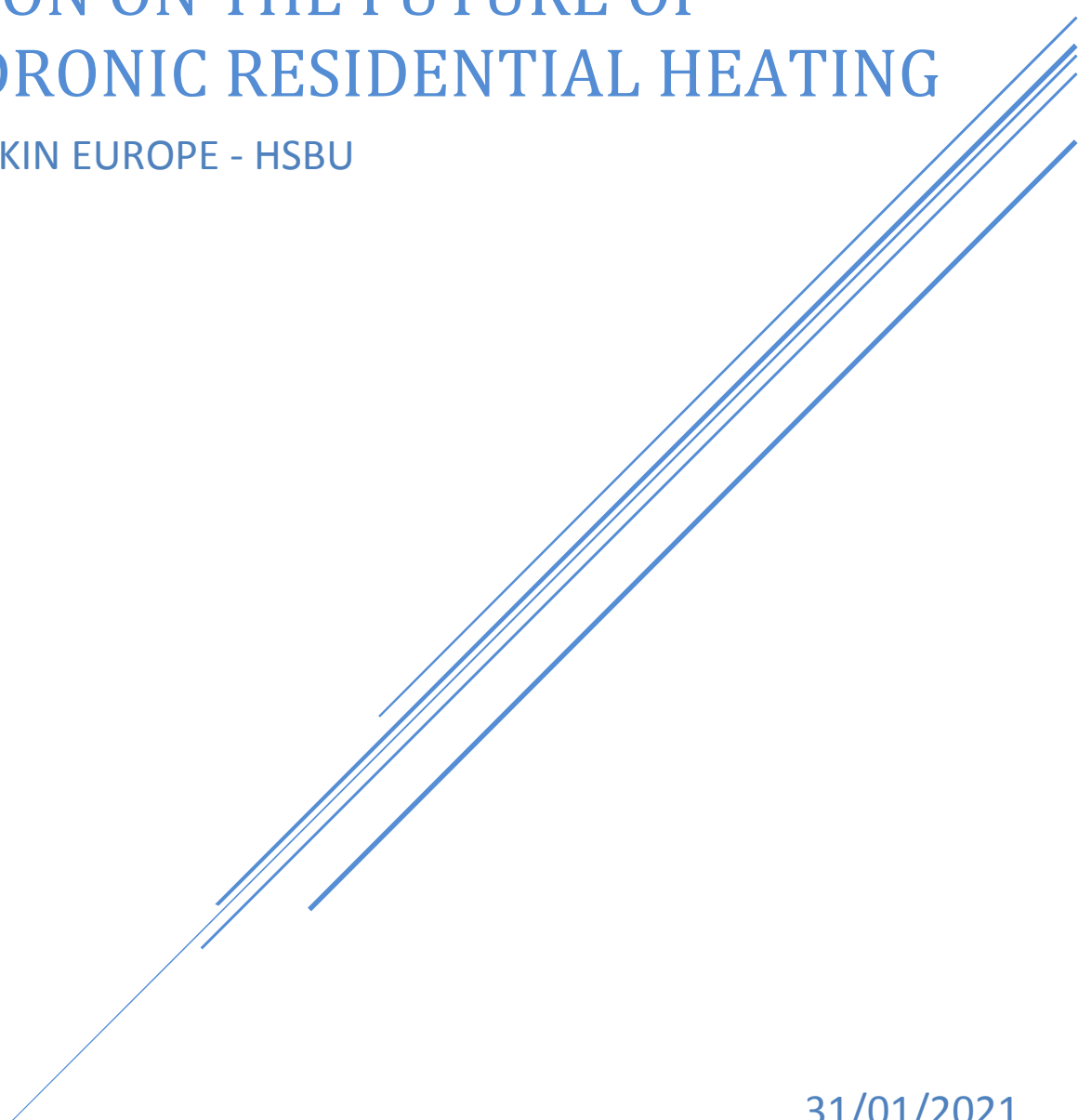


VISION ON THE FUTURE OF HYDRONIC RESIDENTIAL HEATING

By DAIKIN EUROPE - HSBU

A series of four parallel blue lines that start from the bottom left and extend diagonally towards the top right, creating a sense of movement and direction.

31/01/2021

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Introduction

In this document, Daikin reflects as leading heat pump manufacturer, on the Green Deal initiative to make Europe a carbon neutral economy and how residential hydronic heat pumps will play a key role within the residential sector and its impact in the heating industry.

Making Europe a carbon neutral economy is impossible without decarbonizing the building sector and the heating sector. Particularly impacting the efficiency of the building sector is the residential heating sector where fossil fuels such as coal are still used to heat European homes. European homes where the distribution is primarily made through water based (hydronic) system(e.g. radiators..)

From Daikin view, we need to answer the following question:

How to decarbonize this predominant residential heating system in Europe, which is distributed through hydronic technology?

Residential Hydronic heat pumps are one the most logical answer to that question.

- Through this document will take you through their advantages in term of adaptability to different market segments.(new built and replacement)
- How they are the solution for the environment and how it is an efficient technology
- Along with this, the hydronic heat pump industry is expected to expand, thanks to growing demand as a result of the renovation wave, which in return will translate into investments in R&D, Product development, manufacturing, sales -including pre and after sales. This will result in increased employment numbers, making it a strong European based heat pump industry sector.
- Ultimately European countries must find ways to end incentives for fossil fuel heating and promote renewable alternatives such as hydronic heat pumps to make heat pumps more mainstream within the residential market.

As Daikin we are determined to take that leap forward, and ensure heat pumps play an integral role in making Europe carbon neutral and in combining decarbonization with sustainable economic growth.

1- Green deal – Building sector transformation, the importance of electrification and heat pumps

The impacts of global warming are beyond dispute, with droughts, storms, and other weather extremes on the rise.

The European Commission has decided on a 'European Green Deal', which sets out to transform the European Union to a carbon neutral economy. The European Commission's Green Deal sets out a clear and ambitious goal: Europe targets to become the world's first carbon neutral continent by 2050. The Green Deal wants to attract (at least) €1 trillion in investments from the European Union, national governments and the private sector to decarbonize the continent. Now confronted with the COVID-19 pandemic and economic crisis, the Green Deal Investment Plan is also at the core of 'Next Generation EU', Europe's COVID-19-recovery program worth €750 billion.

