Decarbonising Heating and Cooling

A Policy Brief from the Policy Learning Platform on Low-carbon economy

July 2023

Interreg Europe

European Union | European Regional Development Fund

Table of Contents

Good Practices

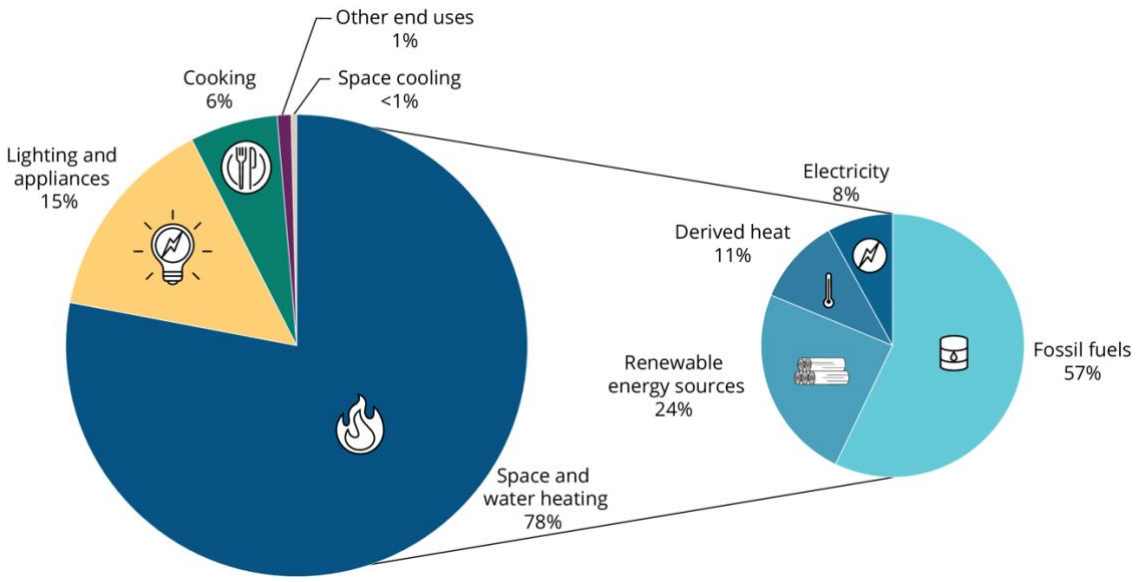
Cover image: District Heating Pipes; Katharina Krell

Summary

Heating and cooling make up a significant proportion of Europe's final energy use, but only around a quarter of this is provided from renewable resources. Heating and cooling are heavily reliant at present on imported fossil fuels, giving environmental, economic, and geostrategic imperatives for decarbonisation. With heating being the main energy cost for European households, providing cheap and sustainable energy also has significant social benefits. While integration of renewables is essential, net-zero in this sector will only be reached with significant improvements in energy efficiency and the use of passive technologies. The European Union has established a comprehensive policy framework for renewable heating and cooling, with several financial and technical support programmes, though much action is still required to reach targets. Local and regional authorities will play a key role given that heating and cooling strategies are highly dependent on local conditions and resource availability.

Europe's Heating & Cooling Sector

Heating and cooling are major contributors to Europe's greenhouse gas emissions, accounting for almost 50% of total gross final energy consumption, but only 23% of this is renewably generated. The contribution of renewables in heating and cooling varies significantly across the EU, from 68.6% in Sweden to 5.2% in Ireland.[1] Heating and Cooling is used for many functions, including maintaining indoor conditions in buildings, industrial applications, and used in consumer and retail services (such as food preparation and preservation, and in agriculture). Most thermal energy is used in buildings, with space and water heating accounting for 60%, while industrial heating processes are the second most used application, making up around a 35%. In private households, space and water heating make up almost 80% of energy use.[2]



Final energy use across EU households (2020). Source: EEA/Eurostat [3]

Cooling is a significantly smaller share of the total energy consumption, but this demand is expected to grow in future because of climate change and increased ambient temperatures.

[1] EUROSTAT, Heating and cooling from renewables gradually increasing (2023)
[2] European Environment Agency, Decarbonising heating and cooling — a climate imperative (2023)
[3] European Environment Agency, Decarbonising heating and cooling — a climate imperative (2023)

Heating and cooling contribute significantly to Europe's energy import dependency, accounting for almost 70% of all of Europe's gas imports in 2016.[4] This has gained increased political attention recently because of the war in Ukraine which drastically increased fossil fuel prices and exposed Europe's reliance on imported gas giving further incentive for decarbonisation. Reducing energy import dependency by decarbonising the heating sector could have the additional benefits of cushioning citizens from energy price shocks and tackling energy poverty. Cold homes have a significant impact on both physical and mental health, so providing cheap and sustainable energy also has significant promise in tackling societal challenges and health costs.

