned for incomes between €39,192 and €60,336). Can be combined with Energy saving certificates provided by companies.

Source: https://www.service-public.fr/particuliers/vosdroits/F35083
https://api.faire.gouv.fr/sites/default/files/2021-07/AidesFinancieres_Juillet2021.pdf

VAT reduction

Type. Central government tax reduction scheme for fossil and RES heating systems.
Description: In France, the purchase of commodities is subject to a reduced VAT rate if they are related to investments in the improvement, the transformation, the fittings, the conservation or certain equipment of buildings constructed more than two years prior (Code Général des Impôts, art. 278-0 bis, 1). Thus, the purchase of such commodities by private individuals is indirectly promoted. The reduced VAT includes boilers, heat pumps, fireplace inserts, wood-burning stoves, solar water heaters. **Also, gas boilers are included.**

Amount the reduced VAT rate is 5.5% (Art. 278-0 bis, *Code Général des Impôts*). Standard VAT rate is 20%.

Source: https://agirpourlatransition.ademe.fr/particuliers/finances/aides-a-renovation/tva-a-55

Tax credit for energy transition Crédit d'impôt pour la transition énergétique (CITE) - CLOSED

The scheme was closed by December 31, 2020; and replaced by the Ma Prime Renov programme.
Type. Central government tax reduction scheme for RES heating systems.
Description: The Energy Transition Tax Credit (*Crédit d'impôt pour la transition énergétique* CITE) applies to expenditure on the insulation of homes or equipment that reduces their energy consumption. In regard to heating, the programme promotes Equipment for heating or the production of domestic hot water powered by wood, solar energy or other biomass; heat pumps other than air / air.
Amount: The tax credit depends on the work done and cannot exceed 75% of the value paid by the owner. The tax credit is however limited to: € 2.400 for one person and 4.800 for a couple subject to joint taxation. The ceiling is increased by 120 € per dependent person (60 € per child in alternate residence).

Source: https://www.service-public.fr/particuliers/vosdroits/F35083
https://www.faire.gouv.fr/aides-de-financement/credit-impot-transition-energetique

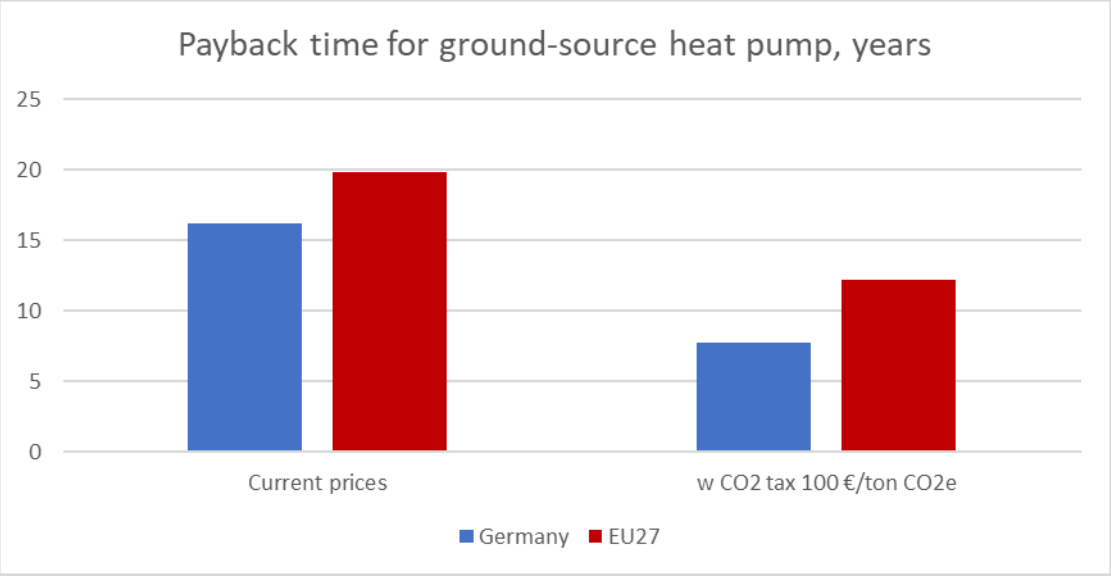
GERMANY

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Grant	500 €	2.000 €	930 €/year
Ground source heat p.	Grant	8.800 €	4.200 €	880 €/year
Solar thermal system	Grant	1.500 €	3.500 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new ground source heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

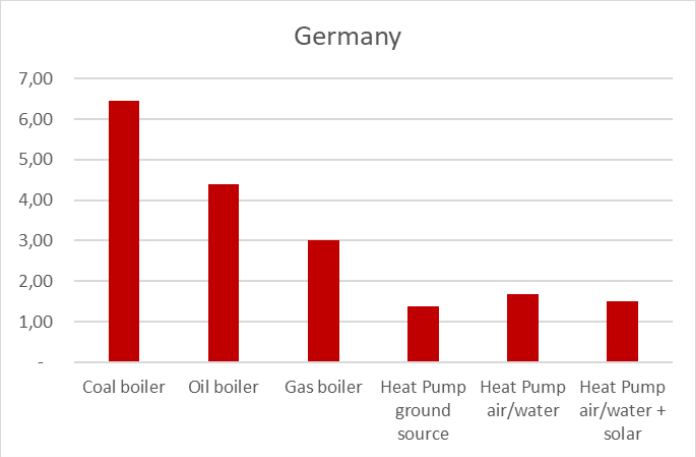
In Germany an additional subsidy of 2.310 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Germany amounts to about 25.300 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 170 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Germany would amount to about 1.900 million €.

CO2e emissions from heating of an individual house



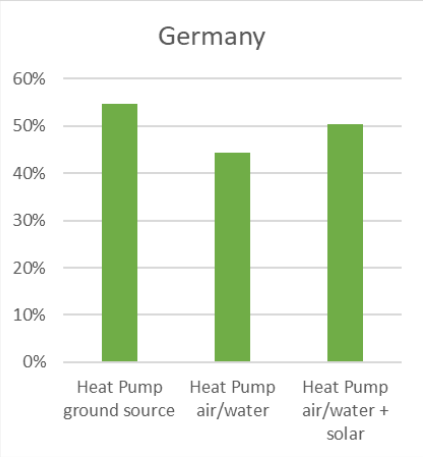


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

The German government has set 2026 as the phase out date for oil in heating in new and existing buildings when alternatives are available.

Support Schemes for households' heating

Refurbishment KfW Efficiency House

Type. Central government grant or soft loan scheme for refurbishment.
Description: KfW promotes the refurbishment of houses if after refurbishment they do not exceed a specific energy requirement for a comparable new house. The maximum loan and repayment grant depends on the energy standard achieved. In order to meet the high energy standard of a *KfW Efficiency House*, extensive investments such as the renewal of heating systems, thermal insulation and replacement of windows, are usually required. It is also possible to implement single measures only, for example for thermal insulation or change of heating system.
Amount: The support is given as a loan and with a possible repayment grant. The maximum annual loan for individual measures is € 60,000. The grant is through the Federal support for energy efficient buildings (see amounts below), but it can be applied for through KfW.

Source: https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/

Bundesförderung für effiziente Gebäude (Federal support for energy efficient buildings)

Type. Central government grant scheme for fossil and RES heating systems.
Description: As part of the support for energy efficient buildings (BAFA) promotes efficient technologies that provide buildings with renewable energy-based heating or cooling. The grants are awarded as partial funding based on the eligible investment costs. It supports gas condensing boilers ("Renewable Ready"). This applies only to hybrid installations where gas is coupled with a renewable technology), hybrid gas heating, Solar thermal systems, Biomass systems, Heat pump systems. It also supports connection to district heating, when over 55% of production is RE-based (over 25% when replacing oil boilers).
Amount: Solar thermal system 30%, biomass system or heat pump system 35% (45% in case of oil boiler replacement), RE ready condensing gas boiler 20%, gas hybrid heating with renewable heat generation 30% (40% in case of oil boiler replacement). There is an annual cap of €60.000 EUR per living unit.

Source:
https://www.bafa.de/DE/Energie/Effiziente_Gebaeude/Sanierung_Wohngebaeude/Anlagen_zur_Waermeerzeugung/anlagen_zur_waermeerzeugung_node.html

https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/

Tax deduction for energy efficient renovations

Type. Central government tax reduction scheme for fossil and RES heating systems.
Description. The deduction was introduced in January 2020 and runs till 2029. The tax deduction can be used in owner-occupied housing for installations that are eligible under the KfW program. It cannot be combined with a KfW grant.
Amount: 20% of the costs. Maximum deduction is 40.000 € per house.

Source: https://www.energie-experten.org/bauen-und-sanieren/altbausanierung/energetische-sanierung/steuerlich-absetzen#c34569

Heating with renewable energies - CLOSED

The programme closed as an independent programme on December 31, 2020. From 2021 support for RES heating systems is part of *Bundesförderung für effiziente Gebäude*. See above.
Source:
https://www.bafa.de/DE/Energie/Heizen_mit_Erneuerbaren_Energien/Foerderprogramm_im_Ueberblick/foerderprogramm_im_ueberblick_node.html

Local incentives in Germany

In Germany there are a number of local incentives at state level. The incentives are generally grants. In the Funding Data Bank (Förderdatenbank) it is possible to find information about and links to state, federal and EU funding. A private company has made a website with a funding data for energy renovations.

Source: https://www.foerderdatenbank.de/. https://www.foerderdata.de/index.php

Baden-Württemberg: Climate Bonus (Kombi-Kredit Wohnen mit Klimaprämie)

Type. Local government soft loan and bonus grant for fossil and RES heating systems.
Description. Possibility for soft loans for renovations eligible for support under the KfW program. A bonus of 2.000 € or 4.000 € for renovations up to "efficiency house 40" or "efficiency house 55".

Source.

https://www.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/neue-foerderprogramme-fuer-hochwertige-energetische-gebaeudesanierung-gestartet/

https://www.l-bank.de/produkte/wirtschaftsfoerderung/kombi-darlehen-wohnen.html

Berlin: Heating Exchange PLUS (HeiztauschPLUS)

Type. Local government grant scheme for fossil and RES heating systems.
Description. The local government subsidizes efficient gas boilers, heat pumps, wood pellet boilers and wood chopping kettles, mini-cogeneration, solar thermal systems, fuel cell heaters, connection to efficient district heating. Support for one- and two-family houses, buildings with max. 20 living units ("Effiziente GebäudePLUS" offers grants for other buildings). The programme can be combined with other funding, but total funding cannot exceed 100%.

Amount. Gas boilers 1.000 €. Heat pumps, wood pellet boilers, mini-cogeneration and fuel cells 3.500 €. Solar thermal system for hot water: 500 €. Solar thermal system for space heating 1.000 €.

Source. https://www.ibb.de/de/foerderprogramme/heiztauschplus.html

Bremen: Replacement of Oil Boilers (Ersatz von Ölheizkesseln)

Type. Local government grant for fossil and RES heating systems.
Description. The local government subsidizes replacement of oil boilers with connection to district heating based on cogeneration or waste incineration; gas boilers combined with solar thermal heating; wood boilers. Can be combined with federal grant (BAFA).

Amount. Connection to district heating 1.000 € (one and two family houses), 100 € per living unit (multifamily houses). Solar thermal systems and wood boilers up to 100% of BAFA grant.

Source. https://www.foerderdatenbank.de/FDB/Content/DE/Foerderprogramm/Land/Bremen/ersatz-von-oelheizkesseln.html

Hamburg: Renewable Heating (Ernäuerbare Wärme)

Type. Local government grant scheme for fossil and RES heating systems.

Description. The local government subsidizes large solar heating systems with above 20m2 collectors, i.e. multifamily systems, air-water and ground source heat pumps. There is no support for gas heating, but support for gas driven heat pumps similar to ground source heat pumps. The programme can be combined with the federal program and the program from KfW.

Amount. Large solar heating: The support is for water heating systems 100 €/m2 (only 75 €/m2 for new houses) and for combined systems also for heating 200 €/m2 (only 150 €/m2 for new houses). Air source heat pumps: 1,500 €, larger systems 40 €/kW nominal heat output. Ground source heat pumps: 4,200 €, for larger systems 100 €/kW nominal heat output, but maximum 15% of heat collector costs (20% for use of wastewater as heat source).

Source. https://www.ifbhh.de/foerderprogramm/erneuerbare-waerme

Niedersachsen: Heat Pump Quarters (Wärmepumpenquartiere)

Type. Local government grant for fossil and RES heating systems.
Description. The local government subsidizes heat pump installations in selected residential areas (quarters) using measurement, control, regulation, and transmission technology. The aim of the promotion is to obtain and use data for the optimization of the operation of heat pumps and for scientific analysis. The grant is in addition to federal funding.

Amount. From 500 € to 7.250 € for the heat pump + max. 2.500 € for the measuring technology.

Source.
https://www.nbank.de/Privatpersonen/Wohnraum/W%C3%A4rmepumpenquartiere/index.jsp

Nordrhein-Westfalen: Promotional Instruments for the Energy Transition (Förderinstrumente für die Energiewende)

Type. Local government grant for fossil and RES heating systems.
Description. The local government subsidizes solar thermal heating. Further support for: biomass heating in combination with solar heating or photovoltaics; climate friendly buildings; drilling, geothermal probes and collectors for heat pumps. Can be combined with federal financing.

Amount. Solar thermal systems: 90 €/m^2 collector, min. 4 m^2 collector, max. 1 m^2 collector per 10 m^2 heated area. Maximum 60% of eligible costs in total.

Source. https://www.bra.nrw.de/energie-bergbau/foerderinstrumente-fuer-die-energiewende

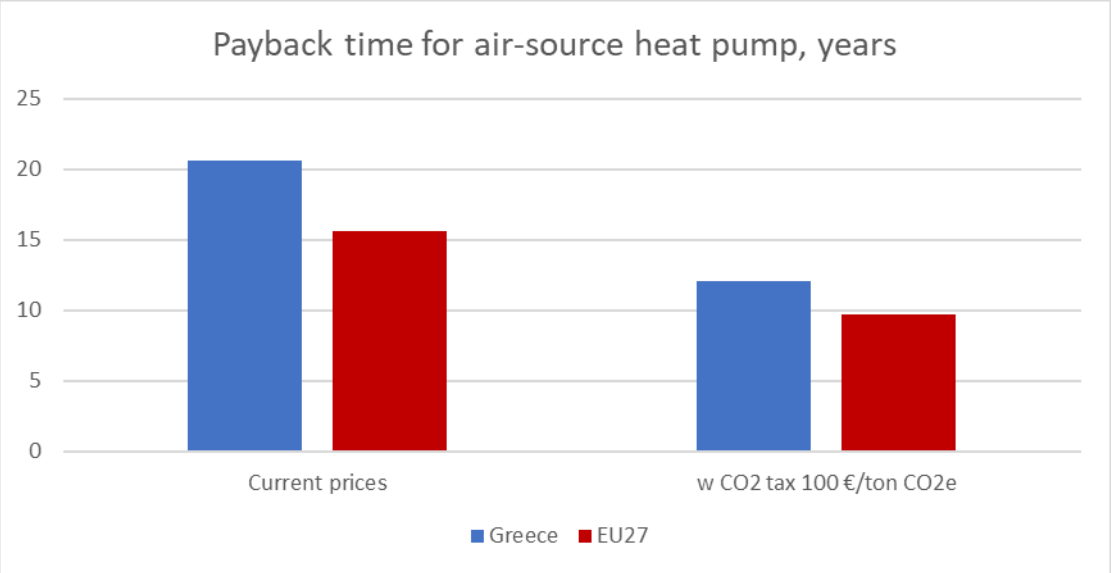
GREECE

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Grant	1.500 €	1.000 €	560 €/year
Air-water heat pump	Grant	6.000 €	4.000 €	500 €/year
Solar thermal system	Grant, tax reduction	3.000 €	2.000 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

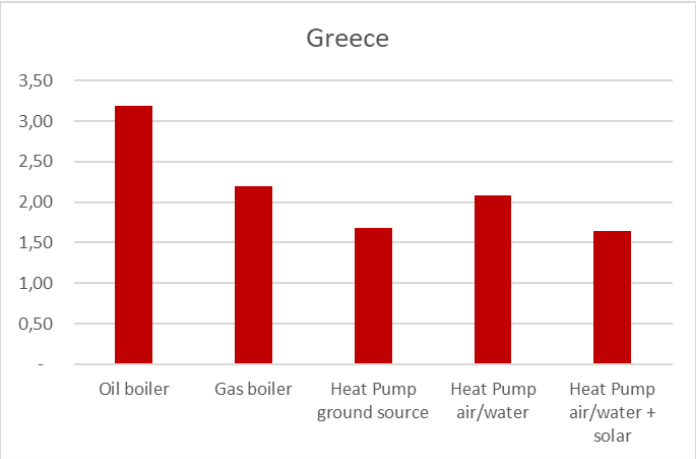
In Greece an additional subsidy of 2.560 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Greece amounts to about 200 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 1.560 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Greece still would amount to about 100 million €.

CO2e emissions from heating of an individual house



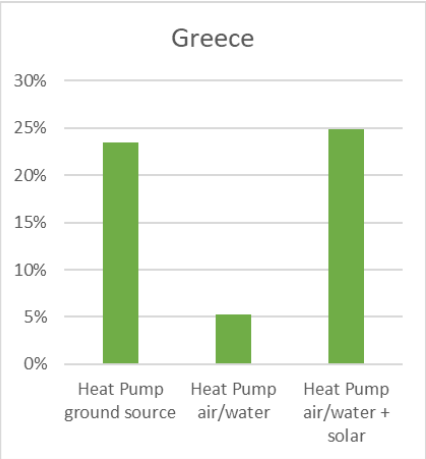


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

Energy Saving at Home II (*Εξοικονόμηση κατ' οίκον II*)

Type. Central government grant scheme for fossil and RES heating systems.
Description: The national Programme *Energy Saving at Home II* (*Εξοικονόμηση κατ' οίκον II*). The program aims to improve the energy performance of residential buildings through the provision of interest-free loans and subsidies (60%, 65% or 70%, depending on the family income, the number of children, etc.). The program remains open until the funds run out, the deadline for programme "round B" is 31 12 2021. The programme grants the upgrading of the heating/cooling systems, including both the replacement with heating systems powered by fossil fuel (oil/natural gas/liquefied petroleum gas) and by renewable sources (biomass and heat pumps).
Amount: The subside covers up to 70% of the costs, depending on the family income, the number of children, etc. The maximum amount is 25.000 € per apartment. The maximum amounts, by category of intervention, are: oil condensing boilers (up to 34 kW) € 6.400, methane and LPG € 3.500; for geothermal heat pumps up to 12 kW € 6.100; for cogenerators up to 20 kW € 6.900; for biomass € 2.000; for air / air heat pumps € 2.000; for solar thermal € 10.000. There are higher amounts for larger heating systems.