Decarbonizing Europe and recovering from the COVID-19 pandemic are massive challenges. When presenting the Eu Green Deal, the European Commission's president Von der Leyen even called it Europe's "man-on-the-moon moment".¹

With the covid-19 crisis, the opportunity was there to accelerate the transition towards a climate neutral economy and many sectors are concerned. By 2030, reaching a 55% greenhouse gases emissions reductions target will be a significant investment challenge for the EU industry, buildings, transport and power generation sector being the main energy consumers and source of emissions, Figure 2 GDP and Net Emissions per industry from 1990 to 2050 (ref: European commission). This target is being applied to each country individually to be climate neutral by 2050.

Several strategic pillars have been defined to support this strategy. Making Europe a carbon neutral economy is impossible without especially decarbonizing the building sector and particularly the heating sector, hence the defined pillar: **Building and renovating in an energy and resource efficient way**. Figure 1 – The European green deal

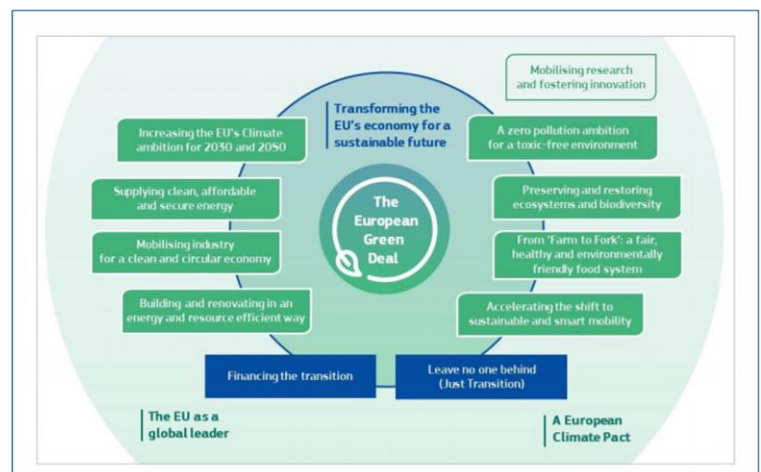


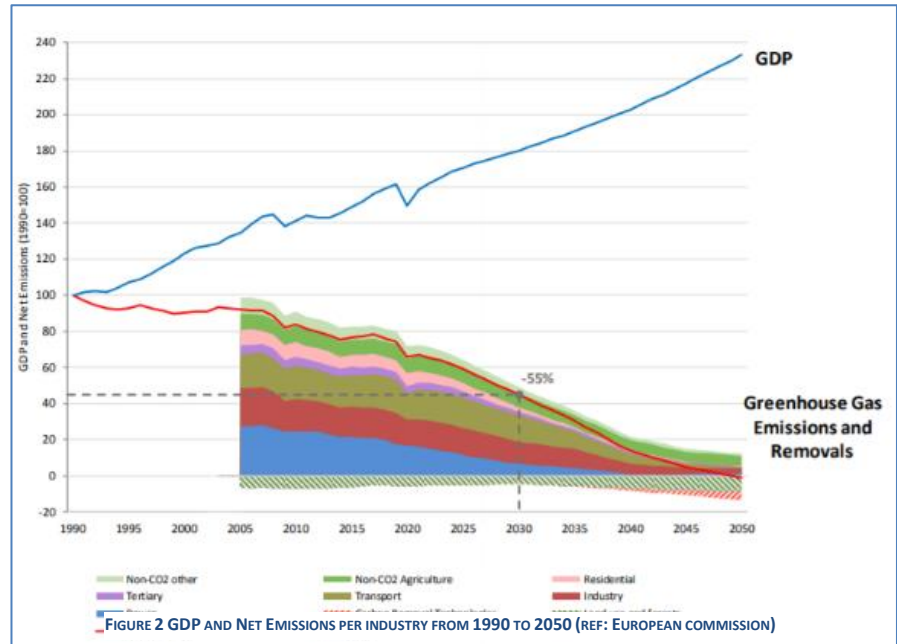
FIGURE 1 – THE EUROPEAN GREEN DEAL

Building sector transformation

¹ https://ec.europa.eu/info/publications/communication-european-green-deal_en

Historically, Europe building stock is very old. More than 220 million building units, representing 85% of the EU's building stock, were built before 2001. 85-95% of the buildings that exist today will still be standing in 2050.² Today, the European union building stock is responsible for approximately 36 % of all CO₂ emissions in the European Union. Taking into account that almost 50 % of Union's final energy consumption is used for heating and cooling, of which 80 % is used in buildings³, the potential for decarbonizing this sector is massive.

Today, 75% of the EU's building stock is energy inefficient. Many homes are still heated with outdated systems that use polluting fossil fuels such as coal and oil. To fully tap into this potential for improvement would require the renovation rate, which is around 1% today, to double and more in the period up to 2030.⁴



The residential hydronic heating system

Since most heated buildings in Europe rely on water to distribute heat in the various rooms. Hydronic (water-based) heat emitters, such as radiators, convectors and surface heating and cooling (e.g. underfloor heating), can be found in almost 130 million EU buildings. Not only are they crucial for peoples' comfort; they also bring energy savings and reduce CO₂ emissions.⁵

The best way to decarbonise this predominant heating system (hydronic heating) is therefore to use all advantages that hydronic heat pump provide to replace current combustion systems.

Secure EU energy system

The transformation goes also through a more secure and resilient EU's energy system. Fossil fuels, while so integrated in our way of life for over 150 years, are exposed to volatile fuel prices and supply disruption. The main imported energy product is petroleum products (including crude oil, which is the main component), accounting for almost two thirds of energy imports into the EU, followed by gas (24 %) and solid fossil fuels (8 %). In the EU in 2018, the dependency rate was equal to 58 %, which means that more than half of the EU's energy needs were met by net imports. The dependency rate on energy imports has increased since 2000, when it was just 56 %.⁶

² Renovation wave communication strategy - released on 14.10.2020

³ European commission: Stepping up Europe's 2030 climate ambition Investing in a climate-neutral future for the benefit of our people – sept 2020

⁴ Renovation wave communication strategy - released on 14.10.2020

⁵ EHI- heating market 2020

⁶ <https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2c.html>

Renewable energy generated in the EU reduces this the risks of import dependency , thereby increasing security of supply.

Role of electrification

The electricity grid enforcement will be essential to enable Europe to reduce this the dependency risk to control its energy within its in own border instead of relying too much on energy imports. The deployment of renewable electricity provides a major opportunity for the decarbonisation of heating and cooling in buildings and industry. The European commission states that *“renewables in heating and cooling would achieve around 40% penetration in 2030”*⁷.