Heat is mainly obtained by burning fuels such as natural gas or biomass, using solar radiation, making use of ambient heat in the air, water or soil, or by converting electricity. Several pathways are used in Europe's energy mix, with different technologies and approaches available, depending on the application. Broadly speaking, these applications are:

- **Space heating** to transmit heat to surrounding areas through radiation and convection;
- **Space cooling** to reduce indoor temperatures, such as through air conditioning;
- **Water heating** to provide water for cleaning, bathing and for space heating;
- **Process heating** for industrial processes, often reaching very high temperatures, such as for steel, concrete and glass production;
- **Process cooling** to remove heat from a process to ensure safety and quality of products.

Depending on the application, a number of technologies are available for heating and cooling, making use of different renewable energy sources. As the main component of heating and cooling use in Europe, this policy brief will focus primarily on **space and water heating for buildings**, touching briefly on other applications. Both space and water heating are essential in our daily lives, providing comfort and supporting good health.

Space heating refers to the process of heating an enclosed area, such as a room or building, for comfortable living conditions. Typically, this is through either central heating or through electric heaters. Central heating systems consist of a boiler or furnace that burns fuel and transfers heat to the surrounding air or water, which is circulated through pipes, radiators, or vents, distributing warmth throughout the building. Electric heaters, on the other hand, convert electrical energy directly into heat using resistive elements. These heaters are often portable and can be plugged into electrical outlets. Electric heaters are commonly used for spot heating or in areas where central heating systems are not available.

Water heating, as the name suggests, involves heating water for various purposes, such as bathing, cooking, and cleaning. These systems can be with or without storage tanks. Storage tank systems consist of a large, insulated tank that stores and heats water. The tank is equipped with a heating element (often electric) or a burner (usually fuelled by gas) that heats the water to the desired temperature to be used when needed. Tankless systems instead heat water as it flows through the unit, and are usually more energy efficient.

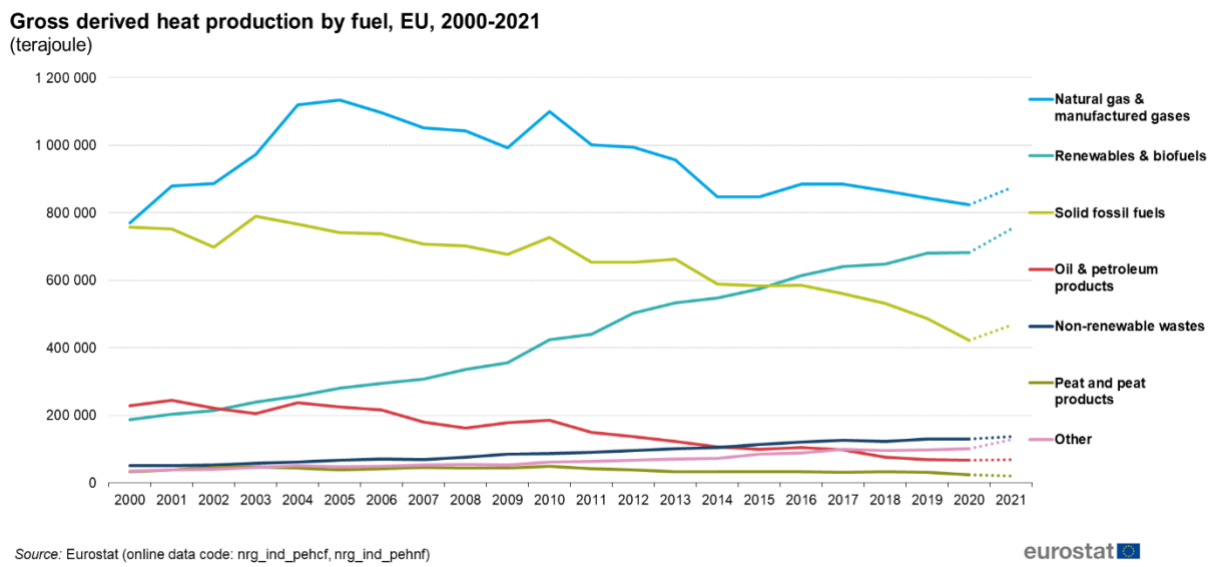
The primary method of heating households varies depending on several factors, but there are a few dominant systems in use.

