

TOPLOTNE PUMPE U SLUŽBI DEKARBONIZACIJE REZIDENCIJALNOG GREJANJA

HEAT PUMPS IN THE SERVICE OF RESIDENTIAL HEATING DECARBONIZATION

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One of most important initiative EU ever made, Green Deal, targets 2050 Europe to be the first climate neutral continent, with carbon neutral economy, and carbon neutral building stock. On the EU member state level, National Energy and Climate Plans are made with 10 year span, which should show more concretely the way every member state is taking, in order to reach own decarbonization targets which contribute to commonly set EU targets. Some of those targets are: reduction of greenhouse gasses emissions, increasing energy efficiency and increasing share of renewable energy. Main driver in many countries is renovation wave of inefficient buildings (75% of all buildings in EU), since building stock is responsible for 40% of energy consumption and 36% of CO₂ emissions (EU Energy Performance of Buildings factsheet). So the opportunity only here is massive. Heat pumps, a solution which was considered an effective and efficient technology for heating and cooling for quite a while, now appear to be a key solution for decarbonization of heating, especially in residential applications (but not only). They are reliable, proven to work, useable in different climates, using clean renewable energy. With their high energy efficiency, heat pumps easily contribute to EU goals of 2050 to achieve climate neutrality. Here will be shown relation between heat pumps and EU decarbonization goals in achieving better tomorrow.

Key words: decarbonization; heat pump; green deal; renewable

1 Introduction

Maybe it is the expected to start from Green Deal, or some well-known EU legislation, to explain why we need to take care our technological solutions support achieving EU decarbonization goals – 2050 is the year Europe targets to become carbon neutral continent – the first in the world. First important milestone is 2030, where emissions are planned to be reduced by 55% compared to 1990 level. Those ambitious targets are a real challenge, because we are not yet on a clear path how to achieve it, so extra efforts are to be taken to find solutions how to really reach those targets. EU is carefully presenting ‘fit for 55’ package², to get attention and change and adapt existing legal climate, energy and transport legislation to support efforts to reach decarbonization targets. But if we would start from the personal perspective of an average citizen of Europe, would it also be easy to explain why we should hurry up and adapt a technology in our homes to less familiar, usually more expensive solutions, because someone said so? Moreover, why would this citizen do it, if it is not mandatory to do it? Is our planet really warming up? There are different groups which promote one or another radical solution, some even don't accept global warming as a fact. Lots of people are still 'agnostics' in this planet warming thing. But whatever the reason is, facts are telling us - we are getting warmer. Could we really miss the chance, and give our personal contribution to an opportunity to stop, or at least slow down the process of global warming? Hopefully not. Green Deal opens a lot of topics, and all to guide our continent towards decarbonization. For our industry, key challenge is to grapple with one of the most difficult steps on this way – decarbonization of energy we use for space and water heating – our everyday energy needs and comfort.

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² <https://www.consilium.europa.eu/en/policies/eu-plan-for-a-green-transition/>

2 Energy used in households

Space heating and hot water preparation are responsible for 78,4% of energy consumption in an average EU household³, as visible in the fig. 1.