Source: https://exoikonomisi.ypen.gr/to-programma
https://exoikonomisi.ypen.gr/documents/10182/146747/%CE%9F%CE%94%CE%97%CE%93%CE%9F%CE%A3+%CE%95%CE%9E%CE%9F%CE%99%CE%9A_II_2018_7%CE%B7+%CE%A4%CE%A1%CE%9F%CE%A0+final.pdf/03e26765-2b06-4033-a1a9-454c6da3d429

Tax regulation mechanism

Type. Central government tax reduction scheme for RES heating systems.
Description. According to the Tax regulation mechanism (Law No. 2238/1994) it is possible to benefit from 10% of the project costs, that may be deduced from taxable income (up to a maximum of € 3.000) for interventions to install renewable heating technologies. This mechanism is mainly used for solar thermal.
Amount. 10% of the costs up to a maximum of € 3.000 – link

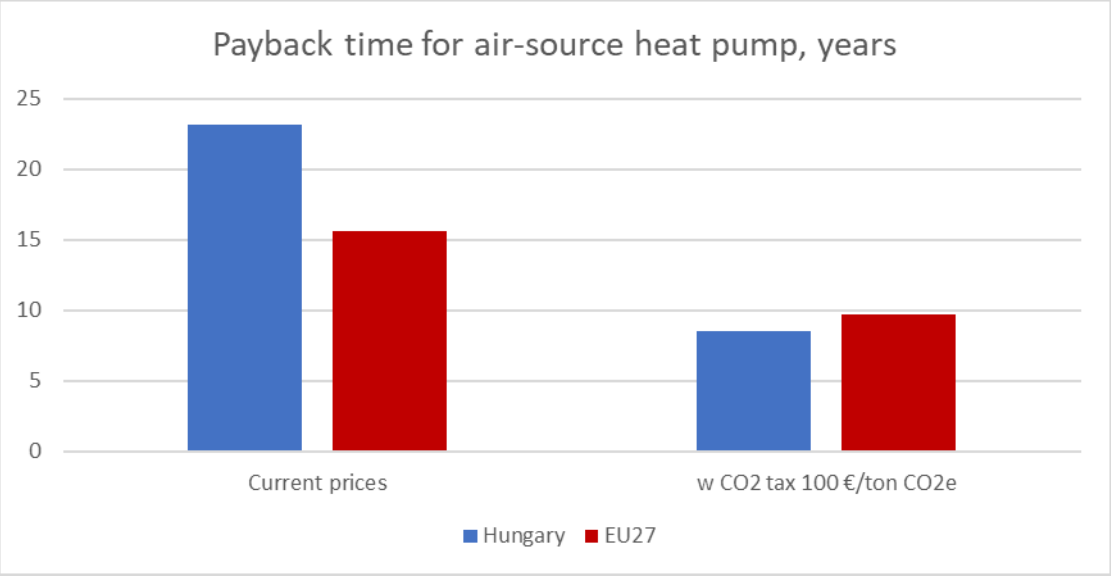
HUNGARY

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Grant	1.250 €	1.250 €	570 €/year
Air-water heat pump	Grant	5.000 €	5.000 €	490 €/year
Solar thermal system	Grant	2.500 €	2.500 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

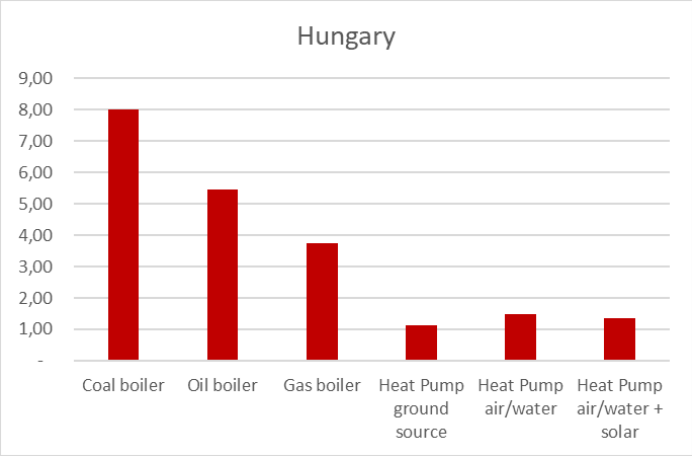
In Hungary an additional subsidy of 3.400 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Hungary amounts to about 4.700 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 670 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Hungary would amount to about 900 million €.

CO2e emissions from heating of an individual house



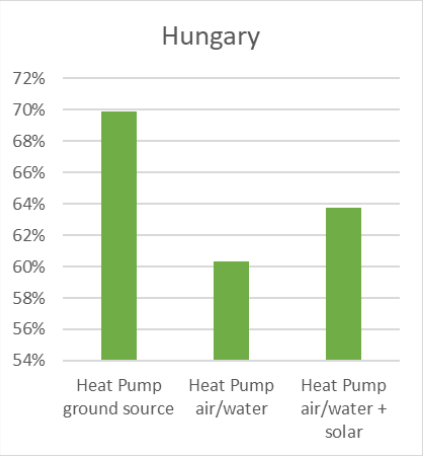


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

Home Renovation Aid (OTTHONFELÚJÍTÁSI TÁMOGATÁS)

Type. Central government grant scheme for RES heating systems.
Description. The program provides renovation aid for families with at least one child (or a planned one), Government Decree No 518/2020 (XI. 25.). The program is effective from January 1, 2021, to December 31, 2022. It supports a wide range of renovations, not only energy-efficiency-related ones. Installation, modernization, or replacement of heating systems are supported, this includes fossil fuels. Installation of solar hot water systems are also supported.

Amount. 50% of the invoiced renovation costs, up to a maximum of HUF 3 000 000.

Source.
http://www.allamkincstar.gov.hu/hu/lakossagi-ugyfelek/otthonfelujitasi_tamogatas_altalanos_tajekoztato
http://www.allamkincstar.gov.hu/files/Lakoss%C3%A1gi%20%C3%BCgyfelek/Otthonfel%C3%BAj%C3%ADt%C3%A1si%20t%C3%A1mogat%C3%A1s/518_2020_korm_rendelet_20210421.pdf

Housing Green Capital Requirement Discount (Zöld Tőkekövetelmény-kedvezmény Program)

Type. Central government soft loan scheme for RES heating systems.
Description. The program promotes with subsidized financing various interventions in the field of efficiency, including change of heating systems (includes gas boilers), installation of solar panel or solar collector; installation of geothermal, air-water, air-to-air heat pump; installation of wind turbine; installation of heat and electricity storage units; thermal insulation of building envelopes. The program runs till 2024.
Amount: the amount of the discount is 5% for the energy quality classification "BB", 7% for the energy quality classification "AA" or higher, 5% for modernization interventions. Minimum level of green interest subsidy is 0.3%.

Source: https://www.mnb.hu/sajtoszoba/sajtokozlemenyek/2020-evi-sajtokozlemenyek/konnyites-hatarido-hosszabbitas-a-lakascelu-zold-tokekovetelmeny-kedvezmeny-programnal

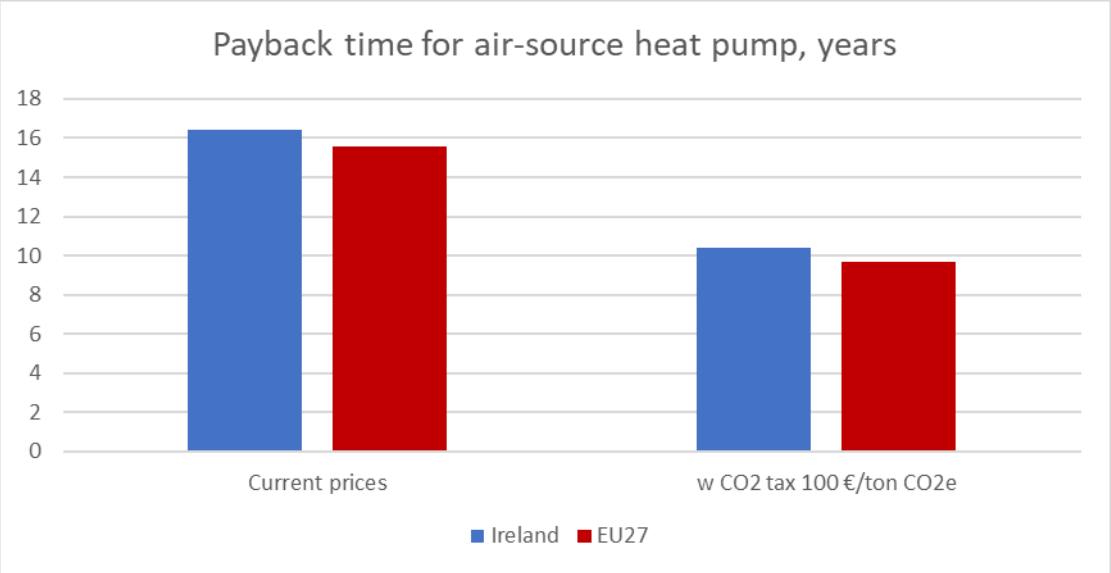
https://www.mnb.hu/letoltes/tajekoztato-zold-kedvezmeny-2020-julius.pdf

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler		€	2.500 €	820 €/year
Air-water heat pump	Grant	3.500 €	6.500 €	620 €/year
Solar thermal system	Grant	1.200 €	3.800 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In Ireland an additional subsidy of 3.570 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Ireland amounts to about 1.400 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 1.890 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Ireland would amount to about 700 million €.

CO2e emissions from heating of an individual house

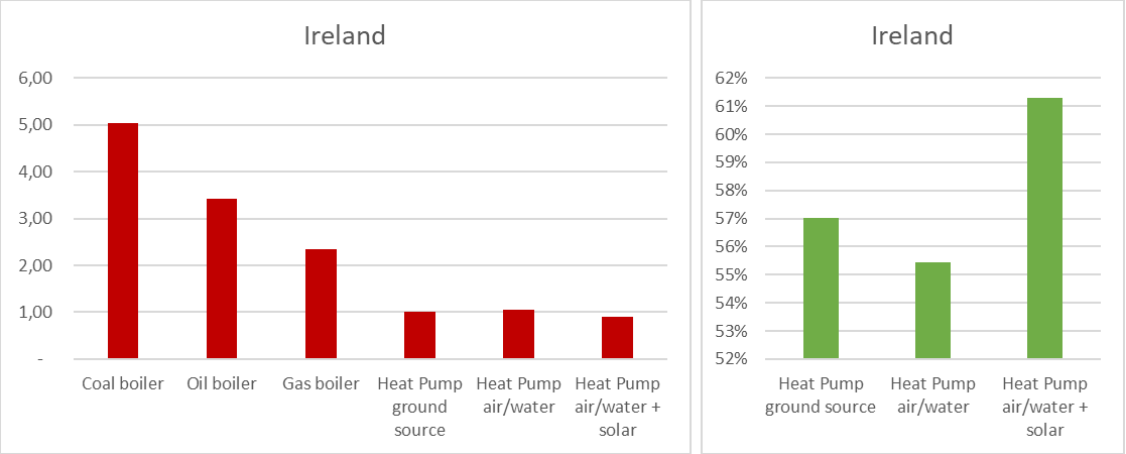


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

The Irish government will ban oil boilers in new building from 2022 and gas boilers in 2025.

Support Schemes for households' heating

Home energy grants: Heat pumps grant and Solar Water Heating grant

Type. Central government grant scheme for RES heating systems.
Description: Sustainable Energy Authority of Ireland (SEAI) provides a wide range of grants to upgrade homes, in order to make them warmer and more energy efficient.
Amount: for Air to Water, Ground Source to Water, Exhaust Air to Water and Water to Water Heat Pumps € 3.500; for Air to Air Heat Pumps € 600. For the Solar Water Heating the amount 1.200 €. If three different upgrades are completed the grant value will be increased by €300. If four the value will be increased by an additional €100.

Source: https://www.seai.ie/grants/home-energy-grants/
https://www.seai.ie/grants/home-energy-grants/heat-pump-systems/
https://www.seai.ie/grants/home-energy-grants/solar-water-heating-grant/

National Home Retrofit Scheme

Type. Central government grant scheme for RES heating systems.
Description: **Description**: This scheme is aimed at engaging groups of private households, registered Housing Associations and Local Authorities and Energy Utilities or other organisations who wish to participate in delivering a "One Stop Shop" type service for energy efficiency works. The programme promotes also heat pump technology, solar PV and solar water heating. This grant is not open to individual homeowners.
Amount: 35% for privates. Maximum grant amount available is €2 million. Applicants must consider grant for at least €100,000.

Source: https://www.seai.ie/grants/national-home-retrofit/

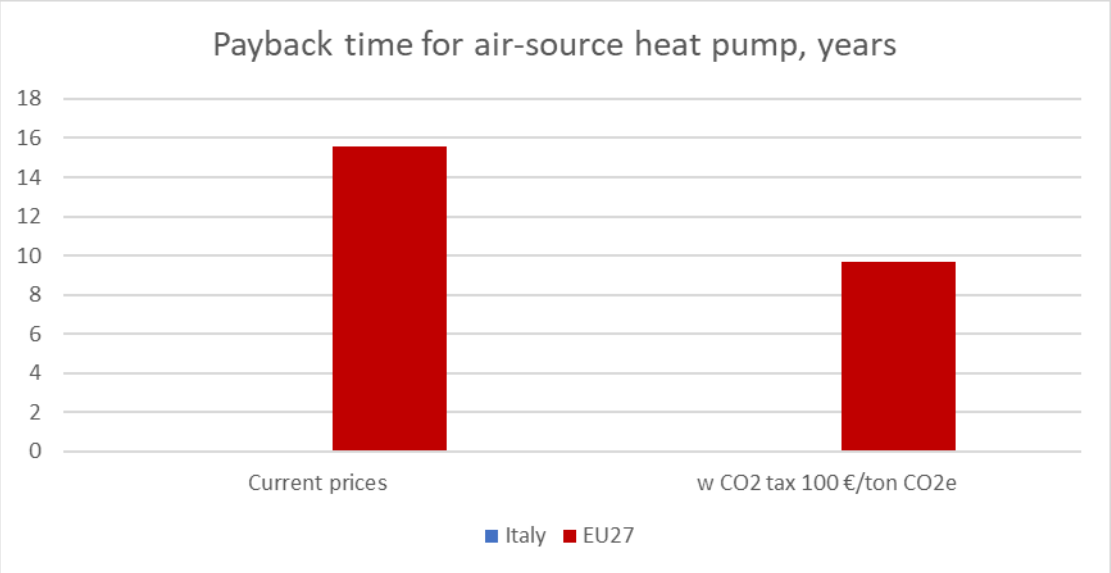
ITALY

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Tax rebate	2.500 €	0 €	1200 €/year
Air-water heat pump	Tax rebate	10.000 €	0 €	750 €/year
Solar thermal system	Tax rebate	5.000 €	0 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies

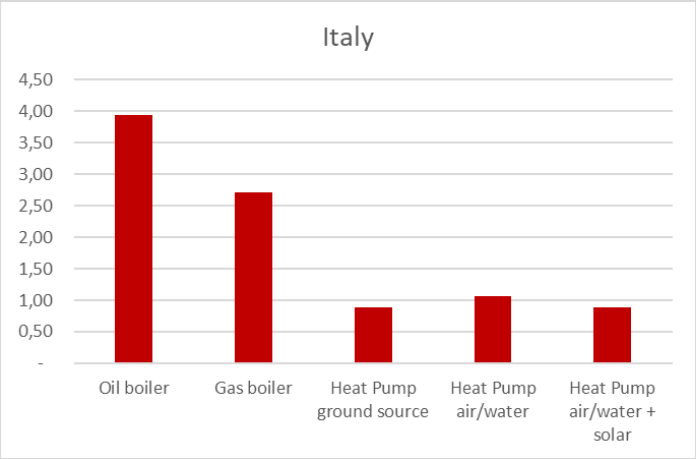


The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In Italy it is possible to receive up to 100% funding, so the simple payback time is 0 years, and there is no need for an additional subsidy.

CO2e emissions from heating of an individual house



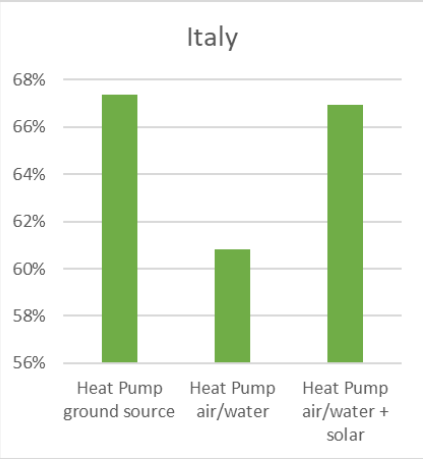


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

The Italian government has set 2050 as the phase out date for all fossil technologies in heating.

Support Schemes for households' heating

"Superbonus"

Type. Central government tax reduction scheme for fossil and RES heating systems.
Description. The so-called law Decreto Rilancio (Relaunch Decree), in the context of urgent measures regarding health, support for work and the economy, as well as social policies related to the epidemiological emergency from Covid-19, increased the deduction rate for expenses incurred to 110% from 1 July 2020 to 30 June 2022, for the "driving" interventions: 1) insulation of over 25% of the external walls surface; 2) replacement of the heating system with a more efficient one, i.e. with heat pumps, condensing boilers, hybrid appliances (integrated heat pump with condensing boiler), micro-cogeneration, solar thermal, biomass boilers (but only in specific cases); 3) seismic risk reduction. If combined with these interventions, also other specific interventions in the field of energy efficiency are subsidised: installation of photovoltaic systems, infrastructure for charging electric vehicles in buildings, efficient windows, shadowing systems, building automation, etc. The energy class must be improved by minimum two (e.g. D to B) – so Ecobonus is the interesting scheme, when it is only the heating plant that is changed. The tax rebate can also become a discount at the point of sale, but several conditions apply.
Amount: tax deduction of 110% of the expenses incurred. Maximum amount: heat pumps € 15.000, 20.000 or 30.000, depending on the kind of the house; condensing heat generators 30.000 €; micro-cogeneration 30.000 €; solar thermal 60.000 €; biomass boilers 30.000 €.

Source: https://www.informazionefiscale.it/ecobonus-2021-detrazione-fiscale-110-65-50-spese-ammesse-limiti-requisiti
https://www.agenziaentrate.gov.it/portale/documents/20143/233439/Guida_Superbonus110__.pdf/49b34dd3-429e-6891-4af4-c0f0b9f2be69

https://www.agenziaentrate.gov.it/portale/superbonus-110%25

"Ecobonus"

Type. Central government tax reduction scheme for fossil and RES heating systems.