From an environmental impact perspective, the increased electrification of end-use sectors accounts for almost 30% of the annual CO2 reductions in 2070 within the EU because it replaces fossil fuels with low-carbon electricity according to IEA report⁸. Although most of the reductions come from the transport sector, the electricity consumption for space heating or cooling in buildings will play a major role as well.

Among the various strategic pillars defined within the green deal initiative launched by the European union the focus on ***Building and renovating in an energy and resource efficient way*** will be essential to reach the carbon neutral target set for 2050. Specifically the transformation of the residential building sector, whether it is for new build or replacement, combined with an improved electrification grid are confirming the key role heat pumps and specifically hydronic heat pumps can play to achieve the ambitious target.

⁷ European commission: Stepping up Europe’s 2030 climate ambition Investing in a climate-neutral future for the benefit of our people

⁸ Energy technology perspective 2020 - <https://www.iea.org/reports/energy-technology-perspectives-2020>

2- Residential hydronic heat pumps are a fit for every residential building

As stated in the previous chapter, since most residential buildings in Europe rely on water to distribute heat in the various rooms it makes hydronic heat pumps an easy fit. The hydronic heat pump technology have known quite some improvements in the recent years which make them fit for any type residential building in Europe whether it is for the new build market or the replacement market.

New build market

Over the years, following the European EPBD directive⁹ all European member states have already put measures in place to ensure that **new built** houses have an improved carbon performance , through making improved building envelope and the use of renewable energy mandatory. As a result, Daikin estimates that heat pumps already have up to 50 percent market share in new (single family) houses. A typical example of such an installation can be found in France (Saint-Malo). A 6 kW low temperature heat pump was selected to cover the heating and domestic water needs of 100 to 130 m² houses.

A considerable additional benefit of hydronic heat pumps is the possibility to cool with it as well. In a standard set up, when a boiler is installed, a second HVAC system is required to be installed in case **cooling** is desired. Therefore, with a hydronic heat pump systems, consumers have it two in one. Cooling becomes more and more a requirement, partly due to climate change effect resulting in higher average temperature, and partly due to the higher insulation level of new built houses. Cooling via heat pump convectors or underfloor heating is the ideal opportunity to cool down the house. Today, hydronic heat pumps provide space heating, domestic hot water and cooling in one system. This creates an additional opportunity in efficiency to make use of one single system, maximizing reduction of CO₂ emissions, as well as benefiting of a single investment that covers the provision of total comfort in a house.

⁹ https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en

Multi family houses

Although we see heat pumps mostly applied **in single family houses**, we do recognize an increased interest in such application in new multi-family houses, even though governmental regulations for new built **multifamily** constructions are less strict when it comes to use renewable energies

Options here range from decentralised individual heat pumps per apartment to (semi-)centralised solutions. Having one heat pump per apartment is quite common for smaller buildings.

This is what was installed in 2017 in Boom (Belgium) where multiple apartment buildings totalised 116 Daikin Altherma 3 R heat pumps. Space heating was covered individually by underfloor heating, and domestic hot water needs were answered with an integrated 230 litre tank in each indoor unit.

Regarding centralised solutions, another project is coming to life in Belgium and the UK with Daikin collective water loop heat pump solution. The system is being set-up with Daikin Altherma Ground source units converted to water source, installed individually in each apartment and a chiller is used as the heat source¹⁰ -Figure 3 - WATER LOOP HEAT PUMP SOLUTION.

As apartment buildings form more than half of new build residential constructions, we believe there remains a large opportunity to further explore for heat pumps¹¹.

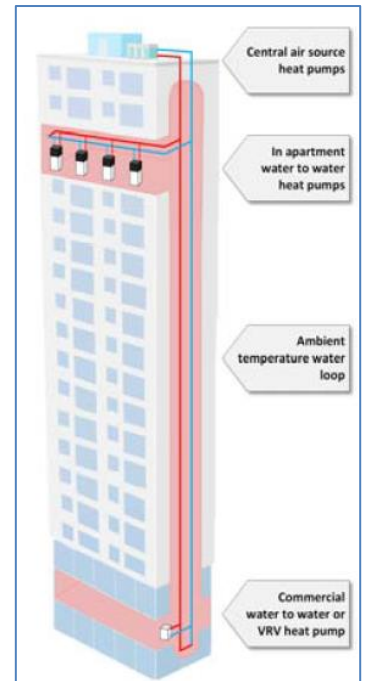


FIGURE 3 - WATER LOOP HEAT PUMP SOLUTION

¹⁰ <https://collectivehousing.daikin.eu/en-GB/>

¹¹ reference to Euroconstruct data

Replacement market

In the **replacement** market, it seems that home owners haven't quite caught on yet. Still a lot of communication must be done around the potential of heat pump in that segment so that the technology is more widely known and accepted.

Examples from across Europe show us the target of replacing fossil boilers with heat pumps is not out of reach. One of the most eye-catching stories occurred in Sweden in the 1980's, where the government started ambitious policy to replace fossil fuel boilers by heat pumps, following the oil crisis in the late 1970s, and the wish to reduce energy use resulting in lower dependency on fossil fuel supply. Today, heat pumps are the standard for heating and cooling Swedish homes. Over 60% of houses feature a heat pump (footnote: include reference to the measure in Sweden. This push to make heat pumps the standard technology for residential heating helped reduce greenhouse gas emissions of Swedish buildings by 90 %¹² and countries are following suit.

What the eighties mean for Sweden, could be the twenties for Netherlands, which is now targeting to move all residential buildings to be off gas in 2050, with the objective to reduce co2 emission by 80% compared to 2019. This policy is expected to result in having 2 key heating systems applied in the Netherlands : heat pump and district heating by 2050, gas boilers are expected to represent a mere 10% of the heating market.¹³

Results are already visible today in the Netherlands with 31.100 heat pumps installed in 2019 vs 5700 back then in 2015. To support this transition, an intensive training program is set up to secure the installer base grows accordingly, covering training of 6,000 engineers during the period 2019-23.

Today, a range of hydronic heat pumps is available to be installed in existing houses, thereby ensuring that the produced water temperatures are equal to the flow temperatures of condensing boilers and thus run through existing radiators. It is consequently a low carbon alternative for boilers.

Daikin recommends to design systems always with a temperature flow as low as possible to reach highest efficiency, though ensuring possibility for higher temperature flows for extreme conditions. Therefore the units are standard equipped with a weather dependent flow temperature setting , allowing the unit by itself to determine the optimum flow temperature to meet the actual demand.

