RENEWABLE HEAT SOURCES: THE BEST AVAILABLE SOLUTION TO DECARBONISE THE HEATING SECTOR

JOINT POSITION PAPER MAY 2017

AEBIOM
EUROPEAN BIOMASS ASSOCIATION

EGEC
GEOTHERMAL

ESTIF
European Solar Thermal Industry Federation

KEY MESSAGES

This paper aims to present the position on the role of electricity in the heating sector.

- Energy demand in the form of heat is best covered with energy production in the form of heat. This is the most efficient approach, as it does not require additional conversions of energy form (the famous 2nd law of thermodynamics).

- Discussions on the link between electricity and heating should pay close attention to the difference between an efficient electrification, carried out using renewable sources of electricity, and smart and efficient heat technologies (such as heat pumps with a seasonal coefficient of performance -SCOP higher than 3), and a wild electrification, which is based on inefficient appliances such as direct electric heaters.

- A wild electrification of the heating sector may increase energy poverty and put European industries' competitiveness at risk as the cost of renewable heat technologies will continue to decrease while electricity will become more expensive in the future. Moreover, until full decarbonisation of the power sector is achieved, such electrification cannot decarbonise the heating sector.

- Energy consumption in the heating sector, including heating, cooling and domestic hot water consumption, is more than twice as large as electricity consumption. Therefore, it would not be possible by 2050 to add the installed capacity needed for such a wild electrification, and leading to the continuation of existing fossil fuel and nuclear power plants.

- A massive and wild electrification of the heating sector, on top of the transport sector, would put the whole energy system under severe pressure and require important and inefficient investments in infrastructure.

- As electricity mixes vary widely across EU member states, switching to electricity instead of renewable heat may severely increase GHG emissions and reduce the options for a strong decarbonisation of the economy.

- Any solution imposed from a systemic top-down approach would not be in line with the Energy Union principle of consumers' empowerment.

- Our energy system has to be considered as a whole, combining efficiently heating and cooling and electricity, towards the design of smart energy grids.

How to apply the energy efficiency first principle and avoid a wild electrification of the heating sector and its negative consequences ?

- In the framework of the Energy Efficiency Directive, the revised Primary Energy Factor (PEF) for electricity should be limited to this directive and NOT apply directly to eco-design and energy labelling. This is to avoid the least efficient electric heaters, which are supposed to be phased-out, from remaining in the market only thanks to the proposed reduction of the PEF. The risk is that the EU regulation misguides the consumer, distorts competition within the heating sector, and promotes inefficient heating solutions. As a matter of fact, the methodology used for determining the PEF in the EED is not appropriate as it does not take into account crucial parameters such as the time of use of electricity, grid losses at distribution level, and the consumption of primary energy in the upstream chain of fossil fuels (from being raw to becoming fuels ready to be converted into electricity)[1].

- In the framework of the RES Directive, only those efficient heat pumps from ambient heat and geothermal energy and with a seasonal performance factor > 3 should be considered renewable energy technologies. This will prevent the most inefficient heat pumps produced from outside of the EU and especially from Asia from flooding the EU markets with no benefits in terms of job creation and local development. Both District Heating and Combined Heat and Power systems with renewables sources must also be developed.

1. For more information, see Primary Energy Factor for Electricity in the Energy Efficiency Directive, AEBIOM-EGEC-ESTIF joint position paper May 2017

INTRODUCTION

Decarbonising the heating sector, 50% of our energy consumption, is unequivocally a major challenge for all EU countries. However, it also offers great opportunities to support local industries, create local jobs, improve air quality and reduce energy dependency by using local sources of renewable heat.

Just like ocean, geothermal, bioenergy, CSP, wind and PV technologies offer decarbonisation solutions in the electricity sector, **efficient biomass, geothermal, solar thermal, air-source, hydrothermal, and geothermal heat pumps** are energy sources and technologies that offer solutions to decarbonising the heating and cooling (H&C) sector by providing **direct renewable thermal energy.**

With the ultimate objective of completely replacing the use of fossil fuels in the H&C sector (responsible for 38% of CO2 emissions today), different solutions exist: energy efficiency, renewable sources of heating or electricity.

This paper highlights the benefits of direct local and renewable heating energy.

WHAT IS HEAT?

Contrary to electricity production where one electron is one electron, the heating sector is composed of various forms of heat.

As final users have specific demand profiles in terms of temperature, capacity, and timing, a variety of applications and sources are required. The table below classifies the heating services (excluding cooking and process cooling) by end-user, service, and temperature.

End-user	Services	Temperature level	Covered by RES-HC?
Households	Space heating / cooling and domestic hot water	Low-temperature (up to 60° C)	Yes
Tertiary (Supermarkets, malls, offices, hotels, swimming pools, etc.)	Space heating / cooling and domestic hot water	Low-temperature (up to 95° C)	Yes
Industry	Greenhouse heating Irrigation with warm water in agro-industries	Low-temperature (60-90° C)	Yes
	Heat and hot water for washing, rinsing, and food preparation.	Low-temperature heat (up to 95° C)	Yes
	Steam for industrial processes, notably to evaporate or dry	Medium temperature (95° C - 250° C)	Yes, in some cases
	Heat for the manufacture of metals, ceramics, glass (through hot flue gases, electric induction, etc.)	High-temperature heat (400° C up-1200° C)	Can only be covered with electricity today