Description. Tax deduction program with a value ranging from 50% to 75% (or to 85% in case of interventions combined with anti-seismic intervention) of the incurred costs for various efficiency measures, including condensing boilers, heat pumps, micro-cogeneration, biomass, solar thermal. The tax rebate can also become a discount at the point of sale, but several conditions apply.
Amount: heat pumps 65% of the expenses, with a maximum ceiling of 30.000 €; condensing heat generators 50% (for individual houses) or 65%, maximum 30.000 €; solar thermal 65%, 100.000 €; biomass boilers 50%, 30.000 €.

Source: https://www.informazionefiscale.it/ecobonus-2021-detrazione-fiscale-110-65-50-spese-ammesse-limiti-requisiti
https://www.agenziaentrate.gov.it/portale/documents/20143/233439/Agevolazioni+fiscali+per+risparmio+energetico+it_Guida_Agevolazioni_Risparmio_Energetico.pdf/364ab72b-b873-c28e-1e75-0ebbf0cdd7a5

Renovation Bonus "Bonus Ristrutturazioni"

Type. Central government tax reduction scheme for fossil and RES heating systems.
Description. Tax deductions for simple houses renovations, which however includes energy saving interventions, including photovoltaics and RES or fossil heating systems.

Amount: tax deduction of 50% of the expenses incurred. Maximum amount: 96.000 €.

Source: https://www.informazionefiscale.it/bonus-ristrutturazioni-2021-novita-come-funziona-lavori-ammessi-beneficiari
https://www.agenziaentrate.gov.it/portale/documents/20143/233439/Guida_Ristrutturazioni_edilizie08092019.pdf/3a3c355b-249d-358a-ae69-a22cff87838b

VAT reduction (IVA agevolata)

Type. Central government tax reduction (VAT) scheme for fossil and RES heating systems.
Description. Discounted VAT at 10% instead of 22% on RES. The reduced VAT is also for condensing boilers (but only for part of the costs).
Amount: the reduced VAT rate is 10%. Standard VAT rate is 22%.

Conto Termico

Type. Central government grant scheme for fossil and RES heating systems.
Description. Conto Termico is a subsidy dedicated to interventions for increasing the energy efficiency and the production of thermal energy from renewable sources. The beneficiaries are mainly public administrations, but also companies and individuals. The scheme is funded with 900 million euros per year, of which 200 are destined to public administrations. Thanks to the programme it is possible to refurbish buildings to improve their energy performance, thus reducing consumption costs and quickly recovering part of the costs incurred. The programme promotes heat pumps (also hybrid and water heater heat pumps), biomass boilers, biomass stoves and Solar Thermal.
Amount: the grant depends on many factors and can reach 40% of the costs incurred.

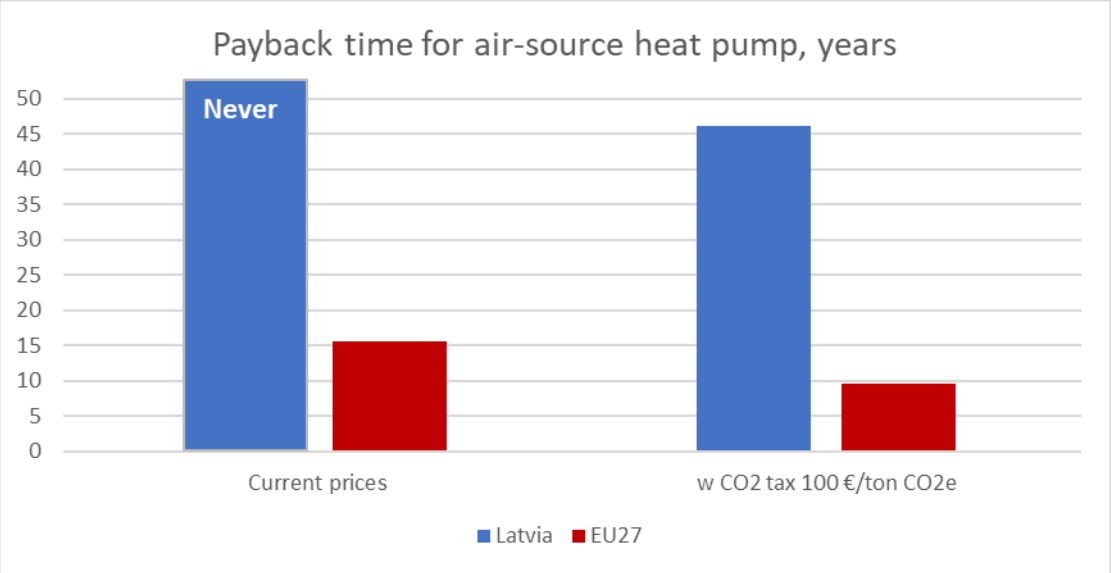
Source: https://www.gse.it/servizi-per-te/efficienza-energetica/conto-termico

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	(Loans)	0 €	2.500 €	530 €/year
Air-water heat pump	(Loans)	0 €	10.000 €	850 €/year
Solar thermal system	(Loans)	0 €	5.000 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

Since fuel costs are cheaper for a gas boiler than a heat pump, the investment will never be paid back.

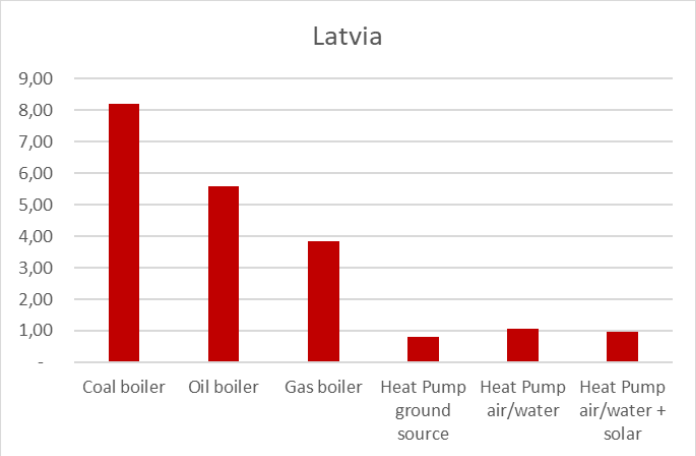
In Latvia an additional subsidy of 10.000 € is needed for the considered average household, since the household cannot pay back the investment by fuel savings with current prices.

The total additional cost to substitute all gas boilers in Latvia amounts to about 300 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 8.400 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Latvia still would amount to about 250 million €.

CO2e emissions from heating of an individual house



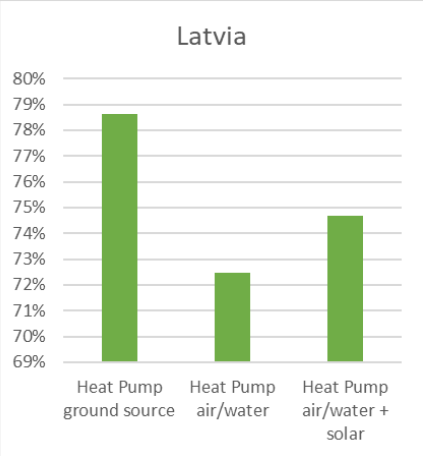


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

Support for energy renovation of houses

Type. Central government soft loans and grants scheme for fossil and RES heating systems.
Description. The Council of Ministers approved a family support program by December 2020. It provides for the provision of portfolio guarantees for commercial bank loans for the implementation of energy efficiency improvement measures for private homes. The program will also promote: the purchase and installation of a new boiler. Due to the scarce resources available, the program is expected to provide an average of only 500 loans per year for the implementation of energy efficiency measures in the private housing sector. There is also a grant scheme available for families with minimum 3 kids or residing outside Riga/Jurmala regions; if there is minimum 20% reduction in energy consumption, and minimum energy class C is reached after the renovation. The grant will be available for only 240 houses per year.

Amount. The guarantee rate will be up to 30% of the loan amount, not exceeding € 20.000. The grant will be € 5,000.

Source: https://www.em.gov.lv/lv/pirmo-reizi-privatmaju-ipasniekiem-bus-pieejams-atbalsts-maju-atjaunosanai-un-energoefektivitates-uzlabosanai

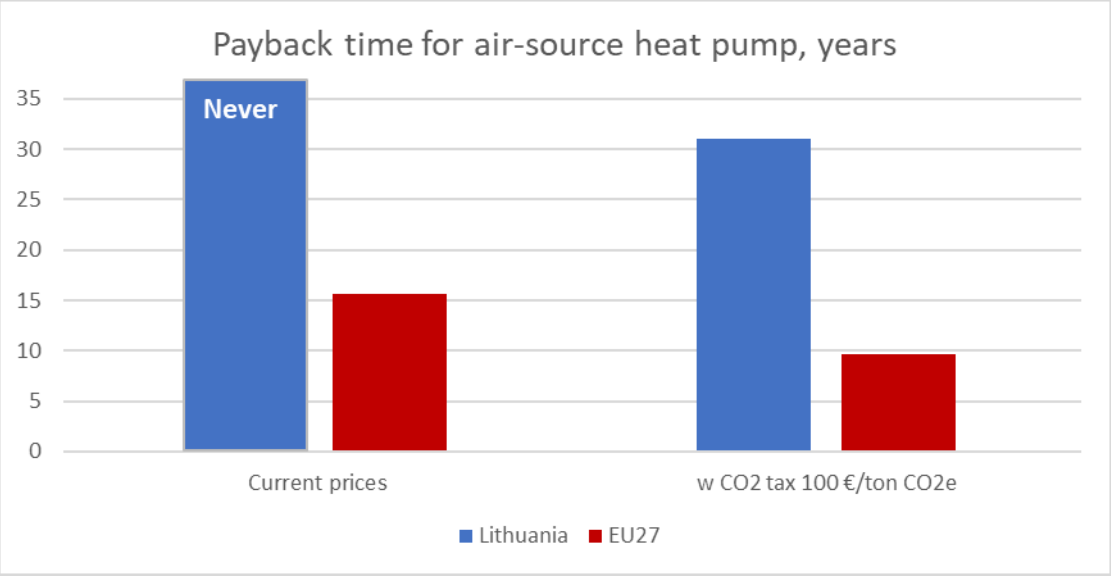
New programmes will be available in 2022.

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler		0 €	2.500 €	440 €/year
Air-water heat pump		0 €	10.000 €	560 €/year
Solar thermal system		0 €	5.000 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

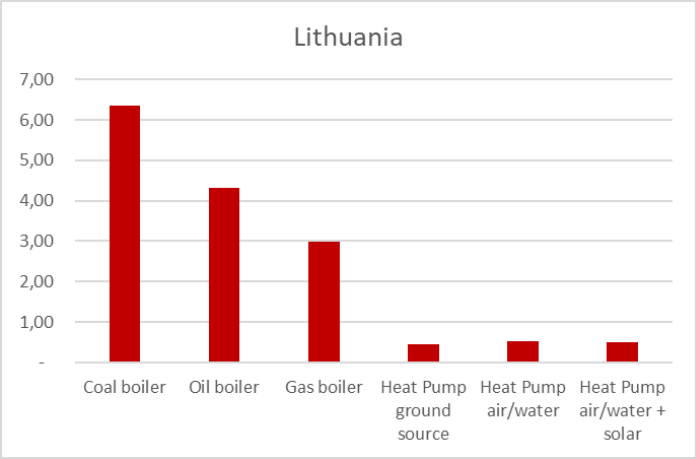
The payback time refers to the net investment after subsidies (upfront cost).

Since fuel costs are cheaper for a gas boiler than a heat pump, the investment will never be paid back.

In Lithuania an additional subsidy of 10.000 € is needed for the considered average household, since the household cannot pay back the investment by fuel savings with current prices.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 7.610 € would be needed for the considered average household to pay back the investment in 8 years.

CO2e emissions from heating of an individual house



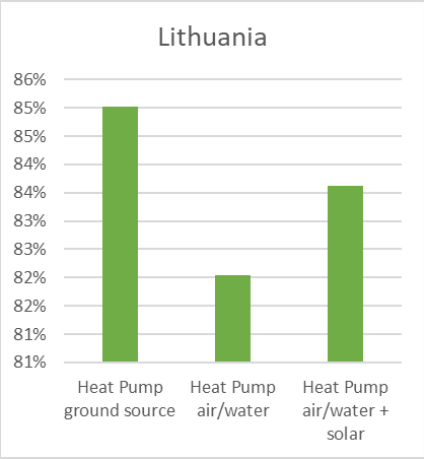


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

Boiler replacement in households "Katilų keitimas namų ūkiuose" – CLOSED for applications

Type. Central government grant scheme for RES heating systems.
Description.The *Katilų keitimas namų ūkiuose* incentive is dedicated to the households to replace old inefficient biomass boilers with efficient biomass (biofuel) boilers or with heat pumps (geothermal, aerothermal or hydrothermal). The subsidy covers 50% of the expenses incurred. The program budget is around 15 million euros. The call was open for applications between March 31 and April 30, 2021. The Call, which is part of Measure 04.3.2-LVPA-V-111 Priority 4 "Promotion of energy efficiency and production of energy from renewable sources" of the Operational Programme for EU Structural Funds Investments for 2014-2020, is managed by the Environmental Project Management Agency under the Ministry of Environment of the Republic of Lithuania (Aplinkos projektų valdymo agentūra). There are no new calls planned.
Amount: 50% of costs eligible for support.

Source: https://www.apva.lt/katilu-keitimas-namu-ukiuose/
https://www.apva.lt/en/ongoing-projects/

Programme of modernisation of multifamily houses Daugiabučių namų atnaujinimo (modernizavimo) programa

Type. Central government tax scheme for refurbishing.
Description. Flat owners, who participate in the programme and modernise their buildings, are eligible for 30% rebate of total renovation costs, concrete percentages depending on a set of implemented improvements. Recently new legislation in this area have broadened scope of renovation – from the so called engineering or small renovation, which includes heat substation, hot water piping, sewage system, thermostatic valves on radiators, heat cost allocators on radiators to a full package of measures including thermal insulation of the building envelope, windows replacement and others. The programme is leaded by the Housing energy efficiency agency (BETA Būsto energijos taupymo agentūra).
Amount: 30% rebate of total renovation costs.

Sourcehttp://www.betalt.lt/veiklos-sritys/programos/daugiabuciu-namu-atnaujinimo-modernizavimo-programa/102/?c-45/t-105

Climate Change Programme

Type. Central government grant scheme for RES heating systems
Description. Support for use of renewables in private and public sector. Subsidizes solar heating, heat pumps, replacement of fossil fuel boilers with biofuel, etc. Applications are accepted from June 21 till December 31, 2021, or until funding is used. Total amount of fund is only €1 mill. For the private sector. The programme is only for private legal entities and not for households. **Amount.** Maximum subsidy 30%.

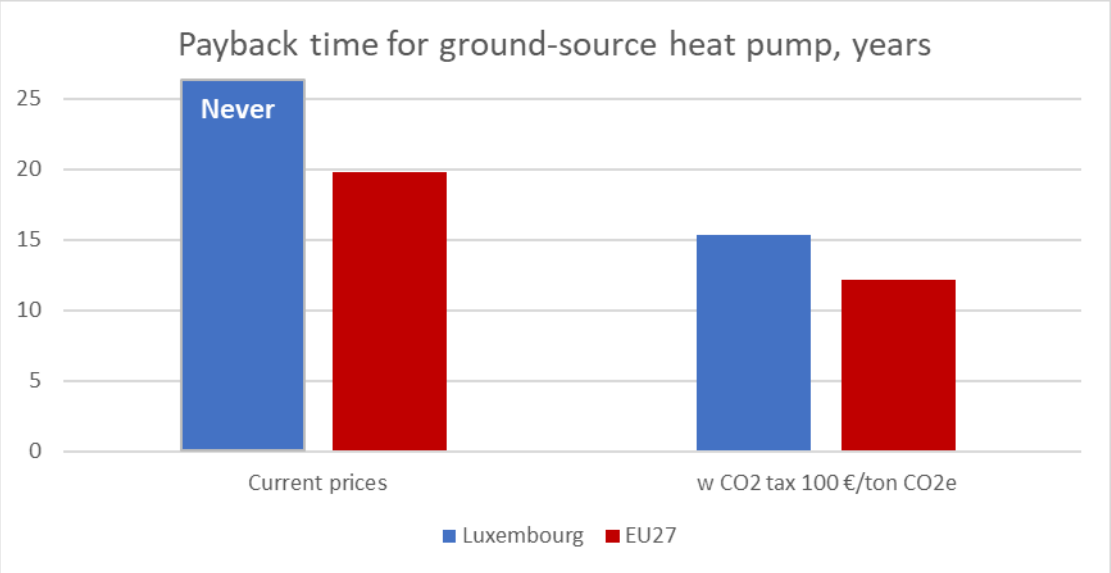
Source:.https://www.apva.lt/en/national-investments/climate-change-program/

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler		0 €	2.500 €	680 €/year
Ground source heat p	Grant	6.500 €	6.500 €	860 €/year
Solar thermal system	Grant	2.500 €	2.500 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new ground source heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

Since fuel costs are cheaper for a gas boiler than a heat pump, the investment will never be paid back.

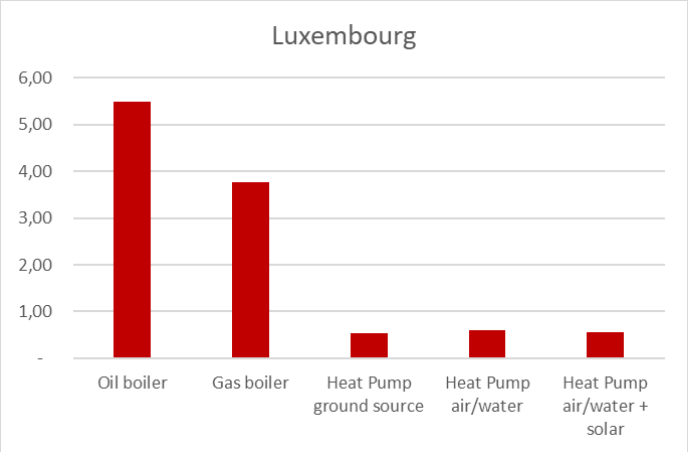
In Luxembourg an additional subsidy of 6.500 € is needed for the considered average household, since the household cannot pay back the investment by fuel savings with current prices.

The total additional cost to substitute all gas boilers in Luxembourg amounts to about 400 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 3.370 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Luxembourg would amount to about 200 million €.

CO2e emissions from heating of an individual house



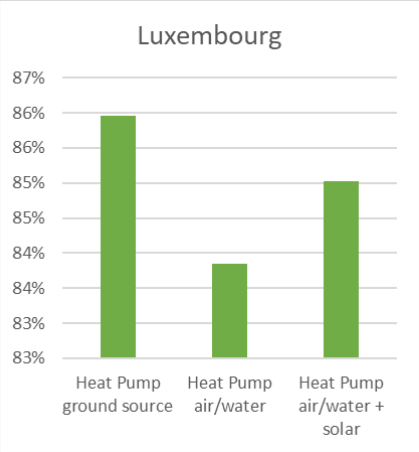


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

In Luxembourg a ban on both oil and gas boilers in new buildings will be in place from 2023.