Daikin has recently developed a dedicated unit to meet this segment, the Daikin Altherma 3 H HT. One of the first product installed replaced an oil boiler in Stuttgart (Germany). The house, built in 1988, has a living space of 230 m2. The Daikin Altherma 3 H HT came along with several advantages regarding heat emitters. The owners could keep their underfloor heating in the living room. They decided to modernize their radiators that would require less heating input for the same output and a better heat distribution on first floor¹⁴.

¹² <http://heatnetworks.se/history-of-heating/>

¹³ <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/07/The-great-Dutch-gas-transition-54.pdf>

¹⁴ https://www.daikin.de/de_de/kunden/referenzen-privatmarkt/renovierung_daikin_altherma_3_H_HT.html



The heat pump is a great deal, fitting perfectly throughout Europe, meeting new build and replacement requirements. Another argument for hydronic heat pumps is their strong advantage to be a great solution for the environment.

3- Residential hydronics heat pumps are the solution for the environment

Today, the European building stock is responsible for approximately 36 % of all CO₂ emissions in the Union.

Taking into account that almost 50 % of Union's final energy consumption is used for heating and cooling, of which 80 % is used in buildings¹⁵, the potential for decarbonizing this sector is massive. Something that the heat pumps will help succeeding at in 3 different ways:

- HP make use of renewable energy
- HP are an energy saving technology
- HP are a lower carbon technology compared to fossil combustion technology

Reducing greenhouse gas emissions through use of renewable energies

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

- Various type of **hydronic Heat pumps** exist and within the residential segment the following renewable technologies can be used.

Air to water heat pumps

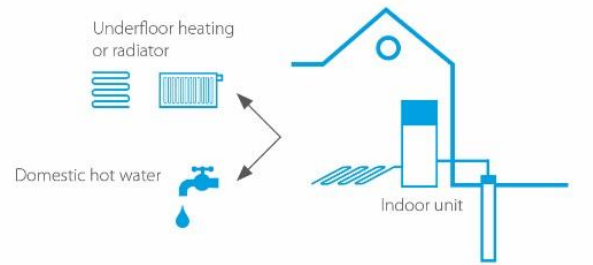
An air to water heat pump extracts heat from the outside air. This system transfers the heat indoors through a water circuit. An air to water heat pump can also meet your domestic hot water needs and, if needed, can provide pleasant coolness in the summer. This system offers a stable room temperature all year round



¹⁵ An EU Strategy for Heating and Cooling, consulted 17 September 2020, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0051&from=EN> and its Staff Working Documents, consulted 17 September 2020, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016SC0024&from=EN>

Ground to water heat pump

A ground to water heat pump extracts heat from the ground and convert it to the heat we use for heating at home. The advantage of geothermal heating is that the energy extracted does not depend on the sun or wind, and that it is the most constant

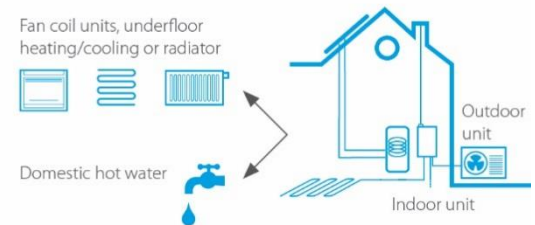


- In the case where end users live in the area with weak electric grid 100% electric heat pump are not possible, there is the option to opt for an hybrid heat pump.

Hybrid heat pump

Hybrid heat pumps have been developed as an intermediate solution. In many countries hybrid heat pump solutions have been developed, with an air to water heat pump is used in combination with a combustion boiler, especially to start decarbonization in on-grid areas.

Some hybrid heat pumps do manage the trade-off between both technologies by searching for the most economical or ecological condition depending on the specific operation conditions. Other hybrid heat pumps are more functioning as simple bi-valent options, where domestic hot water production is generated only by the combustion part.

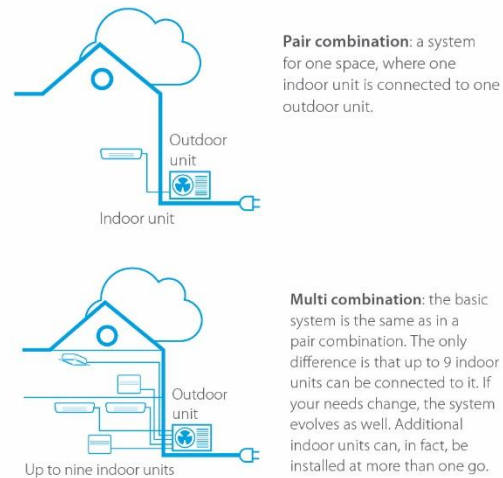


Hybrids do have a place in the market, especially in a transition period during which end users are made familiar with the heat pump technology. By using smart control technology hybrids can also offer flexible switching between energy carriers (gas, electricity) ; which is reinforced by the use of storage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

- An alternate solution to hydronic heat pump, often used in southern parts of Europe, is the air to air type of heat pumps

Air to Air heat pump

An air to air heat pump extracts the heat from the outside air and releases it as warm air inside your living space. During summer, this process is reversed: the heat indoors is removed and transported outdoors. This system guarantees you a constant temperature all year round



Heat pumps are an energy efficient technology

The thermal efficiency of a heat pump is described as coefficient of performance (COP). This factor describes the ratio of thermal energy produced (in other words the useful energy available for heating or cooling) over input energy to the process (in case of the electric compression heat pump this is the electricity needed to run the compressor).



FIGURE 4 EFFICIENCY OF A HEAT PUMP: THE RATIO BETWEEN USEFUL ENERGY AND ENERGY INPUT¹⁶

The efficiency of a heat pump systems in operation depends on the unit's efficiency and the thermal energy requirements of the building in which it is operated. In residential applications, the energy demand of the building depends mainly on its energetic quality and its local climate zone. The seasonal efficiency of a heat pump is determined by weighing the efficiency of the unit at standard operating conditions with the number of days at which these occur. The resulting measure is the Seasonal Coefficient of Performance (SCOP). This factor is determined using European standard EN 14825 and is also used to provide a more realistic comparison of heat pumps across different climate zones. The approach is the

¹⁶ EHPA white paper

basis to determine heat pump efficiency in the ecodesign regulation which is then applied to determine the energy label for heat pumps.¹⁷

Heat pumps are a lower carbon technology compared to fossil combustion technology

To demonstrate this point, *VHK Review study* report compares the GHG emissions between products when accounting for differences in product life and heat load. For each kWh of required heat, the carbon impact of a heat pump today is about half of a high efficiency gas boiler. It has even a lower carbon footprint potential due to the further decarbonization of the EU electricity production¹⁸.