Source: IEE FRONT final report p6

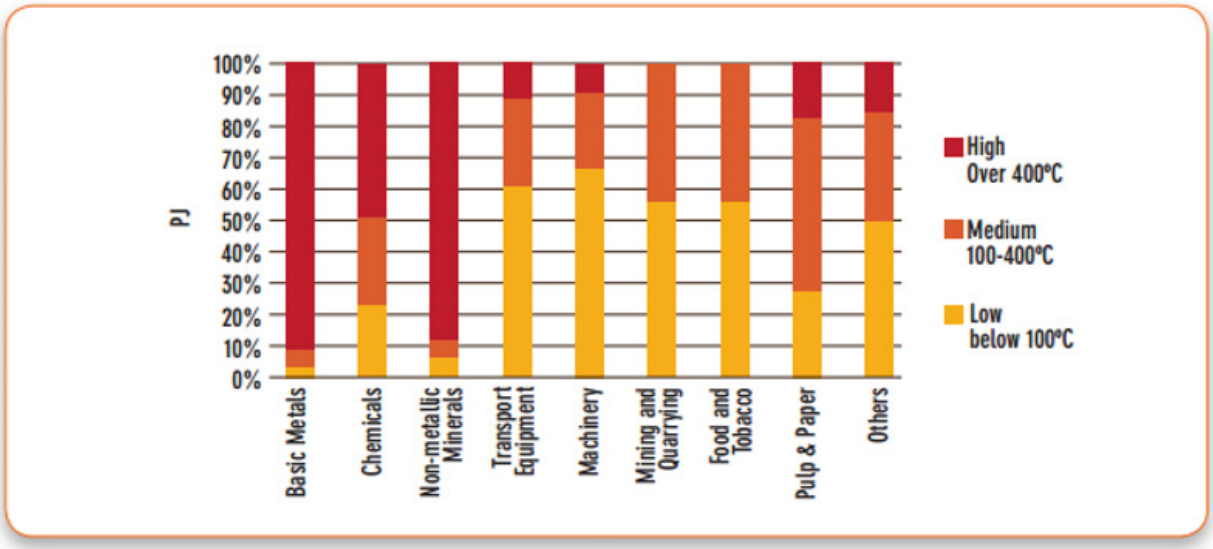
WHAT ARE RENEWABLE HEATING SOLUTIONS ?

Renewable (RES) heating solutions are **direct sources of heat** coming from **renewable sources** such as **biomass, geothermal and solar thermal energy. Efficient heat pumps** with a coefficient of performance (COP) higher than 3 are also considered as RES heating solutions due to the higher efficiency performance of these installations.

WHERE CAN ELECTRICITY PLAY A ROLE ?

The above table shows that RES heating solutions can supply most of heat demanded, specifically in the low temperature needs that we find in the building sector to heat homes.

However, no current RES technologies can cover the high temperature industrial heating processes above 400 C. The use of decarbonised electricity, in these applications, is hereby recommended.



Source: Industrial heat demand by temperature level and industrial sector, Ecoheatcool (2006).

According to the study Decarbonizing Europe's Energy Intensive Industries[2], the use of biomass waste as a feedstock can replace most of the oil-based inputs in the chemical industry. In the steel industry however, a move towards higher levels of electric arc steel and away from blast furnace production is recommended.

2. Thomas Wyns and Matilda Axelson, Institute for European Sudies, Vrije Universiteir Brussel

PART 1: THE HEAT DEMAND IS MORE SIGNIFICANT AND VERY DIFFERENT FROM ELECTRICITY DEMAND - IS ELECTRIFICATION OF THE HEATING SECTOR FEASIBLE ?

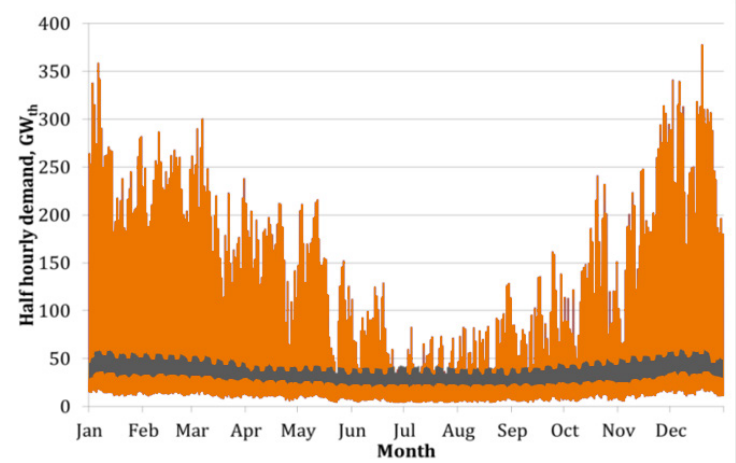


Figure 20: Synthesised national half hourly heat demand (red) for 2010 and actual half hourly national electricity demand (grey) [52].

Source: Sansom, Robert: Decarbonising low-grade heat for a low carbon future. London 2014.

The above diagram shows the UK's calculated heat demand versus electricity demand over a year. Electricity grid and power supply would have to be increased multi-fold in order to cover heat demand, leading to unaffordable system costs with unacceptable over capacity during summer.
In fact, this shows the **challenge of covering heat demand with electricity production**, not only due to the quantity of electricity that would be needed, but also the challenge of seasonal changes that would create overcapacity during summer.
A massive, top-down electrification of the energy system is destined to **put under severe pressure the whole system**, such as in peak situations.