Support Schemes for households' heating

PRIMe House 2017

Type. Central government grant scheme for RES heating systems.
Description. The Ministry of the Environment (Ministère de l'Environnement) grants subsidies for investment projects undertaken to improve the long-term sustainability of a residential building; implement technical installations making use of renewable energy sources (solar thermal systems; solar photovoltaic systems; heat pumps; wood-fuelled boilers; implementation of a heat network and/or connection to a heat network). The PRIMe House 2017 scheme also applies to the construction of new sustainable dwellings, and for which the building permit is applied for between 1 January 2017 and 31 December 2021.
Amount: solar thermal system for production of domestic hot water 50% of actual costs (maximum € 2.500); solar thermal systems with auxiliary heating 50 % of actual costs (max € 4.000); Geothermal heat pump (geothermal probes, geothermal collector or latent heat accumulator systems with solar thermal collector) 50% of actual costs (max € 8.000 for an individual house and 6.000 per housing unit for a multi-unit building); Air-water heat pump 25% of actual costs (max € 2.500, only for near zero single family houses); compact device including controlled mechanical ventilation and recycled air/water heat pump (only for near-zero energy single-family houses) 25% of actual costs (max € 2.500); Wood pellet or wood chip boiler 40% of actual costs (max € 5.000 for an individual house and 4.000 per housing unit for a multi-unit building); wood pellet stove (connected to the heating network) 30% of actual costs (max € 2.500); log boiler or combination log/pellet boiler 25% of actual costs (max € 2.500 for a detached or a semi-detached house). Installation of a buffer tank with a capacity of 30 l/kW (wood pellet or wood chip boiler).

Source: https://guichet.public.lu/en/citoyens/logement/construction/performances-energie/aide-financiere-logement-durable-2017.html
https://guichet.public.lu/en/citoyens/logement/renovation-transformation/performances-energie/aide-installations-techniques-regime-2017.html

Zero-interest "KlimaPrêt" climate loan and Low-interest "KlimaPrêt" climate loan

Type. Central government soft loans scheme for refurbishing.

Description. *KlimaPrêt* climate loans aim to promote sustainable renovation of dwellings that are over 10 years old by prefinancing the renovation work. These climate loans contribute not only to responsible energy consumption and environmental protection, but also to lowering energy costs, and increasing the comfort and value of the dwelling.

Amount for the Zero-interest: The beneficiary of the zero-interest climate loan must pay back only the capital of the loan, in the amount of no more than EUR 50,000, over 15 years maximum. The Ministry of Housing also offers a one-time capital grant, equal to 10% of the main loan (capped at EUR 5,000), so as to reduce the overall amount that is to be paid back.

Amount for the Low-interest: Low-interest climate loans are limited to a main amount of EUR 100,000 per building over a duration of 15 years. The Government awards an interest subsidy of up to 1.5% and equal to no more than 10% of the main amount (i.e. maximum EUR 10,000). The interest rate of the subsidy can by no means be higher than the actual interest rate of the loan.

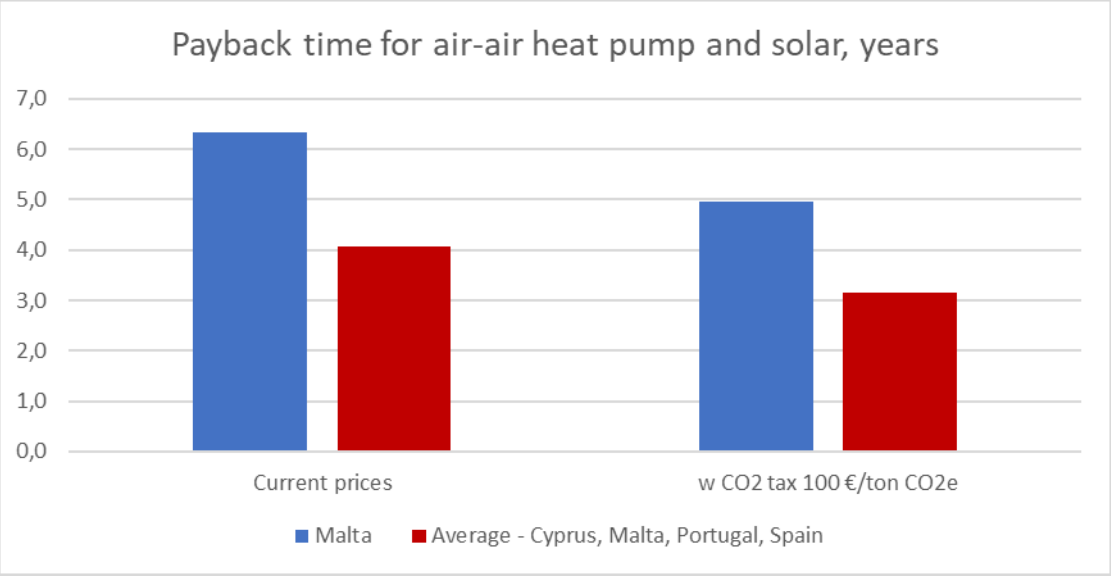
Sources:https://guichet.public.lu/en/citoyens/logement/renovation-transformation/prets-climatiques/pret-climatique-taux-zero.html
https://guichet.public.lu/en/citoyens/logement/renovation-transformation/prets-climatiques/pret-climatique-taux-reduit.html

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Oil boiler		0 €	3.500 €	410 €/year
Air-air heat pump		0 €	1.500 €	20 €/year
Solar thermal system	Grant	1.400 €	1.300 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old oil boiler with a new air-air heat pump and solar thermal. For Spain it is an old gas boiler that is substituted.

The payback time refers to the net investment after subsidies (upfront cost).

In Malta there is no need for an additional subsidy for the considered average household to pay back the investment in 8 years.

CO2e emissions from heating of an individual house

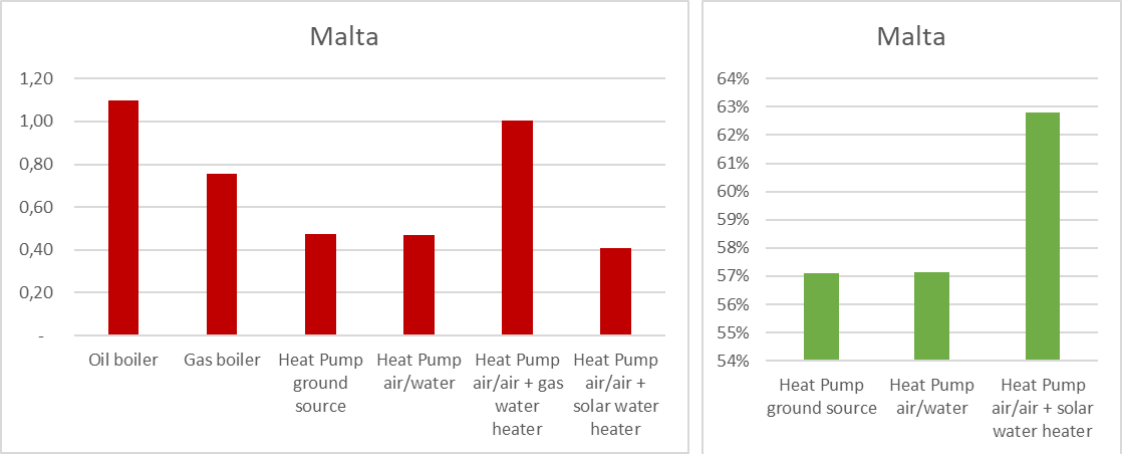


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to oil

The comparison is made with an oil boilers because this is the most common fossil heating system in place in Malta.

Support Schemes for households' heating

Solar Water Heater Scheme

Type. Central government grant scheme for RES heating systems.
Description. The Solar Water Heaters scheme is administered by the Regulator for Energy and Water Services to encourage the use of energy efficient equipment in the domestic sector. This scheme is funded through national funds and applies to private individuals (natural persons) for use in their residential properties, and for organisations that are not carrying out an economic activity. This scheme was launched by means of Government Notice GN539 of 2021 as amended by GN776 of 2021 and is valid until December 31, 2021.
Amount: This scheme provides a grant of 50% of the eligible costs up to €700 for a basic solar heating system and up to €1,400 for a premium type, exceeding 100-litre capacity (max. 75% of costs). Another supplementary fund of up to €500 is allocated for general maintenance of the solar heater over its lifetime. Eligible expenditure includes the purchase of a Solar Water Heater or Collector including VAT and its maintenance over the years.

Source:https://rews.org.mt/#/en/sdgr/465-2021-solar-water-heater-scheme
https://www.energywateragency.gov.mt/news/new-solar-water-heaters-and-heat-pumps-schemes-launched/

Heat Pump Scheme

Type. Central government grant scheme for RES heating systems.
Description. The Heat Pump Water Heater scheme is administered by the Regulator for Energy and Water Services to encourage the use of energy efficient equipment in the domestic sector. This scheme is funded through national funds and applies to private individuals (natural persons) for use on their residential properties, and for organisations that are not carrying out an economic activity. This scheme launched by means of Government Notice 538 of 2021 is valid until December 31, 2021, or until funds are exhausted.

Amount: This scheme provides a grant of 50% of the eligible costs up to €1,000. Eligible expenditure includes the purchase of a heat pump water heater including VAT.

Source: https://www.rews.org.mt/#/en/sdgr/466-2021-heat-pump-water-heater-scheme

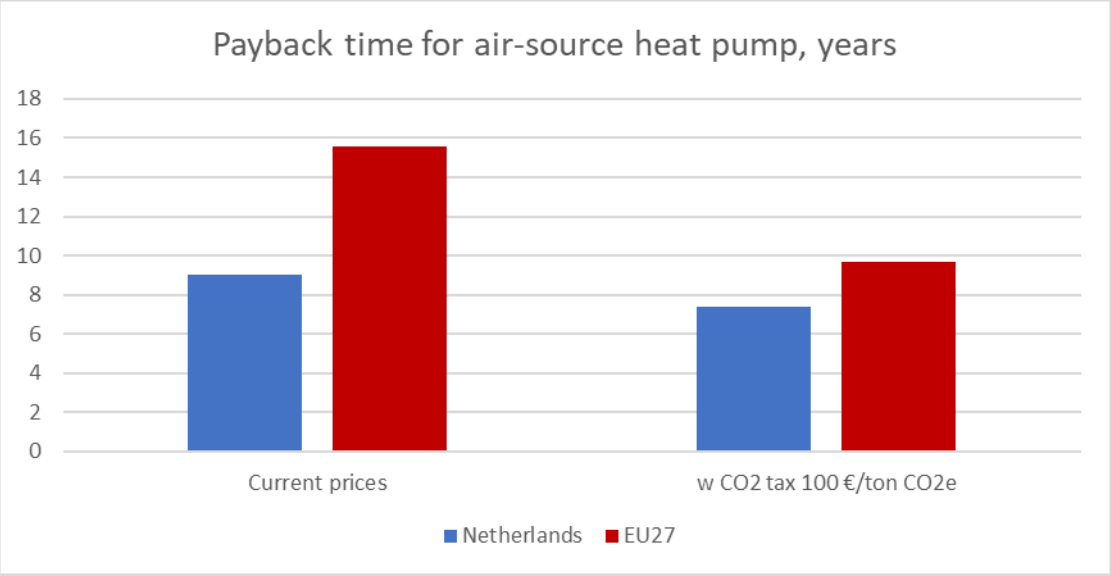
NETHERLANDS

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler		0 €	2.500 €	1150 €/year
Air-water heat pump	Grant	2.200 €	7.800 €	560 €/year
Solar thermal system	Grant	1.000 €	4.000 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

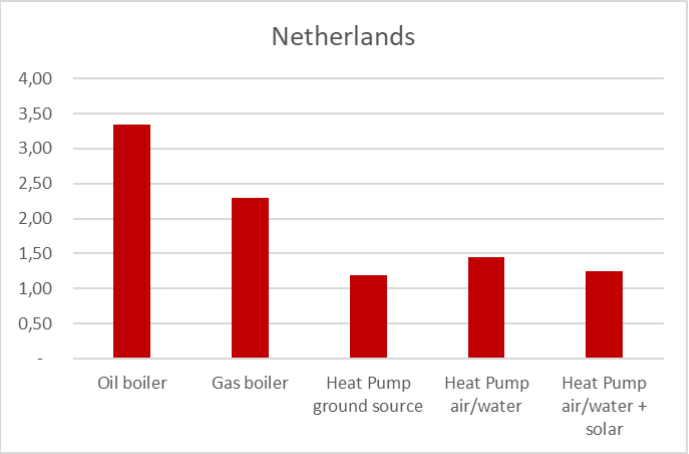
The payback time refers to the net investment after subsidies (upfront cost).

In the Netherlands an additional subsidy of 1.430 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in the Netherlands amounts to about 7.900 million €.

If a carbon price of € 100 per ton CO_2 was introduced, there would be no need for an additional subsidy.

CO2e emissions from heating of an individual house



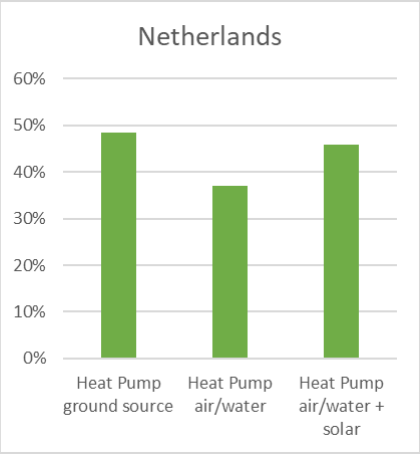


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

The Dutch government has removed in 2018 the obligation for gas distributors to connect new buildings. This has led to a *de facto* ban on gas boilers in new buildings.

Support Schemes for households' heating

Sustainable energy investment subsidy scheme (Subsidie duurzame energie voor particulieren ISDE)

Type. Central government grant scheme for RES heating systems.
Description. The Sustainable energy investment subsidy (ISDE) is dedicated to heat pumps, solar boilers, connection to district heating and thermal insulation. This will reimburse part of the costs after purchasing the device. Heat pumps up to 70 kW are promoted. The heater has to be equipped with an air-to-water heat pump, a groundwater heat pump or a water-to-water heat pump. Solar water heaters, with a total opening area of up to 200 m^2, are also promoted. The solar boiler is intended for the production of domestic hot water or for heating a room in combination with the production of domestic hot water.
Amount: For the heat pumps the subsidy is €500 for heat pumps smaller than 1 KW. For an air-water heat pump larger than 1kW the subsidy is € 1,100 +100 €/kW; for water-water and ground source heat pumps the subsidy is € 2.500 for heat pumps between 1 and 10 kW (+100 €/kW for larger heat pumps). There is a premium of €150 for A+ heat pumps, and €300 for A++ or higher. For the solar thermal up to 10 m^2, the subsidy amount is 0.68 € per kWh of annual production. For a 4 m^2 solar system the grant is about 1,000 €.

Source: https://www.rvo.nl/subsidie-en-financieringswijzer/isde/woningeigenaren
https://zoek.officielebekendmakingen.nl/stcrt-2020-65131.html

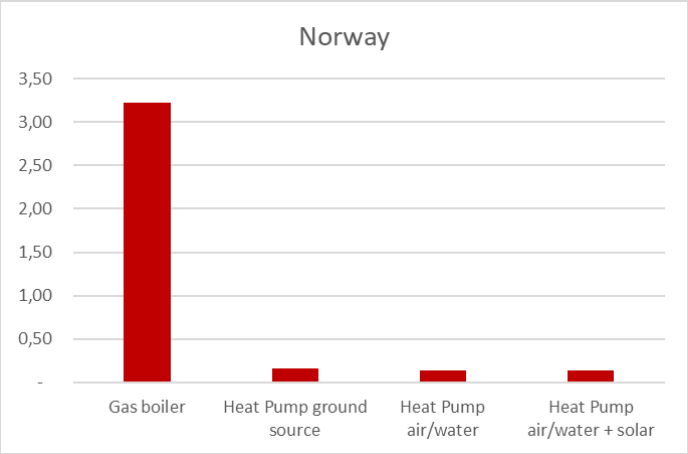
NORWAY

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Air-water heat pump		0 €	10.000 €	420 €/year
Solar thermal system	Grant	600 €	4.400 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

CO2e emissions from heating of an individual house



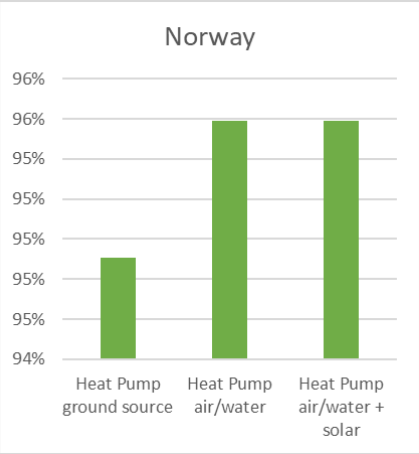


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

In 2020 the Norwegian government became the first in the world to ban the use of oil in heating in both new and existing boilers. Consumers had to replace their oil technologies by that year.

Support Schemes for households' heating

Enova Grant (Enovatilskuddet)

Type. Central government grant scheme for RES heating systems.
Description. Enova, the Norwegian government enterprise responsible for promotion of environmentally friendly production and consumption of energy, grants energy efficient and climate friendly technologies to owners of residential buildings. The program provides incentives for many technologies: thermal insulation, mechanical ventilation, photovoltaics as well as renewable energy plants for heat production. The subsidy scheme for installation of renewable heating systems in residential building was substantially reduced from 2020. Since January 2021 air-air heat pumps are no longer subsidized. Heat pumps for water borne systems are also mainstream and the incentive for air-to-water heat pumps was cancelled July 1, 2021.

Amount: 25% of costs, with following maximum: solar thermal NOK 5.000 more NOK 200 every m^2, up to NOK 10.000; liquid-water heat pumps, biomass stoves (but only with water jacket) and biomass boilers NOK 10.000. Also grants for change to water-borne heating system up to 10,000 NOK and accumulation tank up to 5,000 NOK.