If we take another angle and compare carbon intensity of gas boilers vs heat pumps vs direct electric heating, it is noticeable that heat pumps “can deliver immediate CO₂ emissions savings of 60-70% compared to conventional electric heating and 55-65% compared to an efficient gas boiler.” As stated in the London retrofit case made by Carbon Trust.¹⁹ This can vary country to country as the carbon savings depend on the electricity carbon intensity,

This Carbon Trust report confirms that Heat pumps “are a proven and scalable low carbon heat technology that can be readily and widely deployed to decarbonize heating in London’s existing buildings at all scale, from individual dwellings through to large-scale heat pumps serving heat networks” and that heat pumps are the primary option when it comes to decarbonize heat in London buildings.

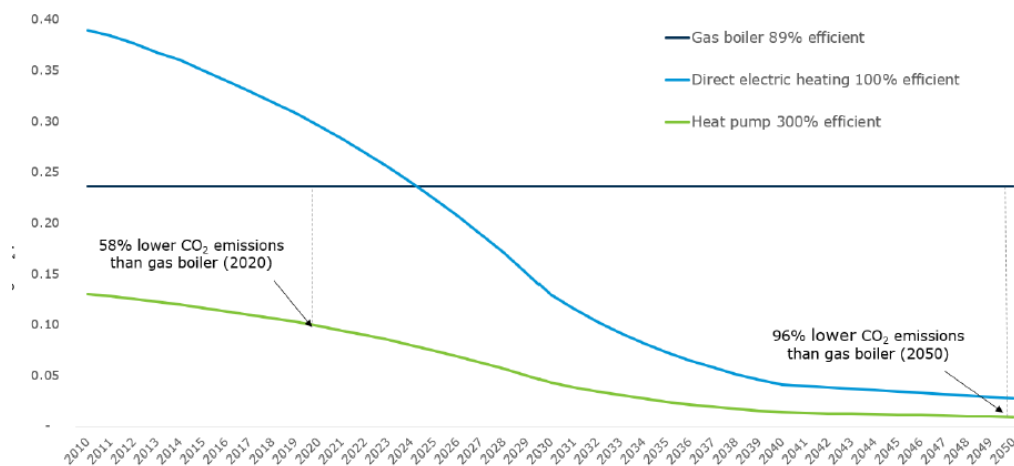


FIGURE 5 - CARBON INTENSITY OF GAS BOILERS AND HEAT PUMPS AT DIFFERENT EFFICIENCIES: 2010-2050

¹⁷ EHPA white paper

¹⁸ VHK Review study Ecodesign and Energy labelling of Space and combination heaters, Task 5, Figure 7, consulted 17 September 2020, <https://ecoboiler-review.eu/Boilers2017-2019/downloads/Boilers%20Task%205%20final%20report%20July%202019.pdf>

¹⁹ London retrofit case made by Carbon Trust



These 3 advantage makes the heat pump a great deal for the environment, matching perfectly the need for Europe to achieve zero CO2emission by 2050, and preserve the environment. Not only it is a great technology for Europe but it is also a technology being developed in the old continent.

4- Investment for residential hydronic heat pumps are made in Europe

Thanks to the high European requirements, as set forward by the Eco-design directive, the EPBD directive, the various European climate conditions per region and the customer expectations, manufacturers are driven to develop heat pumps in Europe, for Europe. This is the case for Daikin who set up its **European Development Centre (EDC)** in 2015 where heat pumps, its accessories and combinable products are being developed, by a team over 130 engineers, representing an annual investment in new heating product development of over 30 M€.

The industry has been working continuously on improving the performance level of hydronic heating pumps, and Daikin's European Development centre has played a key role in this.

Some achievements in industry's and Daikin's progress are :

- Improved efficiency levels, increasing the use of renewable energy (vs electricity): In 2007, the first generation of Daikin Altherma heat pumps was showing a COP of 4,56. The third generation of Daikin Altherma launched in 2019 reaches a COP of 5,1, concluding an increase of 12% over 12 years. As far as the Seasonal COP (SCOP) is concerned, the second generation of Daikin Altherma from 2012 displayed 3.29 in average climate 35°C conditions while Daikin Altherma 3 hits 4,56. On a European level, the EU introduced the energy label framework for the first time in 1992 but this is only in 2015 that all space heaters had to carry an energy label describing its efficiency up to A++. This scale was moved up in 2019 to elevate the requirements up to A+++ label, that Daikin's latest hydronic heat pumps are able to reach.
- Introducing solutions to reduce the sound level of the heat pump's outdoor unit, to meet end users increased sensitivity to ambient noise and/or local government requirements in urban or dense populated areas. Solutions go from applying sound covers on existing units, offering limited sound reduction without effecting overall heat pump efficiency²⁰ to dedicated outdoor units including newly developed components like fans to secure lower sound effect in operation mode²¹.
- Implementing state of the art connectivity technology, from factory mounted integrated man-machine interface²², allowing easy & remote commissioning of units, up to online and voice control via app²³, enhancing the end user efficient use & monitoring of the heat pump.

²⁰ https://www.daikin.eu/en_us/products/EKLN-A.html

²¹ https://www.daikin.eu/en_us/product-group/air-to-water-heat-pump-high-temperature/daikin-altherma-3h-ht.html

²² <https://youtu.be/zUTwGQHYt7s>

²³ https://www.daikin.eu/en_us/product-group/control-systems/daikin-online-controller.html

- Creating specific design features transforming both the indoor and outdoor units into much more attractive units. For Daikin, the product design has now become a core value for its European developed residential units²⁴.

Heat pumps have gradually stepped up a great deal over the past decade and have all the specs and looks to meet the industry and public's requirements in Europe. And even beyond, as we experience an increased sales interest in our European developed products in other the Americas and Australasia.

²⁴ Outdoor units, second generation https://www.daikin.eu/en_us/products/ERRQ-AV1.html vs. third generation Daikin Altherma https://www.daikin.eu/en_us/products/EPRA014-018DV.html.
Indoor units, second generation https://www.daikin.eu/en_us/products/EHVH-CB.html vs. third generation Daikin Altherma https://www.daikin.eu/en_us/products/EHVH-D6V.html

5- Economic impact linked to residential Hydronic heat pumps

The European heat pump sales grew by 14.4% in 2019 ²⁵– market has reached its fifth year of double-digit growth in a row with 1.5 million units (all heat pumps types) sold across Europe. Assuming a life expectancy of approx. 20 years, the current European heat pump stock amounts to 13.23 million units in 2019 according to EHPA. With approximately 115-120 million buildings in Europe, the heat pump market share in the building stock is around 10%²⁶. To support this market and growth, companies are investing more and more within the heat pump renewable market. Consequently numerous jobs are created around that industry.