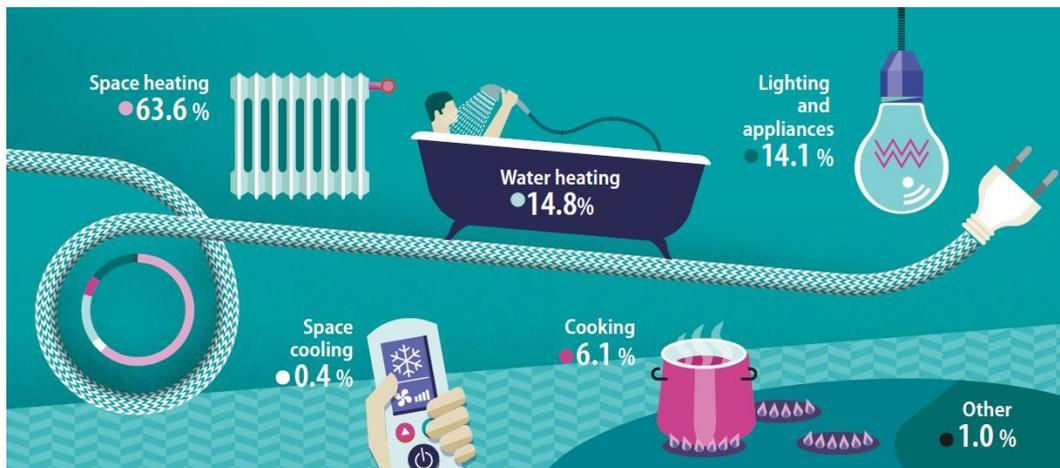


Figure 1: Energy consumption in households in 2018, EU27

About 26,1% of final energy consumption in 2018, goes to households⁴. Easy counting gives that space and water heating in households are responsible for more than 20% of final energy consumption in EU. Out of this 20% of final energy consumption (meant for heating and cooling), only 21,1% is renewable energy⁵. A part of it comes from aerothermal, geothermal and hydrothermal heat energy captured by heat pumps, but still, all those numbers are too low, having in mind the potential and benefits which can and should come out of using renewable energy in our households.

Renovation of a building stock (75% of all buildings need renovation because they are energy inefficient)⁶, which is ongoing in Europe, puts a lot of focus on the building envelope and heating energy source - all to reduce energy consumption of buildings and to decarbonize the energy left. Subsidies, used to boost the renovation of buildings, also subsidise energy source for heating, but it is mandatory that the heating is renewable and decarbonised. Unfortunately, the current renovation rate of 1% per year is not good enough to achieve targets of decarbonised building stock, and this pace will have to be doubled and even trippled in next years. Therefore it increases the pressure to address decarbonization of our household energy for heating from all sides.

Energy sources usually used for heating: fossil (gas, oil, coal for different systems, etc.) electric (heat pumps, electric heaters), wood, biomass (pellets and other), and district heating, which decarbonization depends on the energy source it uses.

3 Decarbonization of household heating by heat pumps

A heat pump is an energy saving technology that transfers heat without the need to generate heat. It uses electrical energy as an energy impulse (i.e. to a compressor) to transfer a heat. A heat pump takes a heat from outside ambient and warms up a warm indoor space even more. In cooling mode the process is reversed³, and heat is given to the outside ambient, and cool space becomes cooler. Of course, for such action, input of electrical energy is required.

Heat pumps are used for effective decarbonization of a heating. First, it uses renewable energy either from air, water or ground (geothermal), and turns this energy to a heat. Such energy, recovered from the ambient, is called useful energy, and this is a difference btw. output energy (heat) and input energy (electricity). Heat pumps produce a lot of useful energy (the output energy is significantly higher than input), and all this energy is renewable. Such renewable energy, used by heat pumps, adds to the renewable energy balance of a respective country, so it contributes to the targets set by country

³ Energy, transport and environment statistics, EUROSTAT 2020, page 24

⁴ Energy, transport and environment statistics, EUROSTAT 2020, page 21

⁵ Energy, transport and environment statistics, EUROSTAT 2020, page 39

⁶ https://ec.europa.eu/energy/content/factsheet-energy-performance-buildings-directive_en

National Energy and Climate Plans (NECP)⁷. Since the output energy is higher than input one, heat pumps are highly energy efficient. Analyzing comparable heat sources (gas, oil, direct electric heating) hydronic heat pumps are three times more efficient and use renewable energy at the same time. As heat pumps are integrative into smart systems, it will play an important role in the energy grid balancing, demand side response (DSR) as intelligent energy use, where the user will be able to increase or decrease the energy use, or even shift it to some other time. Such smart integrability enables preemptive maintenance (remote monitoring systems) which will enable longer, safer and more reliable use of the heating systems. This last part connected to smart integrations, is not yet fully included into the decarbonization benefits of heat pumps.