For instance, France's heating sector is largely electrified. Every year during cold days, the electricity demand increases dramatically, and due to the country's inflexible power system that is largely dominated by base-load nuclear, citizens of some regions are required to decrease consumption and are informed of potential disruptions. Because of this, France is now de-electrifying its heating sector.

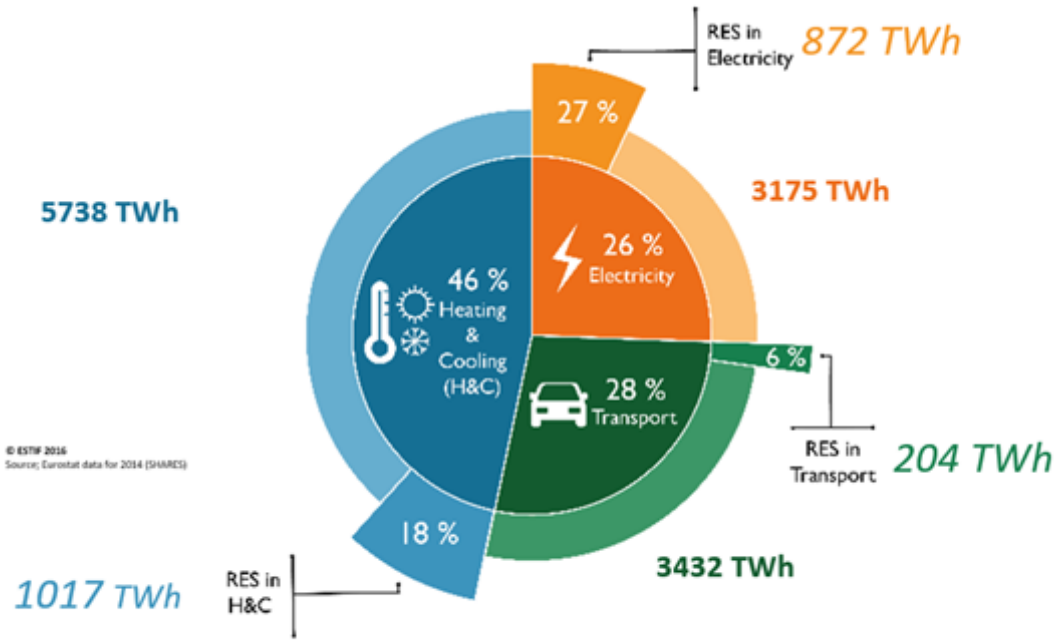
In addition, this electricity production increase must come from renewable sources of energy; otherwise, it does not make sense from a decarbonisation point of view to replace gas for heating purposes by electricity produced from gas or coal (see EU electricity mix).

For a better understanding of the challenges posed by electrification, the following questions should be considered:

- How can we increase RES electricity capacity to cover electricity, transport and heating sectors?
- Can we generate enough RES-electricity to cover the energy demand from these three sectors?
- How much land would be needed to install wind and PV[3]? Would European territory be large enough?

3. Only wind and PV are mentioned as they are usually the only RES sources mentioned when talking about RES electricity decarbonisation. Other sources of RES such as ocean, geothermal, concentrated solar power, biomass are often wrongly overlooked as solutions to decarbonise the electricity sector.

The **objective of decarbonising the electricity sector** is already a real challenge. As depicted in the graph below, only 27% of the electricity sector is currently RES-based, showing great efforts are still needed to fully decarbonise the electricity sector. It therefore becomes an unreasonable goal to achieve, if electricity is to be used in transport as well as the heating sector. Doing so will only lead to continuation, for several decades, of existing fossil fuel power capacity and increased power production from gas and gas imports, meaning more GHG emissions and methane, in particular.



EU28 Sector's shares on total generation (inner ring) & RES shares for each sector (outer) for 2014

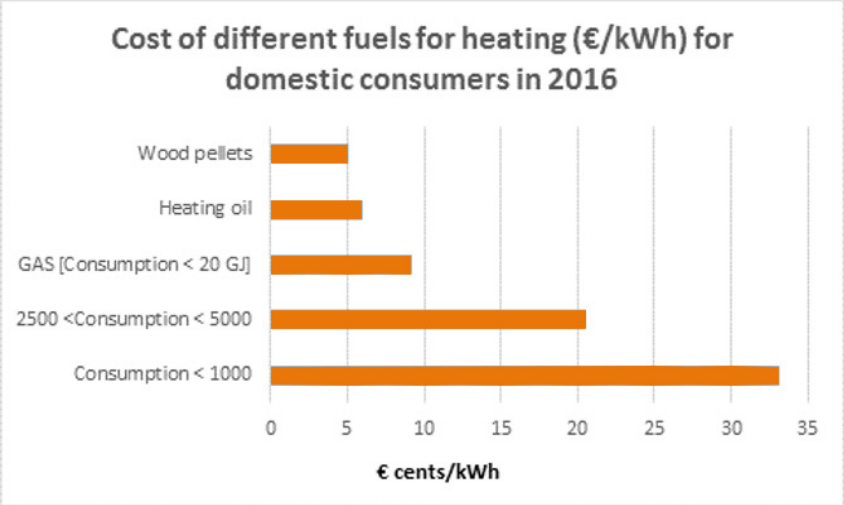
A diversification of energy sources in the H&C sector, by using the enormous potential of RES heating solutions, allows to shape a sustainable and diversified future energy system.