In Europe

The heat pump industry is a robust provider of employment in Europe. While the heat pump value chain (suppliers, manufacturers, installers, dealers) today is global, many leading companies are located in Europe, creating not only products that are installed locally, but also an export opportunity for the region. The EHPA estimates that more than 68 000 full-time jobs are involved to produce, install and maintain the annual sales of heat pumps in Europe (data for 2018). Considering that not all employees work full time in heat pump related projects, the total number of people benefiting from the technology generating employment is even larger.

If we look specifically at the year 2020, 615.000 hydronic heat pumps have been installed for the residential market, resulting in a value of 2.4 billion euros.

In Daikin Europe

The residential hydronic heat pump business and related heating activities is equally a source of economic growth for Daikin Europe, now representing a good 15% of its European business. Over the past 45 years, Daikin has succeeded to build upon its Japanese roots and use the richness of European talent to create a strong and sustainable business throughout all European countries. We now count 5 factories in Europe related to heat pump technology., making every euro invested in heat pump technology a euro invested in local job creation. In Daikin Europe the number of people working for the residential hydronic heat pump technology (engineer, workers, sales) has doubled since 2016.

While the investment on new product development is about 30 million euros in 2020, the investment made in heating production has reached around 56 million up until 2020 due to the increasing market demand and potential for this technology to support both the economy and the renewable target.

²⁵ EHPA market overview and statistics - 2020

²⁶ EHPA market overview and statistics - 2020

These are sizable numbers, and with a promising outlook towards the future, new investments in renewable heating will pay dividends for the European economy and act as a great deal for the member states and companies involved ! Nevertheless, compared to the conventional heating industry (6.4 million boilers sold in Europe in 2020), it is clear that the heat pump industry is still far from being mainstream.

6- How to make heat pumps mainstream ?

Europe plans to decarbonize the future, we call on all EU countries and policy makers to take action on 2 levels.

End fossil fuel – it has already started

The most polluting heating systems must be phased out. And we see first examples popping up, like in Austria, where, as of January 2020, installing oil-based boilers in new homes is no longer allowed in Austria. All incentives for fossil fuels need to be ended or should be reconsidered. In the short term, government incentives can help accelerate the transition to carbon-neutral heating and make heat pumps accessible to all Europeans, but in the longer term more balanced energy prices and a correct indication of the energy and carbon performance of a building need to be the end user motivations to invest in heat pump technology. Indeed the gap between electricity and gas prices in many member states is too high to make a heat pump an economically attractive investment for EU citizens⁹. Incentives can bridge that gap for a certain period, but in the long run, the cost of energy should reflect the carbon intensity more.

Renewable technologies also need a level playing field

Such a policy can only be implemented by changing how price and taxation level are defined. The current situation of prices and taxes in 2019 shows discrepancy between gas and electricity (see annex). A level playing field must be created. High taxes on electricity might cause fossil fuels to appear more attractive to consumers. Policy makers can make sure to check that fossil fuel and electricity are priced and taxed on equal footing.

Instead of making the polluter pay for emissions by adding related cost to the price for fossil energy, most governments still support their use – directly or indirectly – and leave the cost of environmental damage of fossil fuel for society to pay.

Narrowing the gap between electricity and natural gas prices would accelerate uptake in market segments that are already expanding (e.g. air-source heat pumps for new buildings) and foster deployment in new ones (e.g. existing buildings).

Truly strategic policy should prefer not to incentivize any fossil fuel system, while sustainable and energy efficient alternatives such as heat pumps are already available.

Motivate the end-user

Finally, **consumers** who are looking to replace their fossil fuel systems need **to be motivated** to take a closer look at low to zero carbon heating systems

As explained earlier, we – and with us the whole industry - innovate relentlessly to make heat pumps performing and attractive through a mix of product features, pricing, design, installer and end user

friendliness. However, we do see that some consumers don't seem to include heat pumps yet in their consideration set when they replace their heating system.

Governments can set the scene, i.e. through incentives for residential renovations, that offers a strong signal for the consumer: it draws attention to heat pumps. It invites consumers to do a thorough calculation of total cost of ownership and ecological advantages. At that point, the advantages of heat pumps will become evident to consumers. Significant initiatives are already taken, such as :

- Extensive fuel boiler replacement schemes set up in France and Germany
- A 'Super Eco bonus' package is set in motion in Italy, to promote heat pumps, with even a 110% payback credit possibility aimed at low income households

In the short term, subsidies for low to zero carbon heating can help accelerate this transition to carbon neutral heating and make heat pumps accessible to all Europeans . The examples of France, Germany, and Italy clearly show governments are starting to take action

However, in the longer term accurate energy prices and a correct indication of the energy and carbon performance of a building need to be enhanced to motivate the end user to invest in heat pump technology.

We are convinced of the potential and relevance of heat pumps as a key player in the transition. We do take note of and encourage that new technologies are and will continue to be developed in this field. Recently, the use of hydrogen based heating has gained quite some attention. We believe that indeed, this will play a role and will be part of the decarbonisation of heating. However, this solution is at the same time also applicable in other sectors where similar ecological targets exist, eg. Transport, to name one, where alternative might not exist. We estimate that availability is by far not sufficient to answer the demand and cannot be the only technology to look at.

The heat pump is a great deal, together with the deployment of renewable electricity at more fair cost it will provide a major opportunity for the decarbonisation, for heating and cooling in buildings and industry.

7- Daikin Ambition

We at Daikin see that hydronic heat pumps are a technology of today that is ready for mass adoption: every European's next heating system has the potential to be a heat pump

We at Daikin will take on the challenge, as a committed key player in the hydronic heat pump – and by extension heating – industry, to ensure end users are aware of the technology and its advantages. And we'll also create a well-trained installer base to secure proper installation and follow up.

We at Daikin have set our own ambitious target to become a carbon neutral company by 2050.