Source: https://www.enova.no/privat/alle-energitiltak/

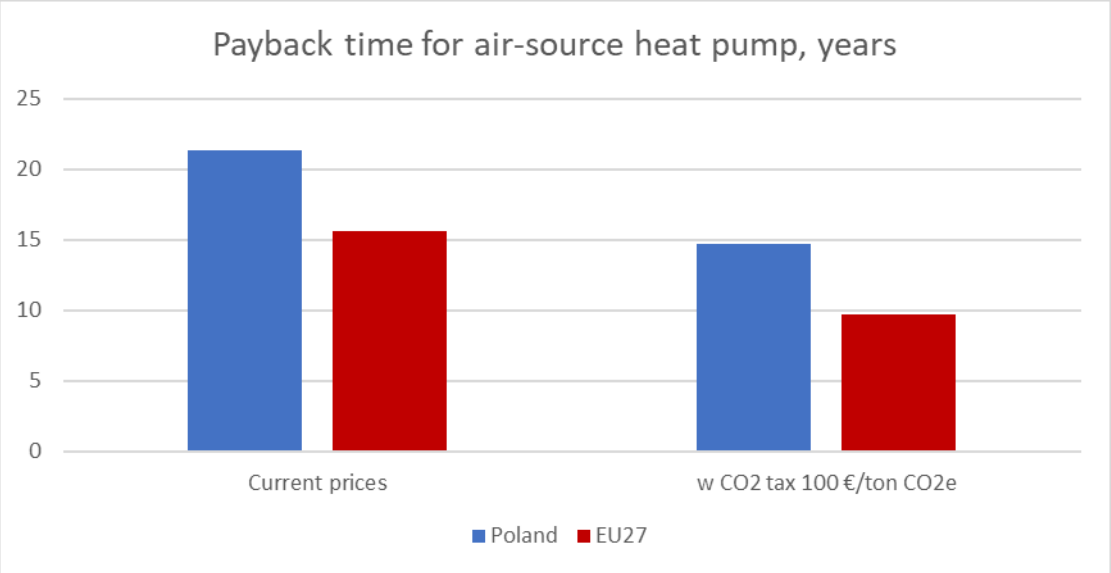
POLAND

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Grant	800 €	1.700 €	760 €/year
Air-water heat pump	Grant	3.000 €	7.000 €	610 €/year
Solar thermal system	Grant	1.000 €	4.000 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In Poland an additional subsidy of 4.600 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Poland amounts to about 3.300 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 3.500 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Romania would amount to about 2.500 million €.

CO2e emissions from heating of an individual house

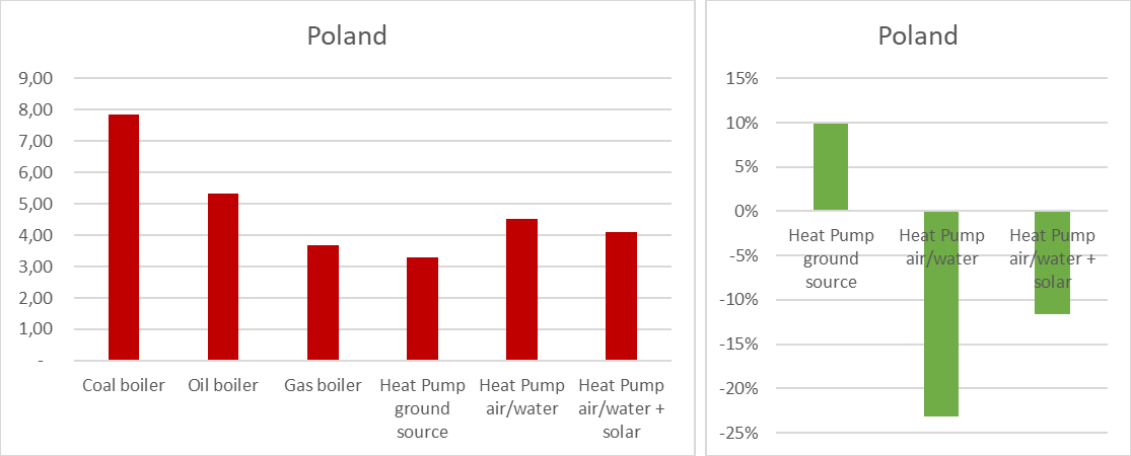


Fig A (left) CO2e-emissions in ton/year/household for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Poland's power generation has a high share of coal thus the CO2-emission is high. As a result, using air-water heat pumps has a higher CO2-emission than efficient gas boilers.

Support Schemes for households' heating

Clean Air Priority Program Subsidies (Program Czyste Powietrze - dofinansowania)

Type. Central government grant scheme for fossil and RES heating systems.
Description. The purpose of the program is to improve air quality and reduce greenhouse gas emissions by replacing heat sources and improving the energy efficiency of single-family residential buildings. It is the main scheme for this type of buildings. Beneficiaries are natural persons who are owners or co-owners of single-family residential buildings, with an annual income not exceeding PLN 100.000. The programme co-finance the replacement of old and ineffective solid fuel heat sources with efficient ones and other interventions. The programme runs till 2027.
Amount. The amount depends on the technologies: air/water heat pump: 30% of the cost, max PLN 9.000, or 60% and max 18.000 for low-income families; air/water heat pump (higher efficiency class): 45% of the cost, max PLN 13.500, or 60% and max 18.000 for low-income families; air/air heat pump: 30% of the cost, max PLN 3.000, or 60% and max 6.000 for low-income families; ground source heat pump: 45% of the cost, max PLN 20.250, or 60% and max 27.000 for low-income families; gas and oil condensation boiler: 30% of the cost, max PLN 4.500, or 60% and max 9.000 for low-income families; coal boilers (only until December 31, 2021): 30% of the cost, max PLN 3.000, or 60% and max 6.000 for low-income families; wood gasification and wood pellet boiler: 30% of the cost, max PLN 6.000, or 60% and max 12.000 for low-income families; wood pellet boiler (best standard): 45% of the cost, max PLN 9.000; electric heating: 30% of the cost, max PLN 3.000, or 60% and max 6.000 for low-income families; solar thermal: 30% of the cost, max PLN 4.500, or 60% and max 9.000 for low-income families. Max 30.000 PLN (37,000 low-income families) in total for projects.

Source: https://czystepowietrze.gov.pl/czyste-powietrze/

Clean Air Priority Program Stop Smog

Type. Central government grant scheme for fossil and RES heating systems.

Description. The program finances the replacement or liquidation of heat sources and thermal modernization in single-family residential buildings of energy poor people in heavily polluted areas. The program is intended for energy poor people who own or co-own single-family residential buildings. Scope of the Program is: the replacement or elimination of high-emission heat sources with low-emission ones; the thermomodernization of single-family residential buildings; the connection to the heating or gas network. The support is through municipalities, municipalites apply to the programme.
Amount: up to 80% of funding for investment costs from the state budget.

Source: https://czystepowietrze.gov.pl/stop-smog-2/

Clean Air Priority Program Thermomodernization relief (Program Czyste Powietrze - Ulga termomodernizacyjna)

Type. Central government tax reduction scheme for fossil and RES heating systems.
Description. The goal of the program is to improve energy efficiency and to reduce dust and other pollutant emissions to the atmosphere from existing single-family residential buildings or to avoid air pollution emissions from newly built single-family residential buildings. High subsidies are dedicated to furnace replacement and thermomodernization of single-family homes. Financial support covers: preparation of design documentation (modernization of the internal installation and replacement of the heat source, reconstruction of the roof for insulation), purchasing of equipment, installations (substation with temperature programmers, heat pumps, condensing gas boilers, solar collectors, photovoltaic cells), purchasing of building materials as a part of building thermomodernization.

Amount: The amount of the deduction cannot exceed PLN 53,000. Higher amounts for combination of thermomodernization and RES installation

Source: https://czystepowietrze.gov.pl/ulga-termomodernizacyjna-2/

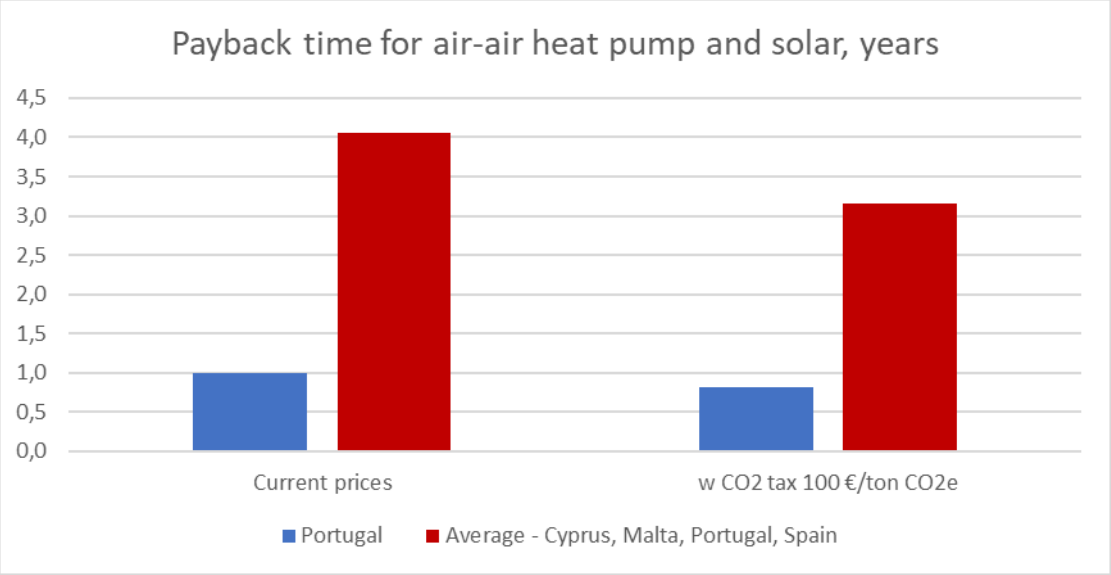
PORTUGAL

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Oil boiler		0 €	3.500 €	610 €/year
Air-air heat pump	Grant	1.300 €	200 €	60 €/year
Solar thermal system	Grant	2.300 €	400 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies

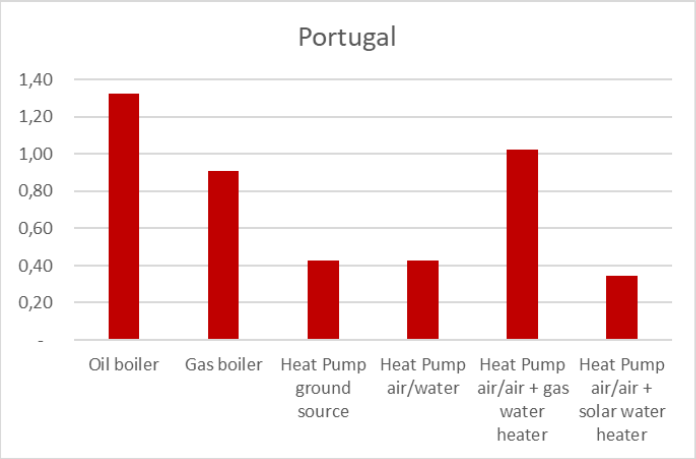


The simple payback time for substituting an old oil boiler with a new air-air heat pump and solar thermal. For Spain it is an old gas boiler that is substituted.

The payback time refers to the net investment after subsidies (upfront cost).

In Portugal there is no need for an additional subsidy for the considered average household to pay back the investment in 8 years.

CO2e emissions from heating of an individual house



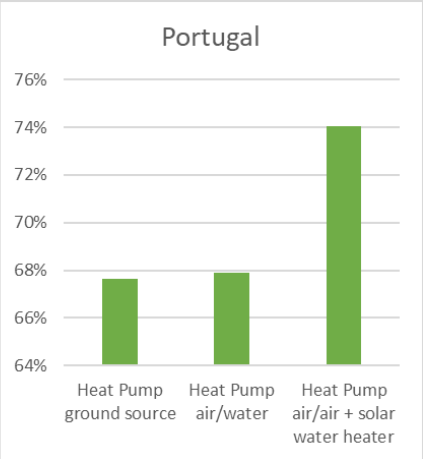


Fig A (left) CO2e-emissions in ton/year/family for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to oil

The comparison is made with an oil boiler because this is the most common heating system in Portugal.

Support Schemes for households' heating

Program Efficient Home 2020 "Casa Eficiente"

Type. Central government soft loans scheme for fossil and RES heating systems.
Description. Casa Eficiente 2020 program provides loans at favourable conditions for interventions aimed to improve the environmental performance of private residential buildings, with particular attention to energy and water efficiency, in addition to the management of urban waste. Interventions can affect the building envelope and its systems. Thanks to the program, subsidized loans are granted, of between a minimum of 2,500 and 100,000 euros. Maximum duration of the loan 20 years. In addition to various energy efficiency interventions, the program promotes the installation of heat pumps, biomass boilers and solar thermal.

Source: https://casaeficiente2020.pt/sobre-o-programa/
https://casaeficiente2020.pt/media/1148/regulamento-casa-eficiente-2018-03-01.pdf

Fundo Ambiental 2021 - Programa de Apoio a Edifícios Mais Sustentáveis (More Sustainable Buildings)

Type. Central government grant scheme for RES heating systems.
Description. The scheme called "More Sustainable Buildings" *(Edifícios Mais Sustentáveis)* is part of the Program *Economic and Social Stabilization Program* (PEES), approved by the Resolution of the Council of Ministers no. 41/2020, that establishes, among others, a set of measures to boost economic employment, by launching of small works, of quick execution and spread throughout the territory, that can absorb some of the impact of the economic crisis caused by the pandemic caused by the disease COVID-19. The scheme subsidizes various interventions: building insulation, more efficient windows, heat pumps, solar thermal, biomass, photovoltaic, water saving, biomaterials, etc. Phase II of the programme has been announced in June 2021.
Amount. Heat pumps and solar thermal 85% of the expenses, up to a maximum of € 2.500; biomass boilers 85% up to € 1.500. The equipment must be minimum energy class A+. Maximum subsidy for a single-family building is € 7,500 in total.

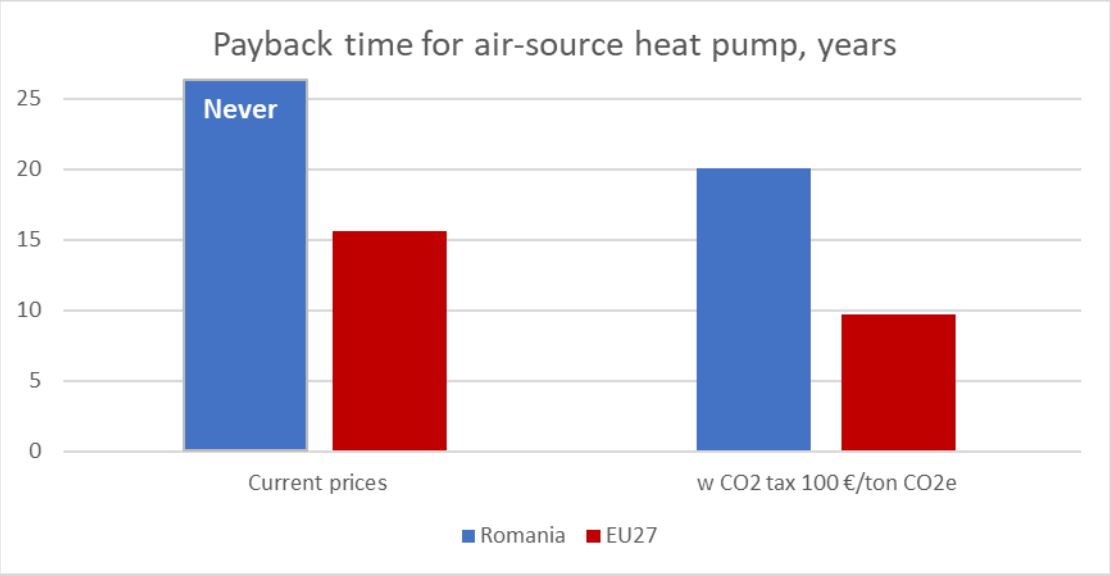
Source: https://www.fundoambiental.pt/apoios-prr/paes-2021.aspx

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Grant	1.250 €	1.250 €	530 €/year
Air-water heat pump	Grant	5.000 €	5.000 €	720 €/year
Solar thermal system	Grant	2.500 €	2.500 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

Since fuel costs are cheaper for a gas boiler than a heat pump, the investment will never be paid back.

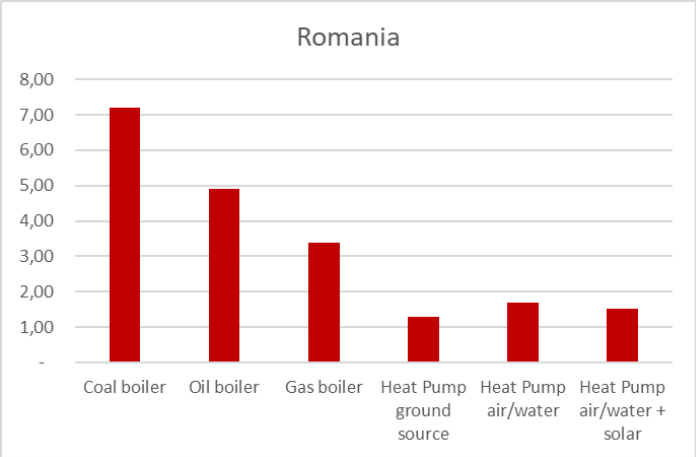
In Romania an additional subsidy of 5.000 € is needed for the considered average household, since the household cannot pay back the investment by fuel savings with current prices.

The total additional cost to substitute all gas boilers in Romania amounts to about 6.300 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 3.160 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Romania would amount to about 4.000 million €.

CO2e emissions from heating of an individual house



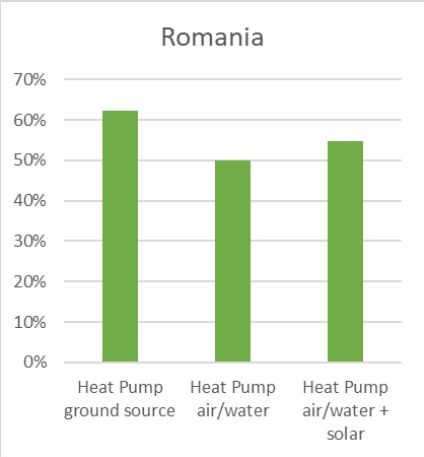


Fig A (left) CO2e-emissions in ton/year/family for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

Program Efficient Home "Casa Eficientă Energetic"

Type. Central government grant scheme for fossil and RES heating systems.
Description. The program *Casa eficientă energetic* is aimed to increase the energy efficiency in the single-family dwellings. The program subsidies condensation boilers, heat pumps (except air/air heat pumps) solar thermal panels, micro cogenerators (natural gas, biogas, gasification of household waste and non-household waste, as wood waste, wood pellets, agricultural pellets), and other interventions (mechanical ventilation with heat recovery, insulation, LED, etc.).
Amount. The amount of financing is granted differently, depending on the energy efficiency indicators reached. the maximum amount is RON 70.000, including VAT for each project, without exceeding 60% of the total value of the eligible investment expenses (40, 50 or 60%).