Key messages:

- Heat demand is much more significant than electricity demand.
- Heat demand consists of peak demand in winter and at night. If covered by electricity, it wouldn't allow to use decentralised PV systems that run mostly during the day and in the summer. It would instead lead to additional overcapacities during summer.
- The final objective is the decarbonisation of the heating sector, not its electrification with electricity mostly produced from fossil fuels. RES heating solutions produce direct renewable heat.
- The RES share in the electricity sector is only 27%; electricity producers still have important efforts to do to decarbonise this sector before looking at new end-uses such as the transport and heating sectors.

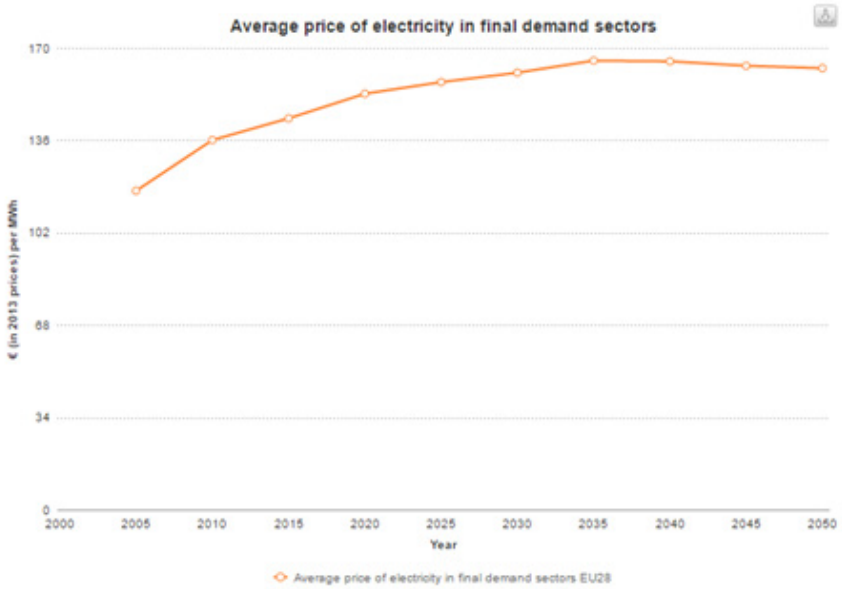
PART 2: **RES HEATING SOLUTIONS ARE CHEAPER AND A REAL SOLUTION TO ENERGY POVERTY**

Geothermal and solar thermal technologies are using free fuels – the energy from the earth and from the sun and just limited auxiliary electricity[4]. Biomass is stored sun energy that can be delivered on demand in winter and that is cheaper than any fossil fuel or electricity, as shown in the graph below.



Sources: Pellets - Aggregated EU figure based on European Pellets Council survey
Other - Eurostat

Additionally, according to the European Commission[5], 'average **electricity prices are projected to increase by 31%** between 2010 and 2030', while the cost of renewable heat technologies will be decreasing according to the same report. It is crucial to guarantee lower prices to **consumers** to have **competition** in the market, not only between electricity suppliers, but also between energy forms (electricity vs. heat).

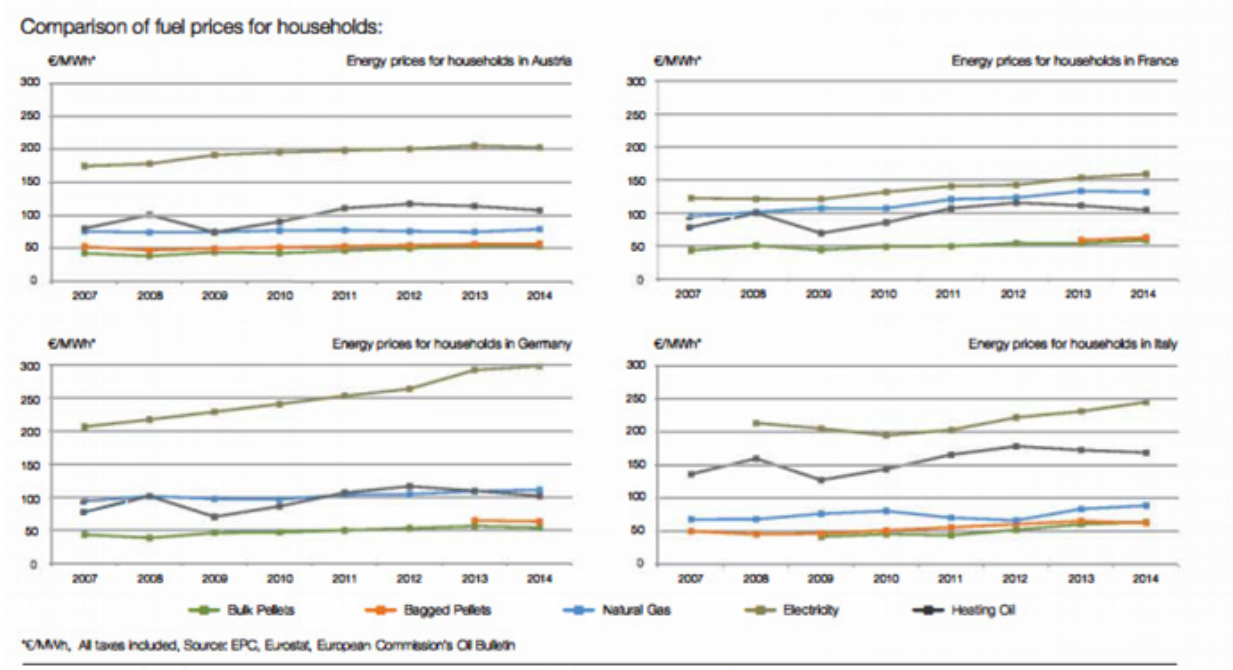


4. Those technologies only use a very limited amount of electricity, for instance to run the water pumps up to the solar collector. Such very limited amount of needed input allows for instance solar thermal to have a coefficient of performance (the ratio between energy input/output) as high as 70.
5. COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A policy framework for climate and energy in the period from 2020 up to 2030