We call upon all stakeholders – politicians, industry leaders and citizens – to do the same and to invest in heat pumps today. If we succeed in making heat pumps the standard of European residential heating, carbon neutrality is within our reach. Sweden made the shift towards heat pumps with amazing results. Now imagine we are able to achieve the same transition across the entire European Union and the potential benefits for our society

We at Daikin fully support the European Green Deal, a great deal with potential to lead us to carbon neutral heating. It is ready to go mainstream – we just need to act

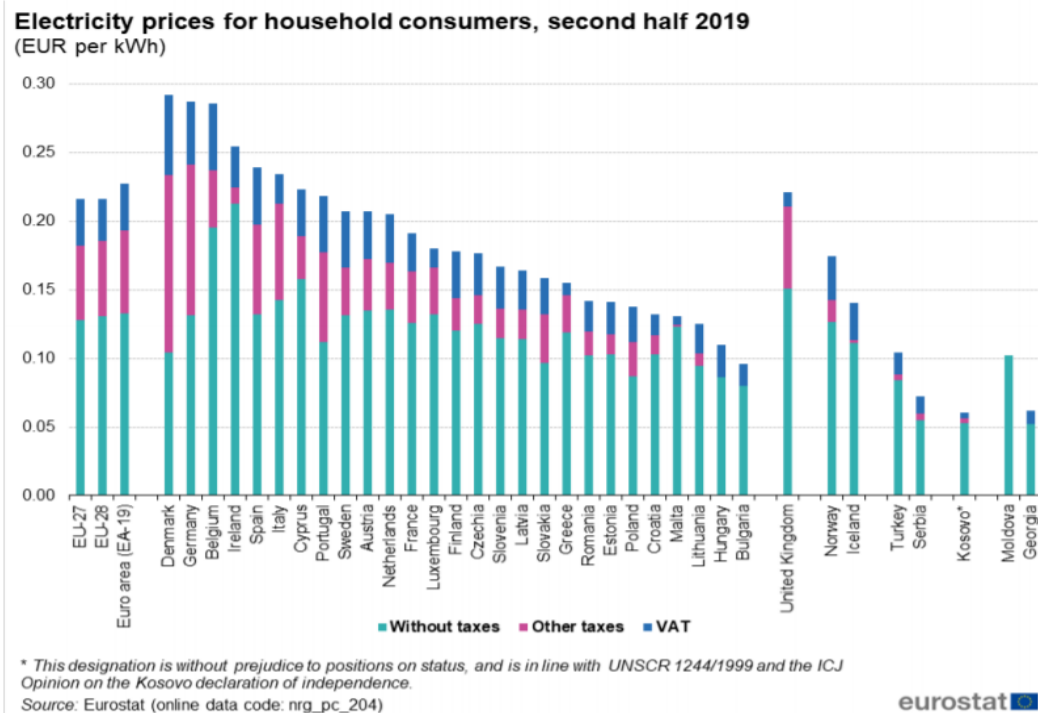
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Annex

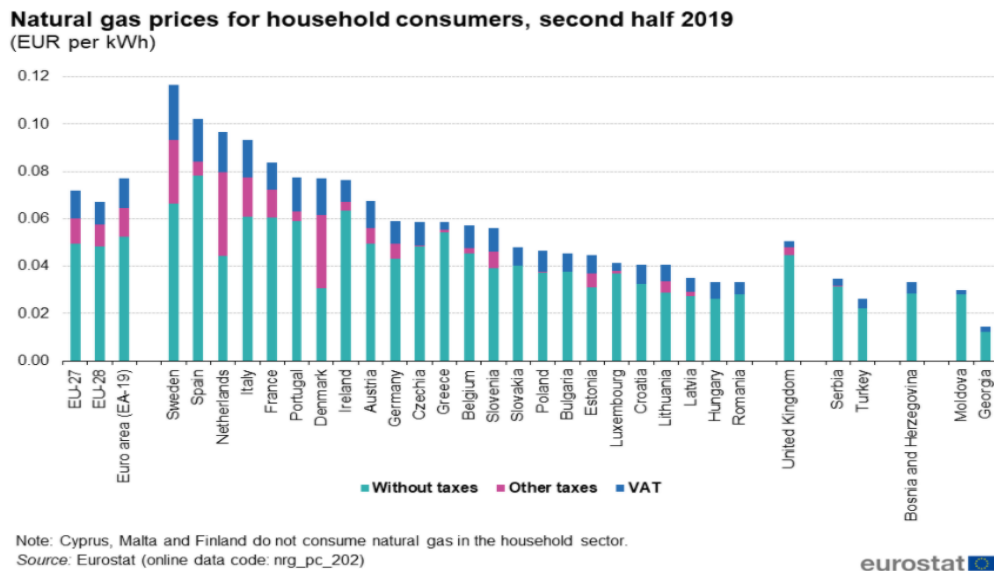
From overall price standpoint prices are three times higher when it comes to electricity. Overall in Europe the electricity price for household consumers is 3 times higher than gas(0.20 euros per kw for electricity versus 0.07 euros for gas) (Figure 6 and Figure 7) For some countries the gap is huge. Belgium and Germany stand at an electric household price of 4.5 times higher than gas (0.28 vs 0.06 euros) Figure 6 and Figure 7)

FIGURE 6 - ELECTRICITY PRICES FOR HOUSEHOLD CONSUMERS – SOURCE: EUROSTAT



²⁷ <https://ec.europa.eu/eurostat/statistics-explained/pdfscache/45239.pdf>

FIGURE 7 -GAS PRICES FOR HOUSEHOLD CONSUMERS – SOURCE: EUROSTAT



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- one of the main element of this price difference is the taxation where electric is much more taxed than gas. Overall in Europe 40% for electricity vs 30% for gas
The gap is even bigger for some key demographic countries in Europe such as Germany and Spain which are at more than 45% taxes on electricity household prices while only about 20% for gas. (Figure 8 and Figure 9)