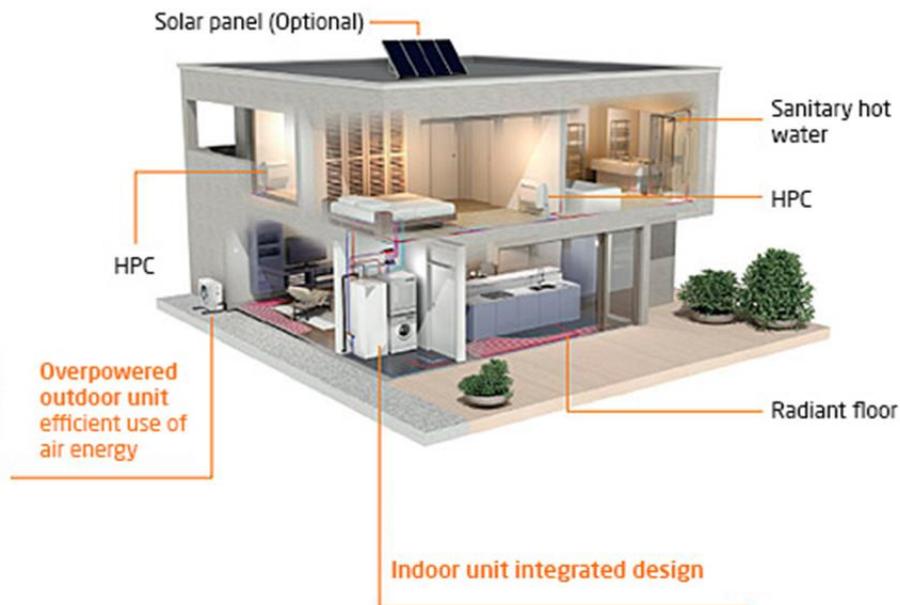


Figure 2: Heat pump installed in one family house with optional solar panel for hot water production

Secondly, it is a low carbon technology which is abundantly available in Europe, so not import dependent. By using heat pumps, we rely on electrical energy as a source of energy for heat pumps, but the energy for heating (or cooling) we receive is much higher (three times and more) and this energy is ‘produced’ in EU (we use ambient which is taken at the site of use). On the other hand, 61% of energy needs of EU in 2019 are imported⁸. It means EU dependency on energy import is critically high, and Europe is taking actions on reducing this dependency. So, we have a lifetime opportunity to strengthen our energy system and reduce energy dependency of EU, and at the same time decarbonize our buildings and industry.

Third point is retrofitting heating system to replace gas boilers with heat pumps. Heat pumps can have an immediate effect on CO₂ emission savings of 55-65% compared to an efficient gas boiler (fig. 3). Carbon savings are expected to increase to 90-100% of carbon emissions by 2050, as the grid will be decarbonized. The European commission states that renewables in heating and cooling would achieve around 40% penetration in 2030⁹, which is a challenging target having in mind today’s figures of 22%¹⁰.

There are two general directions in residential sector for heating decarbonization. First one is considering new buildings, which are in scope of Energy Performance of Buildings Directive (EPBD), which conditions all new buildings to be nearly zero energy buildings (nZEB)¹¹. By respecting those conditions, and using i.e. heat pumps for heating, all new buildings will significantly reduce

⁷ Renewable energy share in gross final consumption of energy, based on RES formula, for more information pls. use https://ec.europa.eu/eurostat/web/products-datasets/-/t2020_31&lang=en

⁸ <https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2c.html>

⁹ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0562&from=EN>

¹⁰ <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20201229-1>

¹¹ https://ec.europa.eu/energy/content/nzeb-24_en

amounts of used energy, and a big part of this energy will be renewable. Second direction in renovation of existing buildings. As already mentioned, European building stock consists of old buildings with very low energy efficiency, spending way too much energy to achieve necessary comfort. Most of them use fossil fuels for heating. By using renewable energy source for heating, such as heat pumps, decarbonization happens instantaneously – fossil fuels are avoided, and high energy efficiency is achieved.