RES H&C technologies are a real solution to **tackle energy poverty** and decrease household energy expenses.

In addition, electricity prices vary greatly, adding uncertainty into consumers' budgets. Since EU's electricity mix is still mainly based on imported fossil fuel, electricity prices are volatile and consumers are vulnerable to geopolitical turmoil.

Solar thermal and geothermal have no fuel cost and biomass prices are much more stable and dependent on local conditions, as shown in the graphs below for four different Member States.



Finally, the infrastructure investment (in transmission and distribution capacities) that would be needed to upgrade the electrical grids in order to meet the important part of our final energy consumption that heat represents are very high and inefficient. The Netherlands TSOs estimate that the Dutch electricity grid would have to be increased by 5 to cover heat demand with electricity. Such investment would be only on carrying energy, not on generation.

Investing the same amount on renewable heat generation would be more effective investment, covering decentralised thermal needs with decentralised thermal supply.

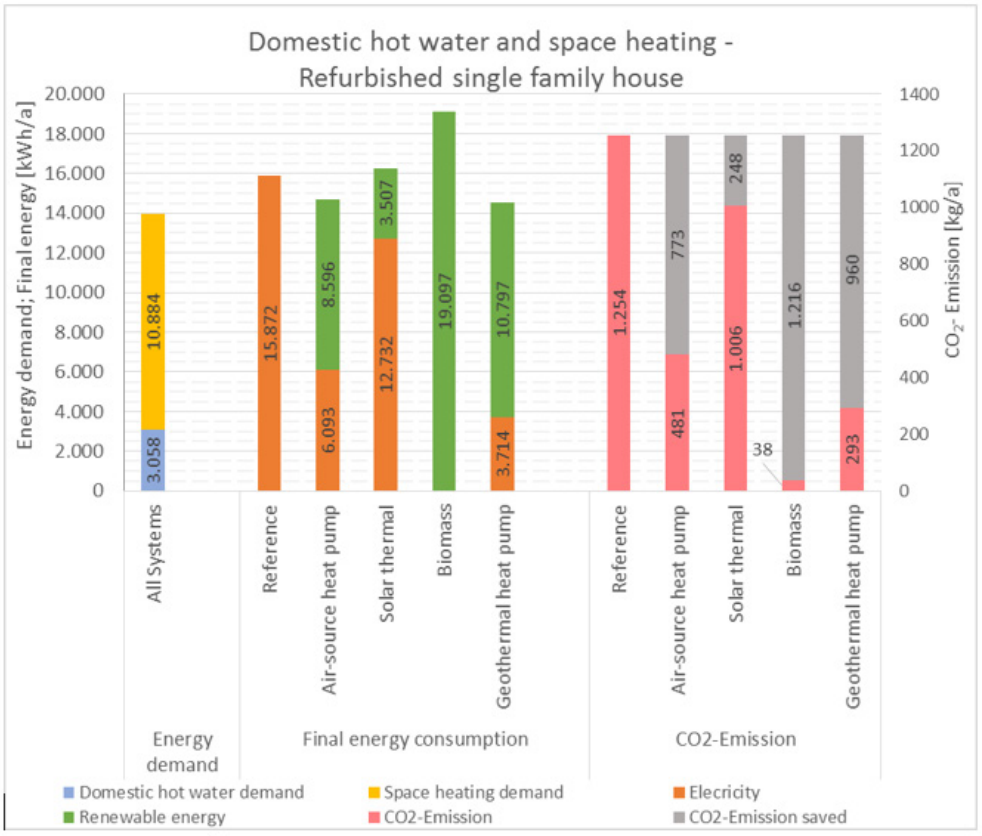
Key messages:

- RES heating solutions are cheaper than electricity in most EU countries. They are a good option to tackle energy poverty.
- RES heating systems' fuel prices are more stable than electricity prices.
- Huge investment in production, transmission and distribution of electricity can be avoided by using direct renewable heating.

PART 3: **RES HEATING SOLUTIONS ARE THE BEST SOLUTION FOR DECARBONISATION**

The IEE FROnT project compared electricity and RES heating systems[6] in terms of energy savings and CO2 emissions reductions. The grey bars on the right side of the graph show the amount of CO2 saved by the respective energy sources compared to the reference system, that works here on electricity (In this case, Swedish electricity mix, which is among EU lowest CO2 intensive electricity mix).