FIGURE 8 - SHARE OF TAXES AND LEVIES PAID BY HOUSEHOLD CONSUMERS FOR ELECTRICITY -SOURCE: EUROSTAT

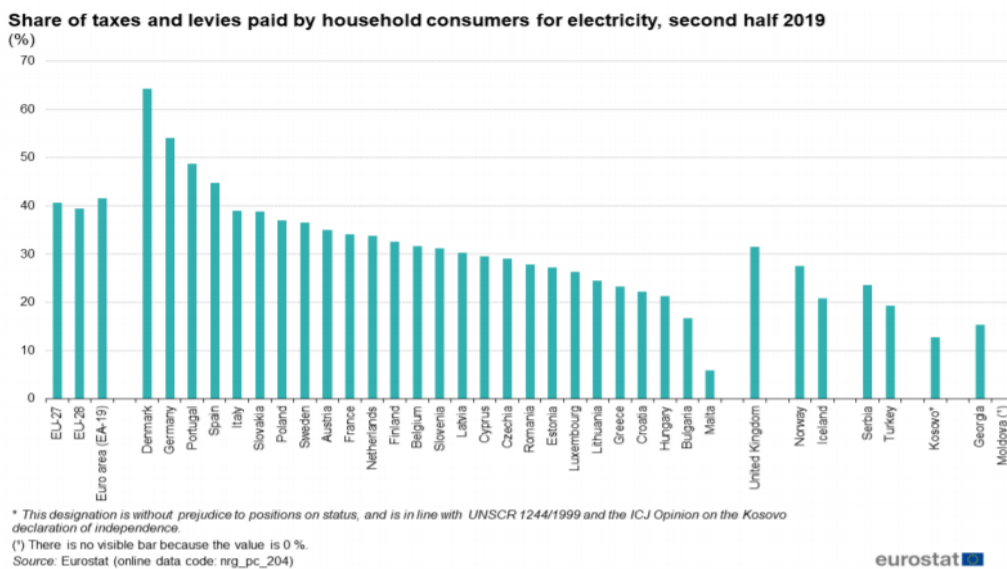
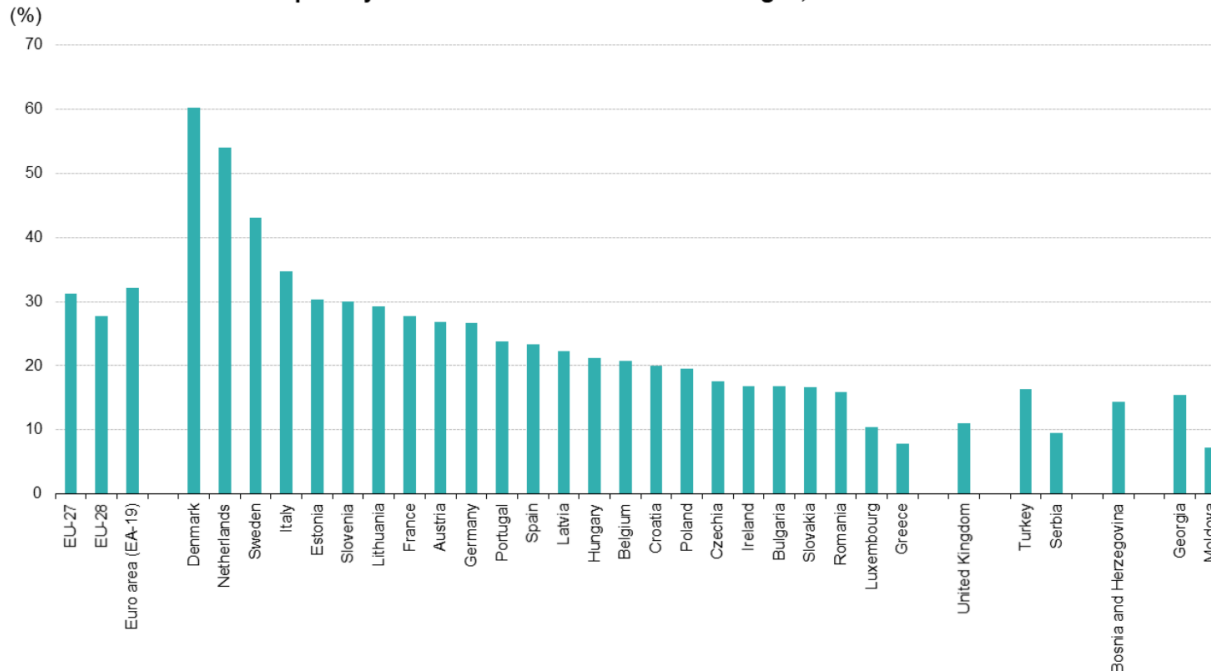


FIGURE 9 - SHARE OF TAXES AND LEVIES PAID BY HOUSEHOLD CONSUMERS FOR NATURAL GAS -SOURCE: EUROSTAT

Share of taxes and levies paid by household consumers for natural gas, second half 2019



Note: Cyprus, Malta and Finland do not consume natural gas in the household sector.

Source: Eurostat (online data code: nrg_pc_202)

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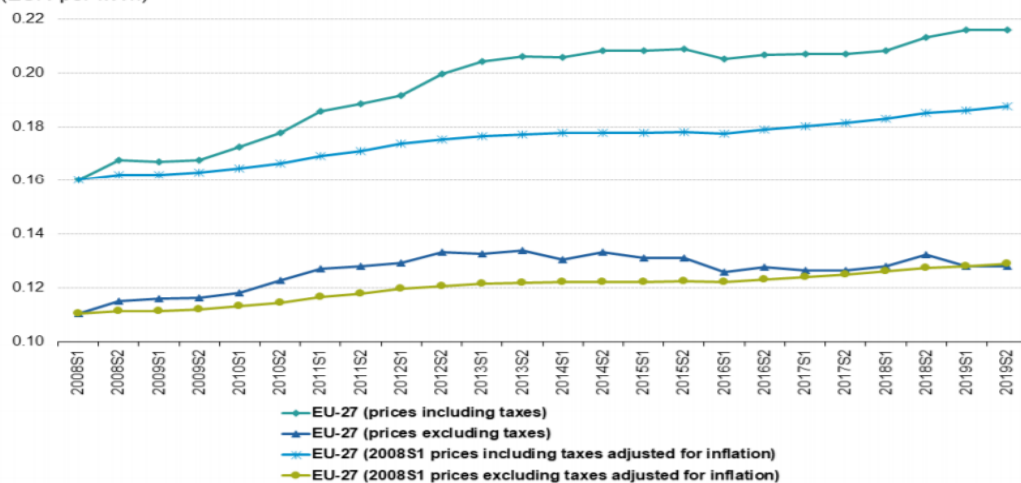
eurostat

Price of electricity without taxes has been quite stable since 2014, standing at about 0.1280 euros per kWh. However, the weight of taxes has increased continuously from 31% in 2008 to 40% in 2019. As a consequence, the total price for household consumers, i.e. including all taxes, was substantially higher (17 %) in the second half of 2019 than in the first half of 2008 when adjusted for inflation. (Figure 10)

FIGURE 10 - DEVELOPMENT OF ELECTRICITY PRICES FOR HOUSEHOLD CONSUMERS, 2008-2019

Development of electricity prices for household consumers, 2008-2019

(EUR per kWh)



Source: Eurostat (online data code: nrg_pc_204)

eurostat