- **Natural gas systems** are common and one third of Europe's heating is provided by natural gas, with many regions dependent on imports. Gas is supplied through pipelines from the site of production, for use in gas boilers or furnaces to provide central heating and hot water.
- **Electricity** can also be used for heating, with electric heaters, heat pumps and electric water heaters available. These are sustainable as long as using renewably generated electricity, and uptake depends on low-cost electricity availability.

[4] European Commission – Renewable Heating and Cooling Strategy (2016)

- **Oil-based heating systems** use heating oil in boilers or furnaces and provide central heating. Oil tanks are installed on the premises to store the fuel.
- **Biomass** is a traditional heating resource, with wood burning fireplaces still used in many remote and rural regions. Modern bioenergy uses mostly sustainable resources, for example, in the form of pellets and wood chips used in biomass boilers and can also provide hot water and central heating.
- **Propane and liquified petroleum gas** (LPG) is used in areas where natural gas infrastructure is not available, with storage tanks installed on the premises.

The EU's gross production of derived heat is produced 38.2% from natural and manufactured gas, followed by renewable energies and biofuels at 31.2%, and solid fossil fuels at 19.6%.[5] The remaining 11% is comprised of non-renewable wastes, oil and petroleum products, peat, and peat products, and nuclear and electricity.

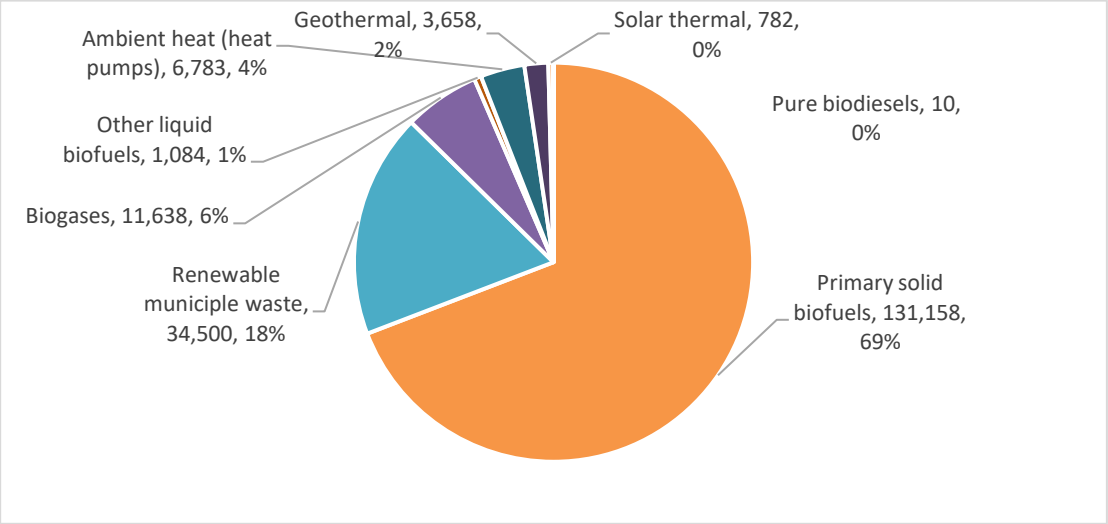


Renewable Energy for Heating in Europe

Around 94% of renewable heat in Europe is generated from biological sources, namely:

- **Primary solid biofuels** (69%), primarily biomass, which is used for heat production or electricity generation in combined heat and power applications. This includes fuelwood, wood residues and by-products, black liquor, bagasse, animal waste, other vegetal material, and the residuals and renewable fraction of industrial waste.
- **Renewable Municipal Waste** (18%), meaning municipal waste of vegetable or animal origin, including the biogenic fraction of mixed waste flows. This 18% refers to the heat generated by incineration, though it can also be converted into biogases via anaerobic digestion.
- **Biogases** (6%), mainly comprised of methane and carbon dioxide produced by anaerobic digestion of biomass or by thermal processes from biomass, including biomass in waste. This includes landfill gas, sewage sludge gas, other biogases from anaerobic digestion and biogases from thermal processes.
- **Pure biodiesels** (<1%) a biodegradable fuel made from vegetable oils, animal fats and recycled restaurant grease, and **other liquid biofuels** (1%), those not included in any of the other categories, such as bioethanol, bio-oil and biobutanol.

[5] Eurostat – Gross derived heat generation by fuel, EU, 2000-2020 (GWh)



Gross derived heat generation in the EU by renewable fuel, GWh (2020)[6]

The remaining 6% is derived from other renewable sources:

- **Ambient heat** (4%), from the air, beneath the surface of solid earth, or in surface water, extracted and brought to a useful temperature by heat pumps, which require electricity or other auxiliary energy to function.
- **Geothermal** (2%) energy available as heat emitted from within the earth's crust, usually in the form of hot water or steam, which can be used directly as heat for district heating and agriculture.
- **Solar Thermal** (<1%) heat from solar radiation which is exploited for energy purposes, such as the production of sanitary hot water or for space heating of buildings. Statistically, this does not include solar energy captured by passive systems for heating, cooling and lighting of buildings.