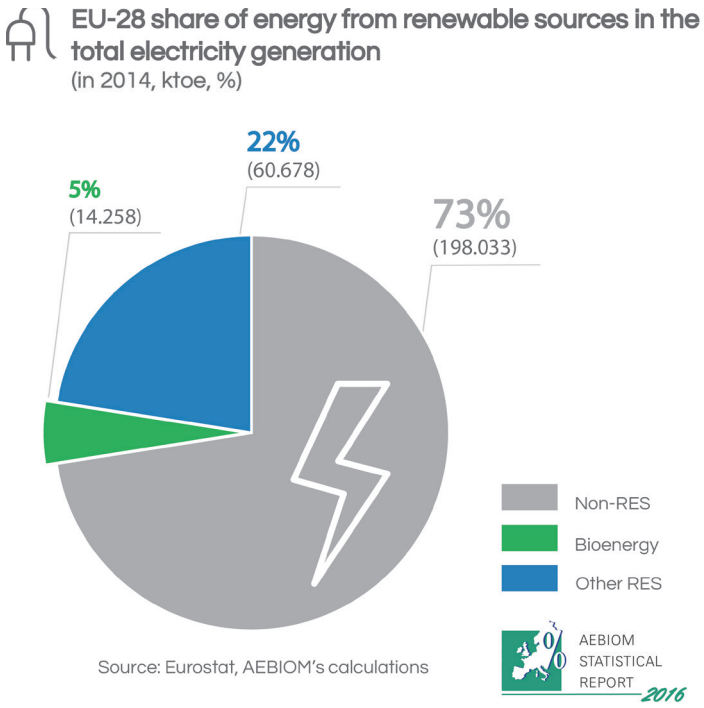
It clearly shows that **all RES heating solutions save more CO2 than electricity**.



Comparison of all observed heating systems for domestic hot water and space heating preparation in new built multi-family houses in Stockholm.7

In fact, the EU electricity mix is still dominated by fossil fuels and is therefore CO2 intensive. The graph below shows the EU electricity mix in 2014. Even if the share of renewables slowly increases over the years, combustible fuels (such as natural gas, coal and oil) are still dominant.

6. FROnT project, Comparison of the Efficiency and CO2 emissions of different heating and cooling systems
7. CO2-emission factor electricity Sweden: 0,079 t CO2/MWh
CO2-emission factor biomass: 0,002 t CO2/MWh



The above graph on the RES share of total generation per sector shows that there is still a lot of work to be done to obtain a 100% decarbonised electricity sector. Using low-carbon electricity is far from the reality of the near future. For example, over 80% of Poland's electricity mix comes from coal. Electrifying the heating sector in Poland would mean replacing gas or oil (or decentralised coal) with coal. One should therefore be careful when stating that electrification leads to decarbonisation of the heating sector.

Using direct and renewable sources of heating is the most effective, real solution to decarbonise the heating sector today.

Renewable solutions for heating and cooling are key to decarbonising the EU: they represent a large untapped potential in terms of installed capacity and of technology innovation. They are best suited to meet the needs of a sector that represents half of the EU's energy consumption and has a significant seasonal variability. The low level of activity in the RES-HC industry in the last decade, notably due to a significant lack of awareness from the general public and decision makers to these solutions (with one third of Europeans not knowing about RES solutions for heating and cooling), upfront expenditures (and low operational costs) and a lack of public policy support, can be greatly accelerated to put the EU on the path to decarbonisation. For instance, if the share of renewables in heating and cooling increased from the current 18.6% to 40% by 2030[8], the total share of renewables would be increased by 6 points compared to the EUCO30 scenario.

Key messages:

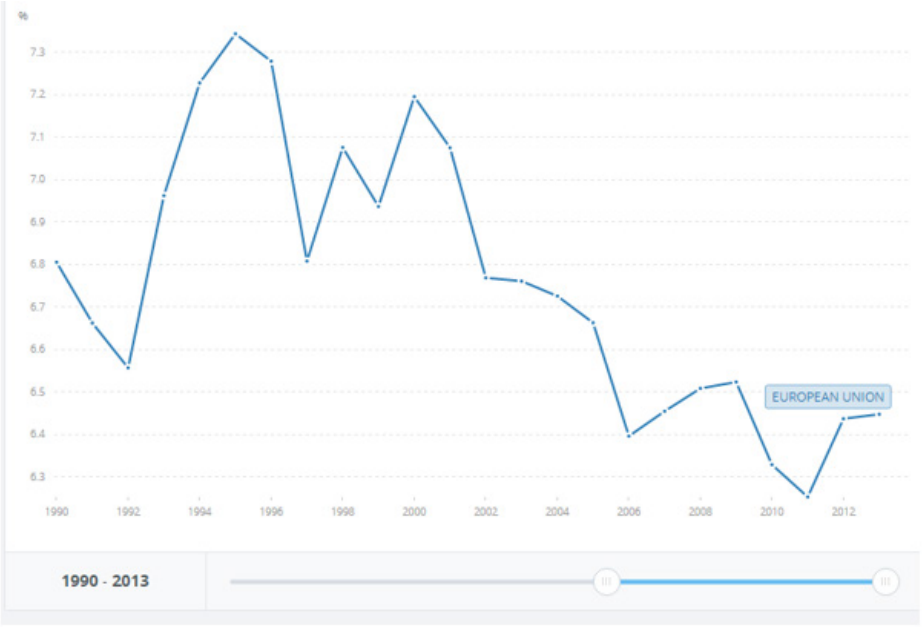
- EU electricity mix is dominated by fossil fuels and is CO2 intensive.
- Great challenges are still ahead to completely decarbonise the electricity system. Electrification doesn't necessarily equal decarbonisation.
- RES heating solutions are mature, available and are the most efficient and cost-effective solution to decarbonise the heating sector.