Source: https://www.afm.ro/casa_eficienta_energetic.php
https://www.afm.ro/casa_eficienta_energetic_ghid_finantare.php

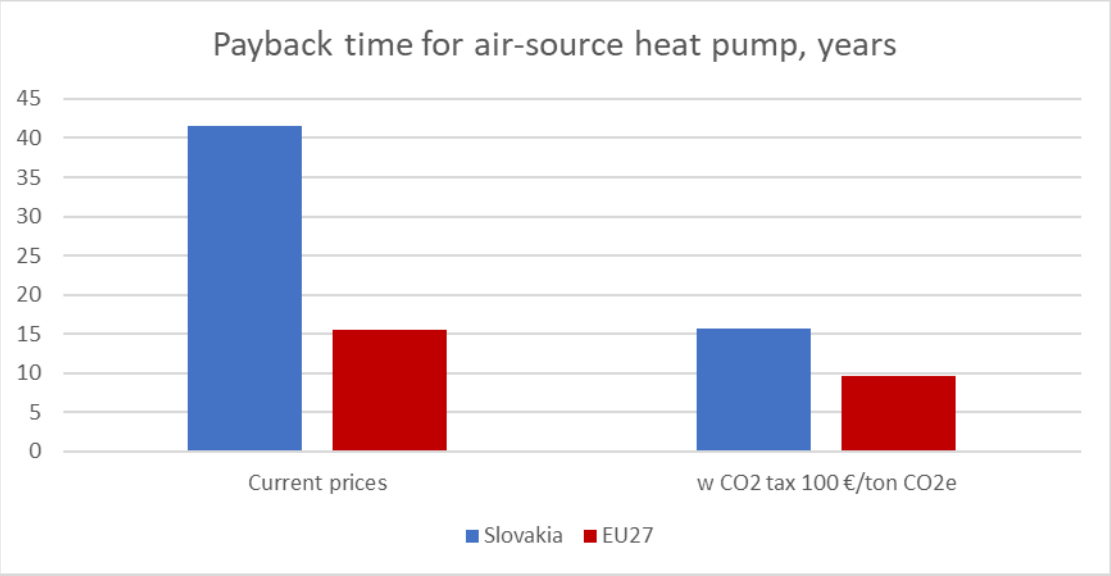
SLOVAKIA

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Grant	2.500 €	0 €	620 €/year
Air-water heat pump	Grant	2.700 €	7.300 €	590 €/year
Solar thermal system	Grant	1.500 €	3.500 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In Slovakia an additional subsidy of 5.990 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Slovakia amounts to about 3.300 million €.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 3.850 € would be needed for the considered average household to pay back the investment in 8 years.

With CO_2-tax, the total additional cost to substitute all gas boilers in Slovakia would amount to about 2.100 million €.

CO2e emissions from heating of an individual house

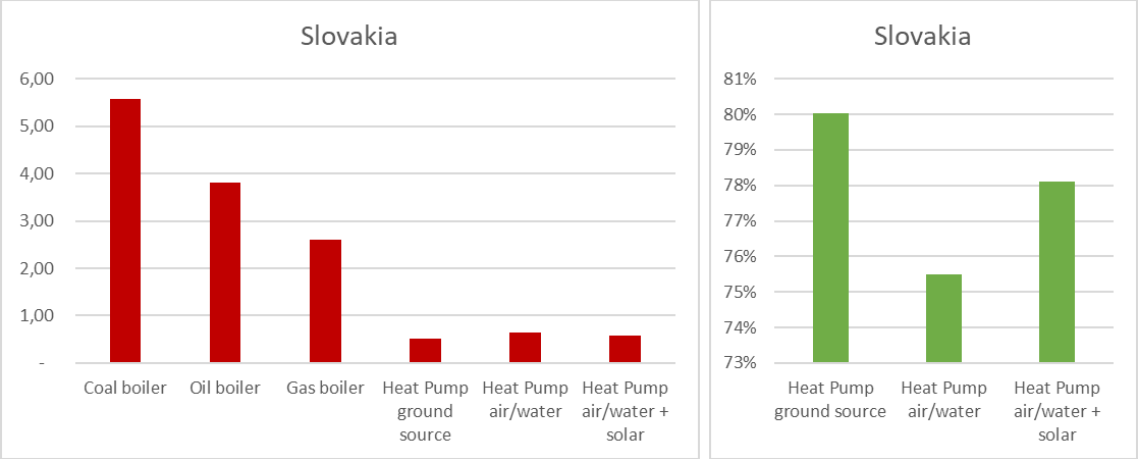


Fig A (left) CO2e-emissions in ton/year/family for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

The Slovak government plans to ban the sale and installation of oil boilers in 2023.

Support Schemes for households' heating

55th call for the replacement of obsolete domestic combustion systems with low emissions (excluding RES)

Type. Central government grant scheme for fossil heating systems.
Description. The 55th *call for the replacement of obsolete domestic combustion systems with low emissions* (*Výzva zameraná na náhradu zastaraných spaľovacích zariadení v domácnostiach za nízkoemisné (s výnimkou OZE) OPKZP-PO1-SC141-55* supports the installation of condensing gas boilers replacing heating with solid fossil fuel. Currently closed for applications. The programme is expected to become active later in the year.
Amount: up to 3000 euro for a gas boiler, installation, and connection to the gas grid.

Source: https://www.op-kzp.sk/obsah-vyzvy/55-vyzva-zamerana-na-opkzp-po1-sc141-55/
https://www.op-kzp.sk/dotacie-na-vymenu-kotlov/

Program Green for households II (Zelená domácnostiam II)

Type. Central government grant scheme for RES heating systems.
Description. Under the Zelená domácnostiam II program of the Slovak Innovation and Energy Agency (Slovenská inovačná a energetická agentúra SIEA), the following technologies are promoted: heat pumps, biomass boilers, solar thermal as well as wind turbines and photovoltaic. The programme is not active currently as the funds are used, but it will become active again later this year (2021). The programme runs until 2023.
Amount. The base rate for solar collectors for a family house is € 400/kW of installed capacity of the solar collectors, the maximum amount of support is 1.400 € per installation; outside district heating areas the amount is € 440/kW and maximum € 1.540 per installation. The basic rate for a heat pump for a family house is € 272/kW of installed heat pump power, the maximum amount of support is €

2.720 per installation. The basic rate for biomass boilers for a family house is 80 €/kW of installed boiler power, the maximum amount of support is € 1.200 per installation. Maximum 50% of the costs.

Source: https://zelenadomacnostiam.sk/sk/domacnosti/podporovane-zariadenia/tepelne-cerpadla/
https://zelenadomacnostiam.sk/sk/domacnosti/podporovane-zariadenia/kotly-na-biomasu/
https://zelenadomacnostiam.sk/sk/domacnosti/podporovane-zariadenia/slnecne-kolektory/

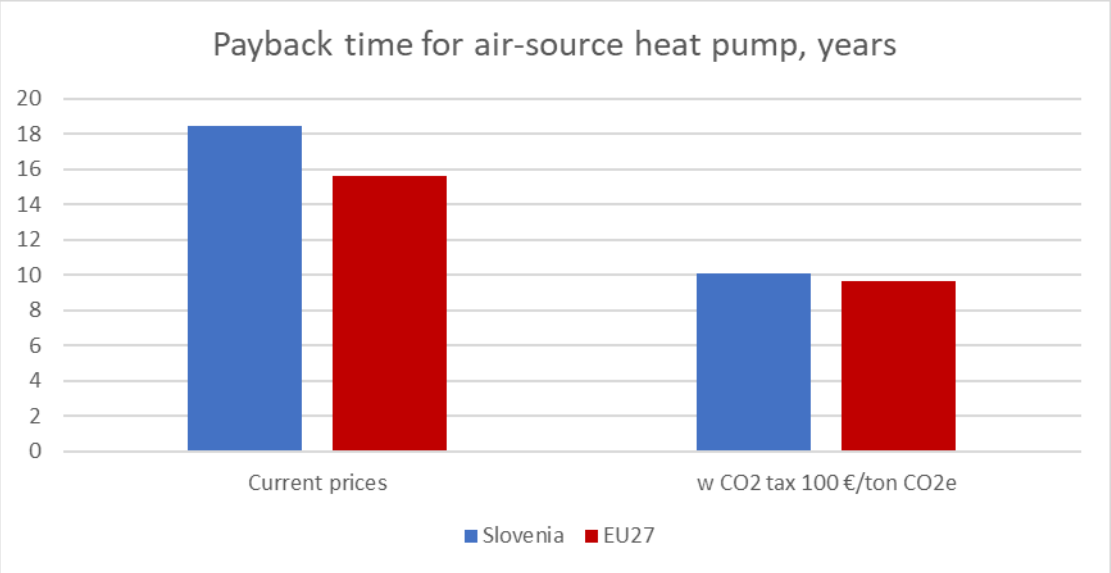
SLOVENIA

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Grant	1.250 €	1.250 €	850 €/year
Air-water heat pump	Grant	3.200 €	6.800 €	690 €/year
Solar thermal system	Grant	1.200 €	3,800 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m² house.

Payback time and additional need for subsidies



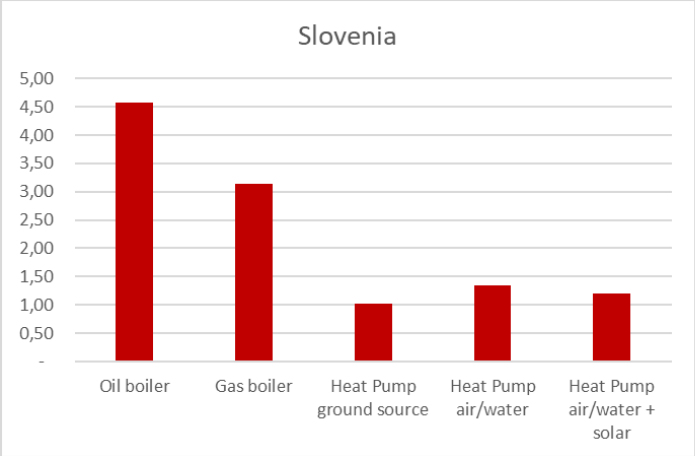
The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In Slovenia an additional subsidy of 4.080 € is needed for the considered average household to pay back the investment in 8 years.

If a carbon price of € 100 per ton CO_2 was introduced an additional subsidy of 1.830 € would be needed for the considered average household to pay back the investment in 8 years.

CO2e emissions from heating of an individual house



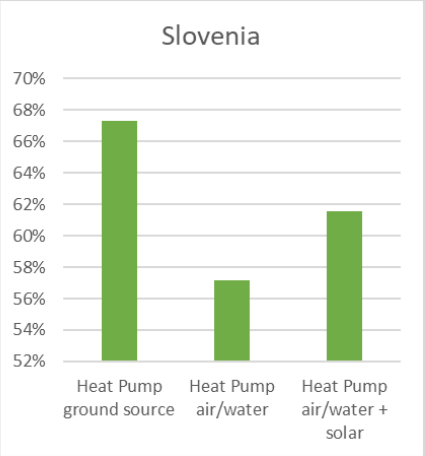


Fig A (left) CO2e-emissions in ton/year/family for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

Eco Fund Subsidies and loans (Eko Sklad)

Type. Central government grant and soft loans scheme for fossil and RES heating systems.
Description. The Eko Fund makes subsides and loans available for various technologies: heat pumps, solar thermal, biomass boilers, condensing gas boilers and micro cogeneration (only loans). It also funds connection to district heating systems and ventilation with heat recovery.
Amount for subsidies. Solar thermal: up to 30% of the investment value (100% for low-income families), maximum € 300 per m^2. Condensing gas boilers: up to 50% of the investment value, 25% for multiapartment houses), maximum € 2.000. Biomass boilers from 20 to 60% (100% for low-income families) of the investment value, maximum from € 2.000 to € 5.000. Heat pumps: from 20 to 50% of the investment value (100% for low-income families), maximum from € 2.500 to € 5.000. When replacing an old heating device, the subsidy is 40% (50% in municipalities with air quality plan). The maximum for an air-air heat pump is € 2,500 (€ 3,200 in municipalities with air quality plan) and for water-water and ground source heat pump € 4,000 (€ 5,000 in municipalities with air quality plan).
Amount for loans. 3-month Euribor plus 1,3%, minimum loan amount € 1.500.

Source:https://www.ekosklad.si/prebivalstvo/pridobite-spodbudo/seznam-spodbud/solarni-ogrevalni-sistem
https://www.ekosklad.si/prebivalstvo/pridobite-spodbudo/seznam-spodbud/plinski-kondenzacijski-kotli-3
https://www.ekosklad.si/prebivalstvo/pridobite-spodbudo/seznam-spodbud/mikro-soproizvodnja-toplote-in-elektrine-energije
https://www.ekosklad.si/prebivalstvo/pridobite-spodbudo/seznam-spodbud/kurilne-naprave-na-lesno-biomaso
https://www.ekosklad.si/prebivalstvo/pridobite-spodbudo/seznam-spodbud/toplotne-crpalke

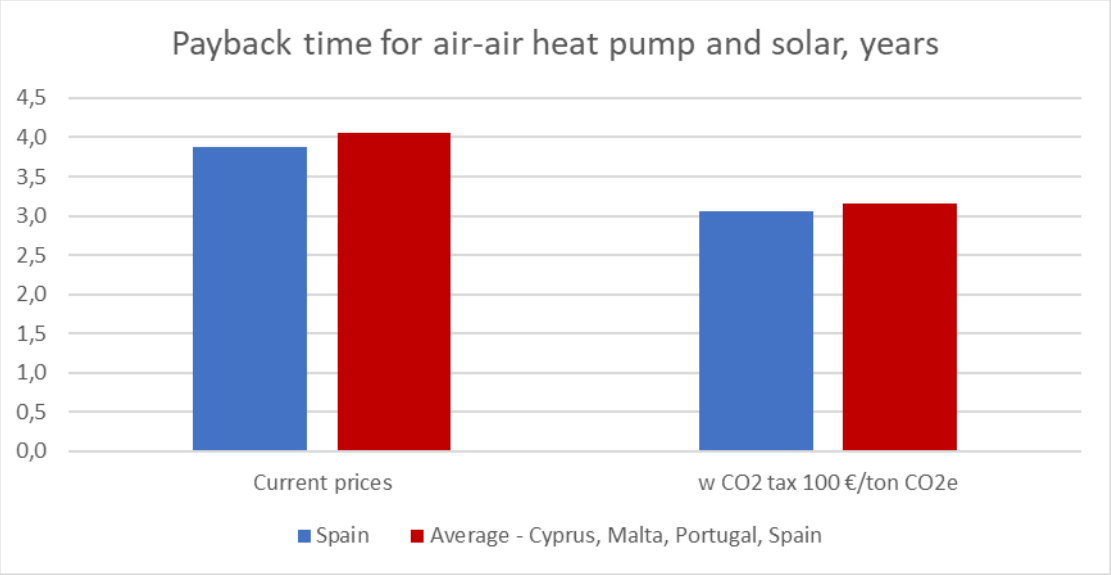
SPAIN

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler		0 €	2.500 €	620 €/year
Air-air heat pump	Grant	1.100 €	400 €	140 €/year
Solar thermal system	Grant	1.800 €	900 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-air heat pump and solar thermal. For Cyprus, Malta, and Portugal it is an old oil boiler that is substituted.

The payback time refers to the net investment after subsidies (upfront cost).

In Spain there is no need for an additional subsidy for the considered average household to pay back the investment in 8 years.

CO2e emissions from heating of an individual house

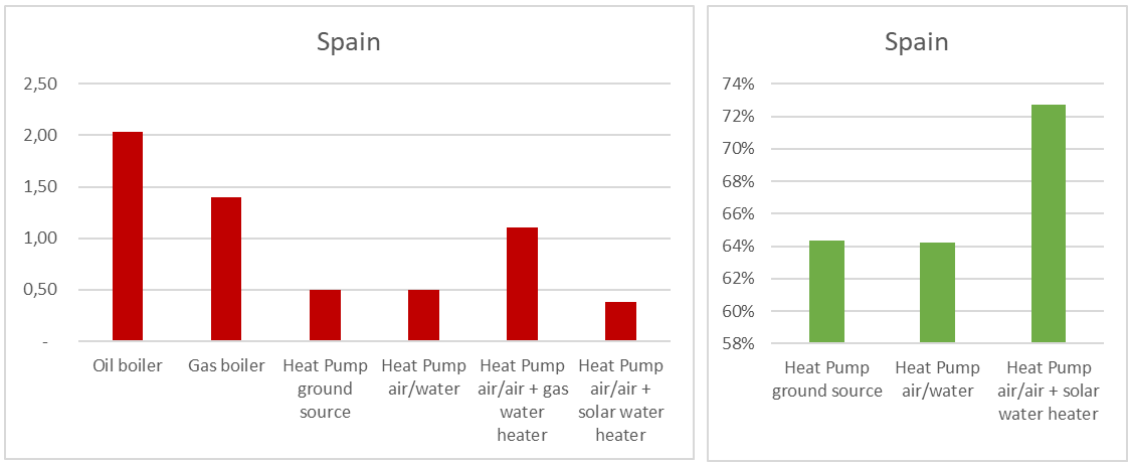


Fig A (left) CO2e-emissions in ton/year/family for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

PREE 5000. Rehabilitación energética de edificios en municipios de reto demográfico

Type. Central government grant scheme for RES heating systems.
Description. PREE 5000 replaces PREE. It is eligible in municipalities with less than 20,000 inhabitant and with no towns larger than 5,000 inhabitants. The Program is governed by Royal Decree 691/2021, of August 3, 2021, which regulates the aid program for energy renovation actions in existing buildings and regulates the direct granting of aid from this program to the autonomous communities and cities of Ceuta and Melilla. The programme promotes the improvement of the energy efficiency of thermal installations and substitution of conventional energy for solar thermal energy, geothermal energy, heat pumps and biomass.
Amount: 40% of the eligible cost.

Source: https://www.idae.es/ayudas-y-financiacion/para-la-rehabilitacion-de-edificios/programa-pree-5000-rehabilitacion

Programa PREE. Rehabilitación Energética de Edificios - CLOSED

Type. Central government grant scheme for RES heating systems.
Description. The Program was governed by Royal Decree 737/2020, of August 4, 2020, which regulates the aid program for energy renovation actions in existing buildings and regulates the direct granting of aid from this program to the autonomous communities and cities of Ceuta and Melilla. The programme promotes also the improvement of the energy efficiency of thermal installations, such as substitution of conventional energy for solar thermal energy, geothermal energy or biomass, improvement of the energy efficiency of the generation subsystems not included previously (e.g. heat pump), improvement of the energy efficiency of distribution, regulation, control and emission subsystems of thermal installations. The programme closes for applications July 31, 2021. The budget was expanded March 3, 2021.
Amount: 35% of the eligible cost. In case of renovation of individual homes or premises within buildings, this percentage will be 25% and 15%, respectively. The value can be increased by, up to 15% if it meets the social criteria, up to 15% if the action reaches energy class A and up to 20% if the action criterion is met integrated.

Source:https://www.idae.es/ayudas-y-financiacion/para-la-rehabilitacion-de-edificios/convocatorias-cerradas/programa-pree

Realización de instalaciones de energías renovables térmicas en el sector residencial

Type. Central government grant scheme for RES heating systems.