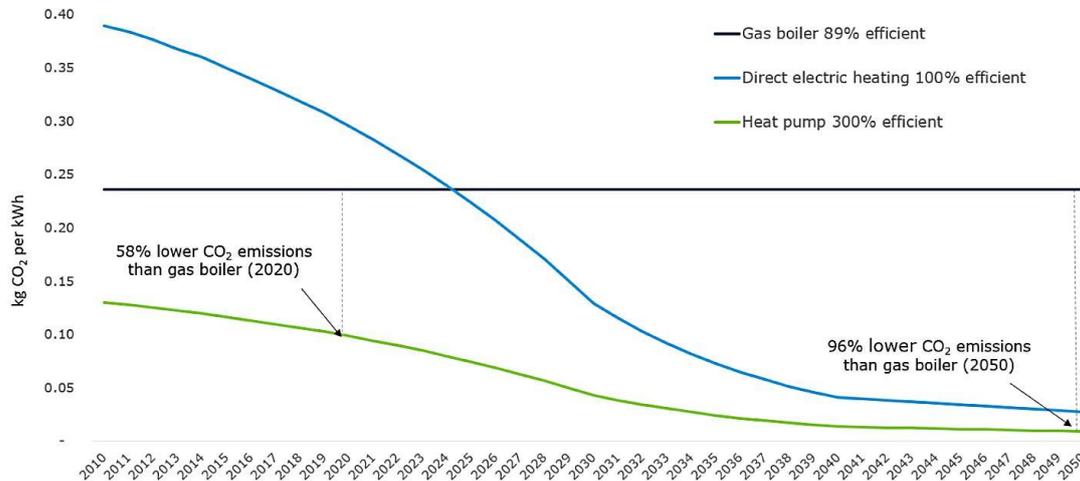


Figure 3: Carbon intensity of gas boilers and heat pumps 2010-2050¹²

4 Conclusion

European hydronic heat pump sector has a highest standard worldwide and it supports EU economic growth. It is estimated it employs 225,000 people (only production, installation and service around 90.000)¹³. The heat pumps, manufactured in Europe and using Europe produced decarbonized electricity, represent the key tool for decarbonization of heating in Europe, which accounts for 20% of final energy consumption. If the residential heating is decarbonized, we have done a huge step towards buildings' decarbonization.

Impact on the CO₂ emission reduction is also very high – replacing fossil gas boiler by a heat pump instantly reduces 55-65% of carbon emissions, which is pretty impressive – more than half of emissions disappear.

But it is not just replacing fossil fuels and decarbonizing of heating. It is also improvement of business and living to a sustainable level, keeping in mind other two components of sustainability next to environment - economic and social component. There is a pending possibility, through renovation wave in Europe, to refurbish 75% of buildings which are energy inefficient. This will have also positive financial and comfort impact for the building users, not only positive impact on environment. It will also 'grease the wheels of economy', in this case European economy, with all kinds of benefits which economy uptake brings. And, as mentioned, user comfort and safety will not be reduced - it should be even higher having in mind flexibility and possibility of a smart integration of heating systems with heat pumps. So, sustainability of heating system with a heat pump is visible in all segments of business and living, contributing also to EU goals set by the Green Deal - to decarbonize our businesses and building stock and to achieve overall carbon neutrality in Europe.

Some problems also have to be addressed. Legal frames in European countries are necessary to be modified and made 'fit for 55'¹⁴ - to create favorable environment, but not only that. Implementing mandatory conditions in regulations to expand use of renewable sources for heating in both new and renovated buildings, would give additional motivation to the users to switch from fossil fuels and other non-efficient heating sources. There is a wide option of tools available to legislators –incentives,

¹² Carbon trust, Heat pump retrofit in London, August 2020

¹³ EHPA Market and Statistic Report 2021

¹⁴ <https://www.consilium.europa.eu/en/policies/eu-plan-for-a-green-transition/>

green loans, low cost electricity tariffs, tax advantages, CO₂ taxes, maximum CO₂ footprint per m², etc.

Finally, special attention has to go to skilled installer market. Europe is missing skilled workers and specialists, and higher financial power of developed part of Europe is attracting skilled workers from lower income markets, creating unequal situation among markets in Europe. Necessary is to take immediate step towards balancing labour market, to start solving discrepancy btw. job profiles needed and job profiles available on the market.

5 References

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