8. Equivalent to a 2 percentage point increase in the national share of renewables in heating and cooling for Member States between 2020 and 2030. This calculation is made considering the EUCO30 scenario figures for energy consumption, and share of renewables in electricity and transport.

PART 4: **RES HEATING SOLUTIONS ARE EFFICIENT AND LEAD TO ENERGY SAVINGS**

Heat demand is decentralised. It should therefore be covered by decentralised heat production (individual RES heating installations or RES district heating). This approach **reduces losses in transport and complexity on the grid managing variability and peak loads.**

According to the World Bank, the losses in EU electricity transmission and distribution networks amounts to more than 6% of the electricity produced.

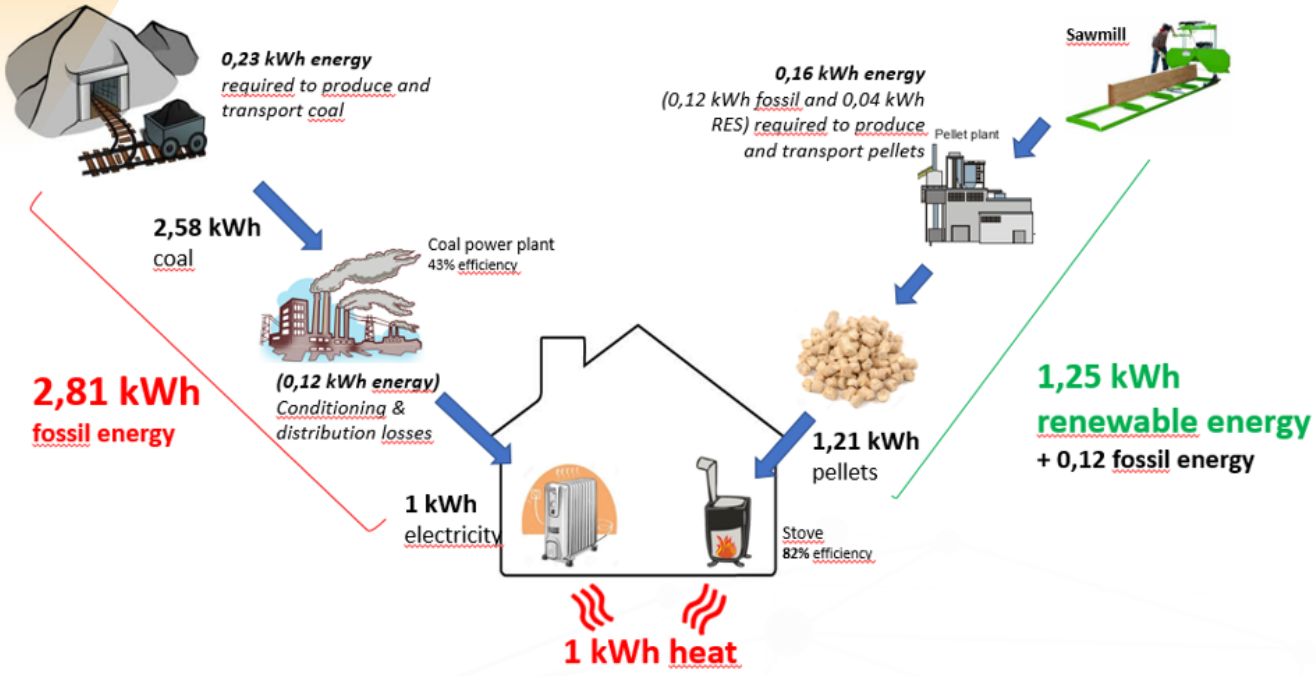


Source: Electric power transmission and distribution losses (% of output) – World Bank

Heat at the temperatures required for space heating is of low energetic quality (low exergy and high entropy). It therefore does not make sense to use high-quality energy like electric power (or even gas) to provide space heating, when clean and sustainable energy that can match these temperatures is in abundance.

Accordingly, **energy demand in the form of heat is best covered with energy production in the form of heat**, as this is the **most efficient approach, not requiring additional conversions in energy form**, as shown in the graph below.

For 1 kWh of heat, 2.81 kWh of coal are necessary but only 1.25 kWh of biomass (+0.12 kWh fossil energy).