Description. The Program is governed by Royal Decree 477/2021, of 29 June 2021, which approves the direct granting to the autonomous communities and the cities of Ceuta and Melilla of aid for the implementation of various incentive programmes linked to self-consumption and storage, with renewable energy sources, as well as the implementation of renewable thermal systems in the residential sector (incentive program 6), within the framework of the Recovery, Transformation and Resilience Plan. The programme runs until 31 December 2023.

Amount. Air-water heat pumps 500 €/kW (max. 3.000 €/dwelling); solar thermal 450-900 €/kW (max. 550-1.800 €/dwelling), a family can expect a subsidy of 1.800 € for a 4 m^2 solar themal system; biomass 250 €/kW (max. 2.500-3.000 €/dwelling); geothermal or hydrothermal heatpump 1.600-2.250 €/kW (max. 9.000-13.500 €/dwelling).

Source. https://www.idae.es/ayudas-y-financiacion/para-energias-renovables-en-autoconsumo-almacenamiento-y-termicas-sector

Local Support for RES heating systems

Different local grants exist in the Spanish regions.

A compendium on different subsidy schemes in the regions, not only for heating systems but for building rehab et. al., can be found here: https://instalacionesyeficienciaenergetica.com/ayudas-y-subvenciones-eficiencia-comunidades-autonomas/

Open schemes for RES domestic heating (in addition to above mentioned national schemes) September 1, 2021:

- Andalusia: Biomass heating.
- Galicia: Biomass, solar thermal, heat pumps.

Support schemes in the Comunidad Autónoma of Aragón:
https://www.aragon.es/-/subvenciones-y-ayudas

Support for geothermal heat pumps in Galicia
Comunidad Autónoma de Galicia gives grants to geothermal heat pumps. Maximum subsidy is 30%.
http://tramites.administracion.gob.es/comunidad/tramites/recurso/ayudas-para-el-ahorro-y-eficiencia-energetica/7410df3a-bb3d-4c74-8fce-f796b4fa1403

Boiler renovation plan (Plan Renove de calderas) - CLOSED

Type. Central government (locally applied) grant scheme for fossil heating systems.
Description. The boiler renovation plan promote is implemented in most Autonomous Communities (regions) of Spain. It is responsible for replacing consumer boilers with more efficient ones, offering economic incentives. The Autonomous Communities are in charge of offering the boiler renovation plan to users with the aim of reducing the energy bill of homes and promoting the use of safer natural gas appliances according to the RITE. These grants are designed for all those users who wish to replace their individual boiler with another condensing boiler that uses natural gas or LPG. It is important to note that the original boiler to be replaced must be electric or make use of a fuel

considered non-renewable. All local schemes are closed for applications. Most of them by the end of 2020. No new announcements yet.
Amount: The subsidy is very variable, but is usually between 100 and 400 euros, depending on the Autonomous Community.

Sources: https://preciogas.com/instalaciones/equipamiento/calderas/plan-renove

Aragon: https://calderas.renovearagon.com/
Comunidad de Madrid https://www.comunidad.madrid/servicios/consumo/plan-renove-calderas-calentadores-comunidad-madrid
Valencia: https://www.vainsmon.es/plan-renove-calderas-valencia/#1484652030190-407b08ef-5de79cb2-4a76

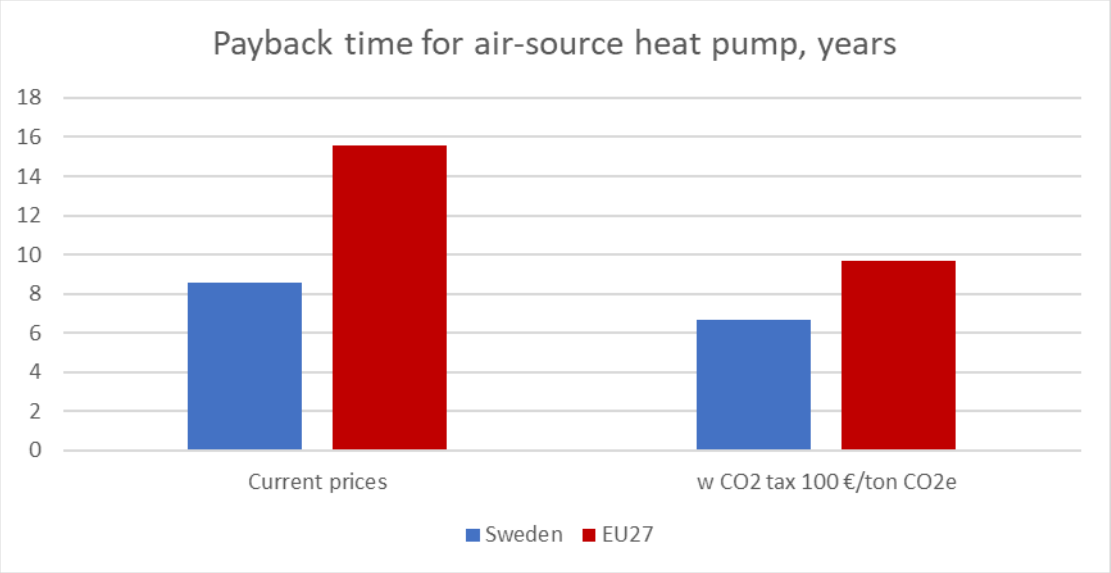
SWEDEN

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Tax rebate	400 €	2.100 €	1300 €/year
Air-water heat pump	Tax rebate	900 €	9.100 €	540 €/year
Solar thermal system	Tax rebate	600 €	4.400 €	

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies



The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In Sweden an additional subsidy of 1.220 € is needed for the considered average household to pay back the investment in 8 years.

The total additional cost to substitute all gas boilers in Sweden amounts to about 10 million €.

If a carbon price of € 100 per ton CO_2 was introduced, there would be no need for an additional subsidy.

CO2e emissions from heating of an individual house

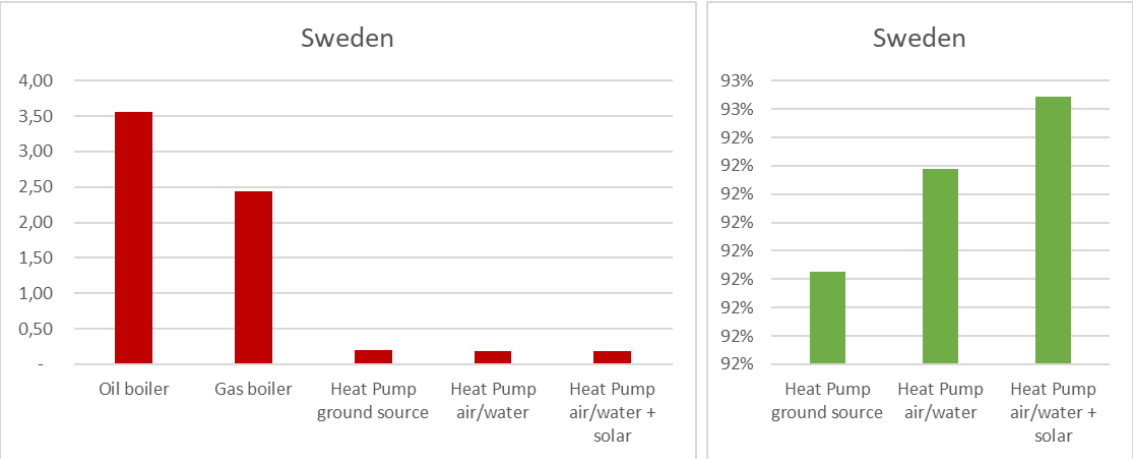


Fig A (left) CO2e-emissions in ton/year/family for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

Tax deduction (Rot-avgrad)

Type. Central government tax reduction scheme for fossil and RES heating systems.
Description. The decision to introduce the ROT (Rot-avgrad) deduction was made in the Riksdag on May 13, 2009. Individuals who own homes, holiday homes or condominiums are entitled to deduct 30% of the labour costs of the installation (not of the technology) for works on the house (in condominiums: for internal maintenance). The deduction may also concern interventions on the heating system, such as the installation of heat pumps, biomass boilers, gas/oil/diesel boilers, solar panels.
Amount: the maximum deduction is SEK 50.000 per year and is 30% of the cost of the work (not the technology).

Source:
https://www.skatteverket.se/foretagochorganisationer/skatter/rotochrut/gerarbetetratttillrotavdrag.4.5c1163881590be297b5173bf.html

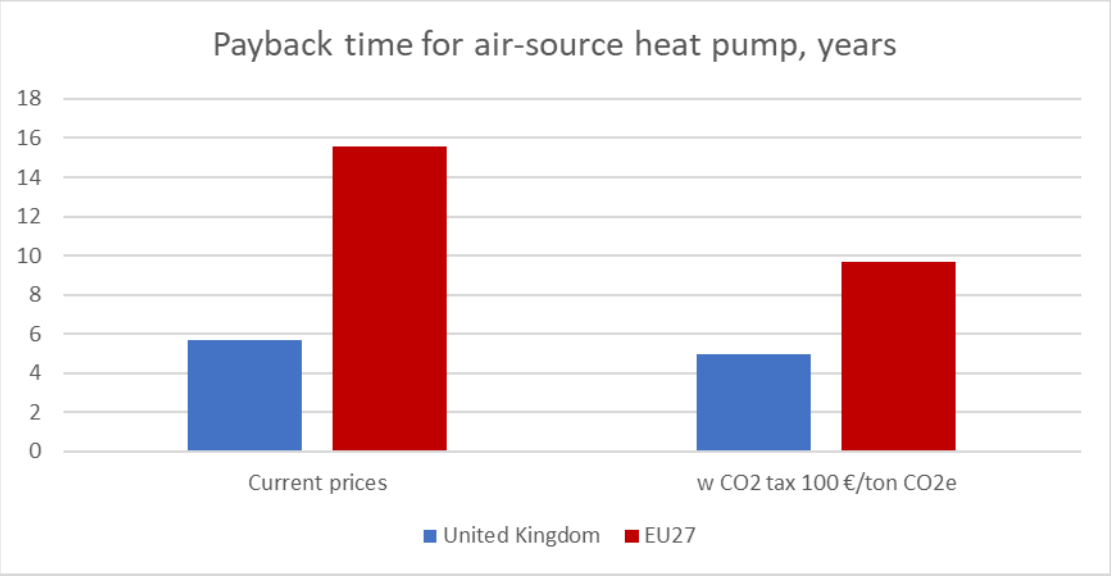
UNITED KINGDOM

Main incentives, upfront costs, and fuel costs

Technology	Type of incentive	Incentive value	Net upfront cost	Fuel cost
Gas boiler	Grant	2.500 €	0 €	610 €/year
Air-water heat pump	Feed in tariff	0 €	10.000 €	-1000 €/year
Solar thermal system	Feed in tariff	0 €	5.000 €	-670 €/year

Incentives and costs for new technologies for a one-income 4-person household living in a 110 m^2 house.

Payback time and additional need for subsidies

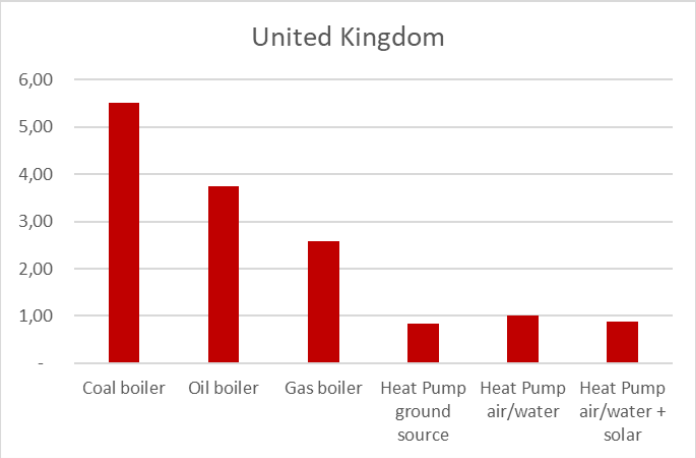


The simple payback time for substituting an old gas boiler with a new air-water heat pump.

The payback time refers to the net investment after subsidies (upfront cost).

In the United Kingdom there is no need for an additional subsidy for the considered average household to pay back the investment in 8 years.

CO2e emissions from heating of an individual house



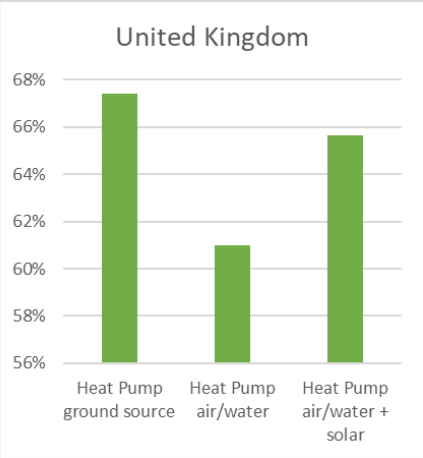


Fig A (left) CO2e-emissions in ton/year/family for different heating solutions
Fig B (right) % lower CO2e-emission when choosing a Renewable energy solution compared to gas

Support Schemes for households' heating

Domestic Renewable Heat Incentive

Type. Central government grant scheme (feed in tariff) for RES heating systems.
Description. The RHI promotes biomass boilers, solar water heating, certain heat pumps. The scheme is available in England, Scotland and Wales. Payments are made for 7 years and are based on the amount of renewable heat made by the heating system, calculated according to the *Domestic RHI scheme*. New build properties will not normally be eligible. The only exception is if the applicant is building his/her own home. The Scheme runs till March 31, 2022.
Amount. According to the document Domestic RHI tariffs table (2021/22), the tariff, in £/kWh are: biomass 0,0701 £/kWh; Air Source Heat Pump 0,1092 £/kWh; Ground Source Heat Pump: 0,2129 £/kWh; Solar Thermal 0,2149 £/kWh. There are limits on the amount of space heating a house can receive payments for. The heat demand limits are set at 20,000kWh for ASHPs, 25,000kWh for biomass boilers and stoves and 30,000kWh for GSHPs. There is no limit for solar water heating systems.

Source: https://energysavingtrust.org.uk/grants-and-loans/renewable-heat-incentive/
https://www.gov.uk/government/publications/changes-to-the-renewable-heat-incentive-rhi-schemes/changes-to-rhi-support-and-covid-19-response

https://www.ofgem.gov.uk/publications-and-updates/domestic-rhi-tariff-table

Green Home Grant - CLOSED

Type. Central government grant scheme for RES heating systems.
Description. The Green Homes Grant heavily supported heat pumps and solar thermal. However, the scheme closed on March 31, 2021, due to bad management The Scheme was labelled "disastrous" by the Parliamentary Environmental Audit Comittee. The Green Home Grant promotes energy improvements in the houses. Homeowners and residential landlords can apply for a grant voucher towards the cost of installing energy efficient improvements to their homes. Insulation and installation of low-carbon heating systems are included. About the low carbon heating measures, the scheme

covers: air source heat pump, ground source heat pump, solar thermal (liquid filled flat plate or evacuated tube collector), biomass boiler, hybrid heat pump.
Amount. Vouchers will cover two-thirds of the cost of eligible improvements, up to a maximum government contribution of £5.000. Households on low income can receive vouchers covering 100% of the cost of the improvements, up to a maximum of £10.000.

Source: https://www.gov.uk/guidance/apply-for-the-green-homes-grant-scheme

Free Boilers Scheme

Type. Central government grant scheme for fossil heating systems.
Description. Energy Company Obligation (ECO) is a government scheme whereby the larger energy companies have an obligation to invest in energy efficiency measures to reduce energy use and resident's energy bills therefore reducing fuel poverty. Funding is available to those on certain benefits towards replacing an old inefficient boiler with a brand-new condensing one.
Amount. Boiler grant funding can vary according to the property and survey will usually be required. The amount can reach 100% of the costs.

Source: https://www.boilergrants.info/

Home Energy Scotland Loan

Type. Local government soft loan and grant scheme for fossil and RES heating systems.
Description. Interest free loans and cashbacks of up to £17,500 are available in Scotland for energy efficiency and renewable heating. Cashback for renewable heating systems is not normally available. The cashback values are subject to availability while funds last or until the end of the financial year – whichever is sooner. Funds will be allocated on a first-come, first-served basis.

Amount. Heating system (gas, LPG or oil boilers): up to £5,000 (no cashback available). Solar water heating systems: £5,000 (£1,250 loan plus up to £3,750 cashback). Heat pumps (air-water, water-water, ground source or hybrid air source to water): £10,000 (£2,500 loan plus up to £7,500 cashback). Biomass boilers or stoves (non-automated, non-pellet stoves or room heaters are not eligible): £10,000 (£2,500 loan plus up to £7,500 cashback). Connections to a renewably powered district heating scheme: £5,000 (£1,250 loan plus up to £3,750 cashback).

Source. https://www.homeenergyscotland.org/find-funding-grants-and-loans/interest-free-loans/overview/

ANNEX: METHODOLOGY AND SOURCES

This annex explains the methodology and sources used in this report, except the sources for information on national subsidies that are given in the country pages.

Greenhouse Gas Emissions from Heating of an Individual House

Heat consumption

The heat consumption is calculated for a house of 110 m^2. For each country it consists of:

- 110 m^2 times the national average specific space heat consumption for 2018 from the Odyssee-Mure database, see: https://www.odyssee-mure.eu/publications/efficiency-by-sector/households/heating-consumption-per-m2.html, except for Belgium, where data is from the BSO database for 2014 (https://ec.europa.eu/energy/eu-buildings-database_en) and for Norway, where data is from SINTEF, Norway.
- The average EU-27 energy consumption for hot water of 3400 MJ/person/year times 4 persons. Energy for hot water is according to Eurostat data from 2018, source: https://ec.europa.eu/eurostat/statistics-explained/images/1/17/Energy_consumption_households_data2019_final.xlsx, divided by 447.7 million EU citizens . We use the EU average for energy for hot water for all countries.
- Reduction to 80% to compensate for the energy efficiency of the present heating system.

Efficiencies

To calculate emissions, first we calculate energy demand for each type of fuel. This is calculated from above heat demand and technology specific efficiencies. For most technologies are used efficiencies from base cases from Ecodesign Review and preparatory studies, but for some technologies we have used market data instead, as there is a fast development of the technology. This is in particular the case for air source heat pumps and ground source heat pumps.

- Coal boiler: 75% from Ecodesign Preparatory Study Lot 15, task 5 report, higher heating value (GCV).
- Oil boiler: 86% from Ecodesign Review Study on hydronic heaters 2019, GCV, source: https://www.ecoboiler-review.eu/Boilers20”17-2019/documents-boilers-2017-2019.htm.
- Gas boiler: 88% from Ecodesign Review Study on hydronic heaters 2019, GCV.
- Air source heat pump for hydronic heating: SCOP 3,6 for average climate, taken as lowest efficiency within the best 25% of the Danish market (the no 19 in a list of 77 air source heat pumps at https://sparenergi.dk/forbruger/vaerktoejer/varmepumpelisten). The BAT on Danish market has SCOP = 3.9. For cold climate we use 3.3 instead of 3,6, based on an average of 9% lower efficiency at cold climate for air source heat pumps (derived from market data).