Source: JRC Well-to-tank Report Version 4.0 European Commission

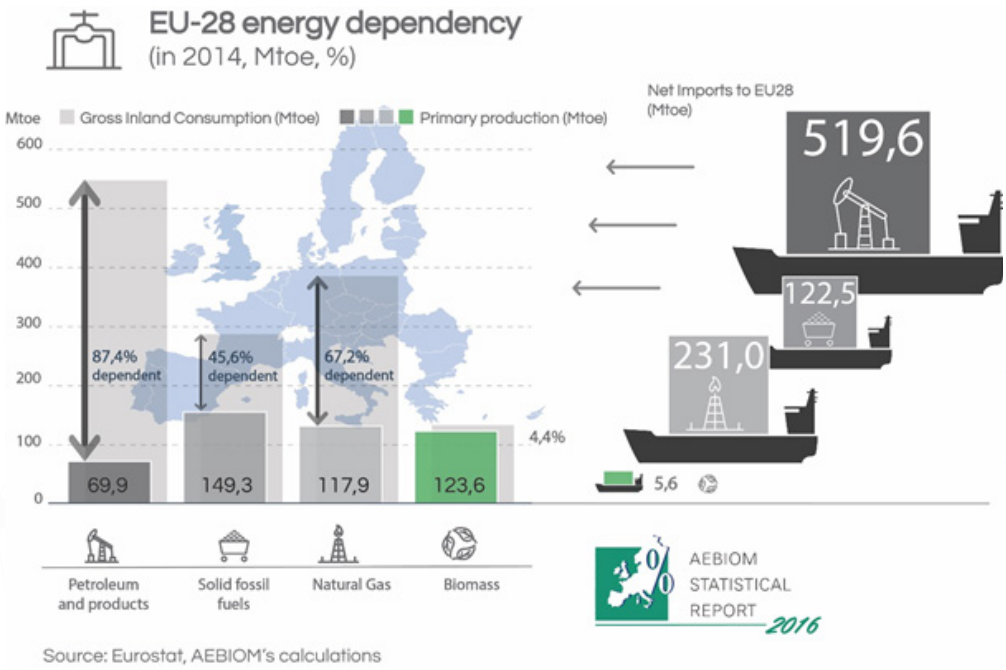
Finally, is electrifying the H&C sector consistent with EU legislation, that is pushing energy production through highly efficient cogeneration meaning plants producing heat and power (ex: RES Directive Article 26.8)? If no direct heating is needed in the future, the losses linked to electricity production will be even higher than current losses in 'power only' plants. Electrifying the H&C sector is in contradiction with maximising the efficiency of energy production.

Key messages:

- Electricity counts important losses in its production, transmission and distribution, as well as great complexity in grid management (even more to introduce variable RES electricity).
- Producing heat with electricity requires additional conversion steps, which is not an efficient use of the resource.
- Using electricity to produce low temperature heat is a waste of a valuable resource with other applications.
- RES heating technologies are efficient technologies that produce direct heat with a renewable source of energy and in the most efficient way.

PART 5: **RES HEATING SOLUTIONS USE LOCAL ENERGY, IMPROVING ENERGY SECURITY OF SUPPLY**

Solar thermal and geothermal energy use renewable, local resources and their industrial value chains are almost entirely based in Europe. Biomass is also a renewable, local resource with 95.6 % of the biomass consumed in the EU locally produced, as shown in the graph below, compared with the high dependency on oil, coal and gas used today in our electricity mix.



While the objective for the electricity sector is to be 100% RES-based, the EU's electricity mix is still very reliant on external imports.

In addition, by incentivising the use of electricity in the H&C sector, the imports of low quality non-European products will be fostered.

On the contrary, if H&C technologies are promoted such as biomass, solar thermal and geothermal, with industrial value chains almost entirely based in Europe, it will incentivise a European know-how and the use of local, EU produced products. The RES H&C technologies offer the EU a real opportunity to become number one in renewables.

Key messages:

- Electricity production is dominated by imported fuels.
- RES heating sources of energy are locally produced, reducing energy dependency and increasing energy security.

PART 6: **RES HEATING INSTALLATIONS EMPOWER THE CONSUMER**

The Energy Union, if it is to work, must rely on EU citizens' participation. Consumer empowerment must therefore be the cornerstone of the Energy Union. This means giving the consumers the power to decide on their own consumption and production patterns.

As such, **they should be given the choice on how to meet their heating needs**. Any solution imposed from a systemic top-down approach (centralised electricity production) is destined to not be in line with the principle of consumers' empowerment. A bottom-up approach (decentralised heat production) is always to be preferred.

Key messages:

- Empowering the consumer means giving the choice to the consumer to produce its own energy, be it electricity or heat, not imposing external supply.
- Increasing the choices for consumers means promoting competition in the market, in terms of solutions, energy sources and/or providers.

CONCLUSION

Massive and wild electrification of the heat sector is not a solution and is the result of a wrong market design which will lead to overcapacity and inefficiencies. The heating sector should NOT only be seen as a way to solve those overcapacities, in order to keep alive utilities' dirtiest assets on the grids.

The European energy system has to be seen as a whole and cleverly thought, and clear priorities must be set.

First, we need to reduce our energy demand in the power, heat and transport sectors.
Second, we need to use all available renewable sources of energy for heat and electricity production.

Third, and only third, have an energy system approach and interconnect electricity, heating and transport sectors.

As our main target is the gradual but steady elimination of fossil fuels from our energy mix, all clean and sustainable options will have a role to play. Therefore, the fuel switch for heating purposes should be covered by the best fitting options: renewable heating sources of energy.

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AEBIOM
EUROPEAN BIOMASS ASSOCIATION

The European Biomass Association (AEBIOM) is the common voice of the bioenergy sector with the aim to develop a sustainable bioenergy market based on fair business conditions. AEBIOM is a non profit Brussels based international organisation founded in 1990 that brings together around 30 national associations and 90 companies from across Europe.

EGEC
GEOTHERMAL

More than 120 members from 28 countries, including private companies, national associations, consultants, research centres, geological surveys, and public authorities, make EGEC the strongest and most powerful geothermal network in Europe, uniting and representing the entire sector.

ESTIF
European Solar Thermal Industry Federation

The European Solar Thermal Industry Federation (ESTIF) is the voice of the solar thermal industry, actively promoting the use of solar thermal technology for renewable heating and cooling in Europe. With around 80 members from 17 European countries, ESTIF represents the entire value chain.