- Ground source heat pump for hydronic heating: SCOP 4.6, estimated in the following way: With present Ecodesign methodology the ground source heat pump with the lowest efficiency within the best 25% of the Danish market (the no 12 in a list of 48) has SCOP = 4. With the proposed change from brine temperatures from -3˚C/0˚C to 2˚C/5˚C, the SCOP will increase around 15%, giving SCOP = 4.6. This change is proposed with the current review of ecodesign regulations, see WG 1-2-3 Space Heaters Interim Report, 17/12 2020, available from https://www.ecoboiler-review.eu/documents.htm
- Air-air heat pump: SCOP = 5.35 for average climate, from Ecodesign Review Study of Air conditioners and comfort fans, 2019, source https://hal-mines-paristech.archives-ouvertes.fr/hal-01796759.

For ratio between higher heating value (GCV) and lower heating value (NCV) is used 1.125 for gas, 1.047 for oil, and 1.04 for coal.

For solar thermal for hot water is used the following coverage of hot water energy demand: it covers 78% in warm climate, 58% in average climate, and 53% in cold climate, calculated with the simplified method for solar water heating proposed by Solar Thermal Europe for Ecodesign regulation with a 4 m^2 solar collector and specifying an L-size water heater. The method is described here: https://www.ecoboiler-review.eu/downloads/20200623_WG4_SolarHeatEurope_proposal_simplified-method.pdf.

The demand covered by solar is subtracted before calculating electricity demand for heat pumps.

The efficiencies of air source heat pumps are for each country taken as the efficiency in the most dominant climate zone for space heating in the country according to Ecodesign and energy labelling regulations. This map shows these climate zones:

Map of climate zones (warm, average, cold) from energy labelling regulation for air source heat pumps, EU 811/2013

The efficiencies of solar water heaters are for each country taken as the efficiency in the most dominant solar climate zone in the country according to Ecodesign and energy labelling regulations.

This map shows these climate zones:

Map of climate zones (warm, average, cold) from energy labelling regulation for solar water heaters, EU 812/2013

Emissions

The emissions are calculated for heating with coal, oil, gas, as well as with electricity for air source heat pumps and ground source heat pumps. In addition to these types of heating is included the option of solar water heating in combination with air source heat pumps. For countries with primarily warm climates (Malta, Cyprus, Portugal, Spain), the option of an air-air heat pump combined with a solar water heater is included. This option is also popular in parts of other countries, including Italy, Greece and France, but we only include it in the four countries, where both warm climate zones for heat pumps and solar heating cover the majority of the country.

Emission factors for fuels are standard CO_2 emission factors from IPCC 2006:

- Gas (methane) 202 g/kWh
- Heating oil: 267 g/kWh
- Coal (bituminous) 340 g/kWh

The emission factors are relative to the lower heating values (NCV) and are the direct emissions with combustion, not including upstream emissions.

Emissions from electricity are for each country the emission from electricity production increased with 7% to include losses in the electricity networks. National electricity emissions are from 2019 from European Environmental Agency, source https://www.eea.europa.eu/data-and-maps/daviz/co2-emission-intensity-8/download.table.

Emissions from power production are reducing with reduction of fossil fuel use in power production, in particular phase-out of coal use. The emissions of the sectors covered by EU-ETS, where the power sector is the dominant, has already fallen 33% from 2005 to 2019 and they will continue to fall, guided by reductions in EU-ETS credits and with introductions of more wind and solar power. For the previous

2030 target of 40% reduction, the emissions covered by EU-ETS were set to reduce 43% 2005-2030. If the present 55% target is also implemented with a 3% higher reduction in the EU-ETS 2005-2030 target, the reduction will be 58%; but it can also be higher, as reductions in the energy sector is faster and often cheaper than reductions in many other sectors. With a 58% reduction 2005-2030, the reduction 2019 – 2030 will be 37%. As this is likely to be achieved in the power sector with reductions of emissions per kWh of electricity rather than with less electricity use, the specific emissions per kWh produced, can be estimated to be reduced around 37% in 2030 compared to the figures given by EEA for 2019.

Refrigerants

For heat pumps emissions from loss of refrigerants to the emissions from electricity production are added.

The loss of refrigerants is estimated to a European average of 63% during the 17-year typical lifetime. This is calculated using the Ecodesign Review Study on hydronic heaters 2019, report 5 page 23. In this report it is assumed that 25% of the heat pumps lose all refrigerants during use (malfunctioning) and that of the remaining 75%, 50% of the refrigerant is recovered at end of life while the other 50% is lost. This gives emissions of 25% + 50% of 75% equal to 25%+ 38% =63% of the refrigerant.

The Ecodesign Review Report find that the refrigerant contents of heat pumps are 4.8 kg for an air source heat pump and 3.09 kg for a ground source heat pump. This is well above that market data for air source heat pumps; but seems reasonable for ground source heat pumps. Thus, for ground source heat pump, we use this refrigerant content and assume R134A as refrigerant. For air source heat pumps, we use market data instead.

We have identified refrigerant content of three air source heat pumps on the market in 2021:

1. Vølund F120-8 with 5.5 kW nominal heating capacity contains 2.4 kg R410 refrigerant with GWP 2088, total GWP of refrigerant 5.0 t CO_2e. See data https://volundvt.dk/produkter/luft-til-vand-varmepumpe/sortimentsoversigt/produkt/f2120-luft-vand-varmepumpe. Of this is lost 63% with global warming effect of 3.15 t CO_2e, annual LCA emissions during 17 years of service life: 0.19 tons CO_2e.
2. Metroair I12 with 9 kW nominal heating capacity contains 2.6 kg R410 refrigerant with GWP 2088, total GWP of refrigerant 5.4 tons CO_2e. Of this is lost 63% with global warming effect of 3.4 tons CO_2e, per year during 17 years of service life: 0.20 tons CO_2e.
3. Toshiba 801H(R)W-E with 7.49 kW nominal heating capacity contains 1.25 kg R32 refrigerant with GWP 677, total GWP of refrigerant 0.85 tons CO_2e. Of this is lost 63% with global warming effect of 0.53 tons CO_2e kg, per year during 17 years of service life: 0.03 tons CO_2e.

We use in this report the average of these examples: emissions: 0.14 tons $CO2_e$/year.

With the change to refrigerants with lower GWP of refrigerants, in particular if legislation will support use of natural refrigerants, the market can be expected to move to R290 and other refrigerants with lower GWP. In the future the example 3 can be expected to be more representative.

For air-air heat pumps, we have identified refrigerant content for two models on the market in 2021:

1. Toshiba Greenline Edge with 3.2-4.2 kW nominal heating power contains 0.76 kg R32 with GWP 776, total GWP of refrigerant 514 kg CO_2e. Of this is lost 63% with global warming

effect of 324 kg CO2e, per year during 12 years of service life: 27 kg CO_2e (Information from Gidex.dk)

2. Toshiba Greenline D9 with 4.5 kW nominal heating power contains 0.9 kg R32 with GWP 776, total GWP of refrigerant 710 kg CO_2e. Of this is lost 63% with global warming effect of 513 kg CO_2e, per year during 12 years of service life: 37 kg CO_2e (Information from Gidex.dk)

We use average of two examples: emissions per unit: 32 kg CO_2e/year.

Affordability of Heating Installations – Upfront Costs

As an indication for affordability, we chose the number of monthly salaries needed to pay upfront costs for heating installations, calculated as investment costs minus generally available subsidies for the standard identified household. We have used the average income of this standardised family in each country according to Eurostat. Subsidies that only are available in special economic zones, such as islands, are not included. Subsidies that are only available with some intervals are included, as far as the subsidy program is still active and will have openings in the future.

The national average income for each country is average net earnings from Eurostat: https://ec.europa.eu/eurostat/databrowser/view/earn_nt_net/default/table?lang=en

As a rule, only the most favourable incentives available to the standard household considered were taken into consideration for the maps based on this report on coolproduct.eu.

Equipment and Installation Costs

The costs are in general adapted from Ecodesign Review Study 2019: https://www.ecoboiler-review.eu/Boilers2017-2019/study-boilers-2017-2019.htm Report 2, 3 and for gas boilers table 10 in report 5 on https://www.ecoboiler-review.eu/Boilers2017-2019/documents-boilers-2017-2019.htm

For oil boilers: Danish equipment costs, from internet offers 2021, as costs in the review study are unrealistic high.

For air source heat pumps is used 10,000 €, which is a more realistic including installation than the 8,177 € used in the review study.

For ground source heat pumps is used the price for air source heat pumps + 3,000 € to cover the extra work with underground brine tubes, total 13,000 €. Though it is still an average rough estimation, this is more realistic than the 22,177 € given in the review study.

For coal boilers: Ecodesign Preparatory Study Lot, task 5 report, table 5-35, equipment + installation costs for 25 kW retort boiler with 20 year service life, see https://www.eup-network.de/fileadmin/user_upload/Produktgruppen/Lots/Working_Documents/BIO_EuP_Lot_15_Task5_Final.pdf

For air-air heat pumps: Ecodesign Review Study of Air conditioners and comfort fans, 2019, source https://hal-mines-paristech.archives-ouvertes.fr/hal-01796759

For solar water heaters, https://www.ecoboiler-review.eu/Waterheaters2017-2019/documents-waterheaters-2017-2019.htm

The following table lists the investment costs according to the Ecodesign review studies in the center column and in the right column it lists the investment costs that we use to calculate subsidies as well as affordability.

Technology	**Cost, Review Study**, Task 2 table 24	**Final price used** incl. work, VAT
Gas boiler replacing old boiler at same location	€ 1,215 + € 1,392 = € 2,607	€ 2,500 (equip. € 1,250, work € 1,250)
Oil boiler replacing old boiler at same location	€ 6,000 + € 6,849 = € 12,849	€ 3,500 * (equip. € 2,500, work € 1,000)
Coal boiler replacing old boiler at same location	€ 4,000 + € 1,500 = € 5,500 in 2007**	€ 6,500 (equip. € 4,800, work € 1,700)
Air source heat pump, replacing boiler	€ 4,000 + € 4,177 = € 8,177	€ 10,000 (equip. € 7,000, work € 3,000)
Ground source heat pump, replacing boiler	€ 7,000 + € 15,177 = € 22,177	€ 13,000 (equip. € 7,000, work € 6,000)
Air-air heat pump one unit per house, also aircon***	€ 1,500	€ 1,500 (equip. € 800, work € 700)
Solar thermal with antifreeze	€ 1,924 + € 978 = € 3,921	€ 5,000 (equip. € 3,000, work € 2,000)
Solar thermosyphon no antifreeze	€ 2,010 + € 663 = € 2,673	€ 2,700 (equip. € 2,000, work € 700)

* Danish equipment cost

** Final price includes 17% price increase 2007 – 2018 in Euro zone.

*** Air-air heat pumps are used as the technology of choice together with solar water heating for countries with primarily warm climate: Portugal, Malta, Cyprus, Spain. A house of 110 m^2 will normally require two air-air heat pumps for heating in warm climate, but as a house owner in the warm climates will often buy an air conditioner for cooling, we only include the investment of one unit. The air-air heat pumps are reversible and can be used as air conditioners.

Fuel costs for heating systems

Gas tariffs are from EUROstat *Gas prices for household consumers - bi-annual data (from 2007 onwards) [NRG_PC_202__custom_1206582]*. The used data are from second semester of 2020 (for UK the first semester 2020).

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_pc_202

Electricity tariffs are based on Eurostat statistics Electricity prices for household consumers - bi-annual data (from 2007 onwards) [nrg_pc_204]. The used data are from second semester of 2020 (for UK the first semester 2020). The prices are for household consumption between 5.000 and 15.000 kWh/year.

From EHPA (European Heat Pump Association) we have had information about special electricity tariffs for heat pumps. Based on this information we have adjusted the tariffs for Germany, Hungary, Poland and United Kingdom. There are also special prices in Austria and Slovakia, but they are already accounted for in the Eurostat data. In Denmark the electricity tariff is lower for the consumption that exceeds 4.000 kWh/year, due to a lower taxation. This is only partially included in the Eurostat data, so we have also adjusted the Danish tariff. (Note: For the adjusted electricity tariffs the division between costs ex. taxes, tax and VAT shown in the graph is not accurate). In some countries, the heat pump tariff is only available for consumers that invest in a second electricity meter and installation. The cost of this is not included.

https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_pc_204&lang=en

Oil tariffs are from https://www.globalpetrolprices.com/heating_oil_prices/.

Annual fuel bills

The annual fuel bills are calculated for a standard household with four members living in a 110 m^2 house.

The annual consumption for heat and hot water is calculated as described earlier in the annex.

The standard tariffs are used for all countries except for United Kingdom, where we have subtracted the feed-in tariff which is available for seven years when installing an air source heat pump. The Feed in tariff is from the *Domestic RHI tariff table 2021-2022*.

https://www.ofgem.gov.uk/publications-and-updates/domestic-rhi-tariff-table

The calculation is made for new technologies to compare the running costs for a new heat pump compared to a new gas boiler (oil boiler in countries without gas for heating). This is to evaluate if households will save on fuel bills for heating if they invest in a heat pump instead of a new boiler.

In general, gas is the most widely spread fossil heating option in EU. Thus, the calculations are made for gas boilers in all countries except Finland, Cyprus, Malta, and Portugal, where oil boilers are used as gas is not available for heating.

The heat pump calculation is based on the electricity consumption using an air-water heat pump in most countries. For Germany and Luxembourg, the calculation is for a ground source heat pump, because the investment in ground source heat pumps is cheaper for a household when subsidies are included.

In Malta, Cyprus, Spain, and Portugal the climate is warm, and the chosen option is an air-air heat pump for heating and solar thermal for hot water.

Payback time and necessary subsidies to reach affordability

The payback time and necessary additonal subsidies are calculated for the same choice of technologies as used in the previsous chapter on fuel costs.

The calculations are based on annual savings on fuel bills, **when substituting an old gas or oil boiler with a new heat pump.** The efficiency for old boilers is set at 80% and the fuel costs are higher than the fuel costs for a new boiler. For new technologies are used the efficiencies described earlier in the annex.

The net investment cost is the cost of the technology minus existing subsidies. The standardised technology costs (meant to just give an estimation of the scale of the investment) are set to 10.000 € for an air-water heat pump, 13.000 € for a ground source heat pump, and to 4.200 € for an air-air heat pump + solar thermal (see details earlier in the annex).

No other running costs are included (they are considered to be approximately the same for the different types of technologies, including for existing Technologies that are replaced).

Payback time

The calculation of simple payback time is the net investment divided by the annual savings on fuel bills.

For UK is used the standard electricity tariff minus feed in tariff for the first seven years, and the standard electricity tariff after seven years.

CO_2-tax

The annual CO_2-emission per household calculated in the earlier chapter is used. We include CO_2-emissions from fuels and electricity. It is calculated as described earlier in the annex. GWP from refrigerants in heat pumps is not included, as this is regulated in other ways.

The CO_2-tax is set at a total of 100 €/ton CO_2. For electricity there was already a CO_2-quota price of approximately 30 €/ton CO_2 at the end of the second half of 2020. Therefore, we are setting the additional CO_2 tax at 70 €/ton CO_2.

CO_2-quato prices are formed with auctions of ETS quotas and with trade on exchanges. One of the largest exchanges is EEX, where the average of the CO_2 quota price in second half of 2020 was 26.82 €/ton CO_2, while end of year price 2020 was 30.92 €/tons CO_2.

See data at https://www.eex.com/en/market-data/environmental-markets/eua-primary-auction-spot-download

We are assuming the existing national taxes are not changed when introducing a new CO_2-tax.

Necessary additional subsidy – financial costs

In this calculation is included financial costs of 2% annual interest rate for a loan for the investment cost. The calculation is made for an annuity loan.

Interest rates are low at the moment and even lower than 2% for some house loans at the moment. This is an average, conservative estimate; some families might need to take a loan with higher interest rates, others do not need to take a loan at all. In several countries soft loans are available for low-income families, so cheap loans are available for them as well.

Financial costs for loans in the EU area can be found at https://www.euro-area-statistics.org/bank-interest-rates-loans.

Cost at European level

We have estimated the cost for each country by multiplying the needed extra subsidy for a standard household with the estimated number of gas or oil boilers in the country.

For most countries gas is the dominant fuel, and we have made the calculations based on the number of gas boilers. There might also be some additional costs to substitute existing oil boilers, but these costs are considerably lower.

According to the IEA, International Energy Agency, in 2018 residential gas use in EU-28 was 102.1 Mtoe while residential oil use was 30.5 Mtoe, see https://www.iea.org/data-and-statistics/data-tables?country=EU28&energy=Balances&year=2018. Thus, the oil use is 30% of the gas use in households. Since oil heating is more expensive than gas heating and existing subsidies are higher for change from oil heating to heat pumps than from gas heating, the additional subsidies needed to make conversion of both oil and gas heating economic (pay-back of 8 years or less) is considerably less than 30% higher than the subsidies needed for the gas heating conversion alone.

Number of gas and oil boilers

We have the number of boilers in 2013 from an EU-study from 2016. *Mapping and analyses of the current and future (2020-2030) heating/cooling fuel deployment (fossil/renewables)*. Work package 2: Assessment of the technologies for the year 2012. Final report March 2014. EC – Directorate-General for Energy.

https://ec.europa.eu/energy/studies_main/final_studiesmapping-and-analyses-current-and-future-2020-2030-heatingcooling-fuel_en

We have used the number of small boilers (<25 kW), since most of these will be in households or the service sector (small businesses).

We have updated these to 2017 stock for the countries included in the *Heating Market Report 2020* published by EHI, European Heating Industries.

http://www.ehi.eu/heating-market-report/heating-market-report-2020/

In the Heating Market Report the data is for all boilers < 400 kW. When updating the data, we have assumed that the share of small boilers is the same in 2017 as in 2013. We have updated the data for the following countries: Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Spain, Sweden and, United Kingdom.

For Poland and Sweden there are large differences between the number of boilers in the EC Mapping and the EHI report. When we compare the number of boilers with the total gas consumption for domestic heating, we find the EC data is more correct for Poland and we have kept these data. For Sweden we trust the EHI data to be most correct.

The annual gas consumption for domestic heating in 2013 can be found in Ecodesign Boilers Task 3, based on EUROSTAT data.

https://www.eceee.org/static/media/uploads/site-2/ecodesign/products/boilers/ecoboiler-task3-final.pdf.

When we compare the total gas consumption for domestic heating with the number of gas boilers multiplied by the average heat consumption for a standard family, we find that the number of boilers is too large in Belgium and Croatia. We assume this is because a large part of the boilers is used in small businesses. Therefore, we have adjusted the number of boilers downwards for Belgium and Croatia.