Renewable Heating & Cooling Technologies

Improving Europe's heating and cooling performance cannot be achieved by renewable technologies alone, however, but needs to be tackled in tandem with increased efficiency. This includes measures such as insulation, heat recovery, and installing new, more efficient, sustainable technologies. This brief will focus mainly on the latter part; new, renewable, and sustainable technologies. For more on other aspects of energy efficiency, there are several Policy Briefs available from the Interreg Europe Policy Learning Platform.

Policy Learning Platform Policy Briefs on Energy Efficiency

For more on improving energy efficiency in heating and cooling, see the Policy Briefs on:

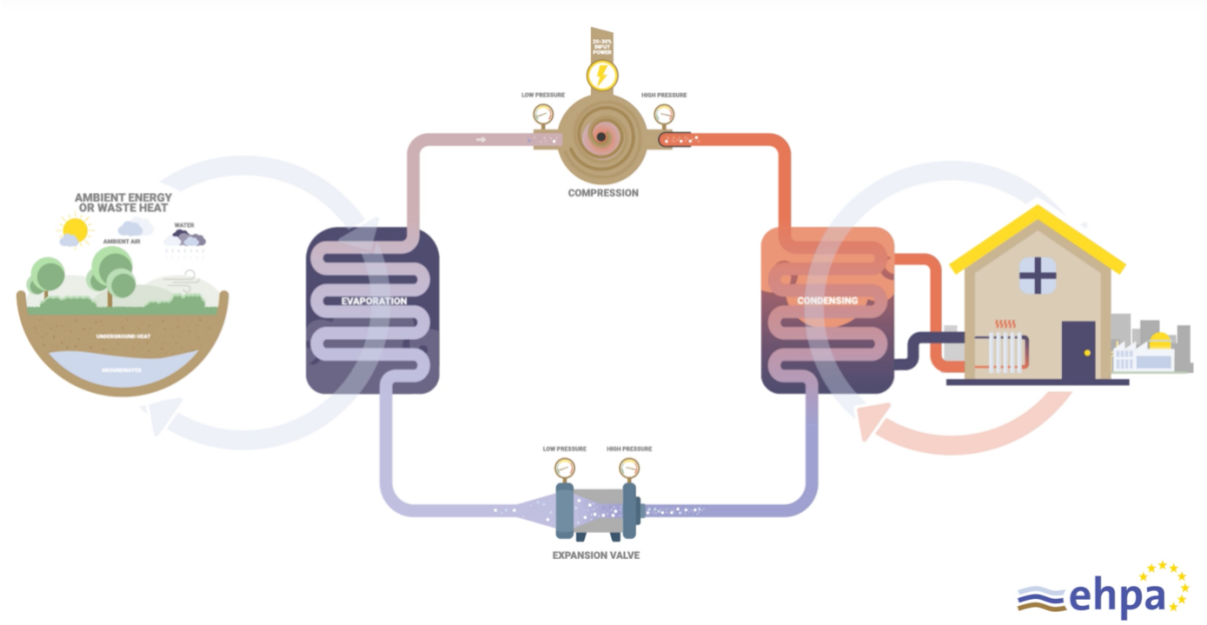
- One-Stop-Shops for Energy Efficiency in Private Households
- Funding Energy Efficiency through Financial Instruments
- Championing Sustainable Energy in SMEs

[6] Adapted from Eurostat (Source)

- Behaviour Change for Energy Efficiency
- Tackling Energy Poverty with Low-Carbon Interventions

With the need to decarbonise this energy intensive sector, there is significant policy focus emerging on supporting the uptake of renewable heating and cooling technologies, several of which are available for use in residential, commercial, and industrial applications.

Heat Pumps are used for both heating and cooling purposes, by transferring heat from one location to another using a refrigeration cycle**.** In heating mode, they extract heat from the outside environment and transfer it indoors. In cooling mode, they extract heat from indoor spaces and release it outside. They are highly efficient as they transfer, not generate, heat to where it is needed, and can be powered by renewable electricity.



Heat Pump Refrigeration Cycle. Source: European Heat Pump Association

There are three types of widely-used heat pumps:

- **Air Source Heat Pumps** which extract heat from the outdoor air and transfer it inside for heating or release it outside for cooling;
- **Ground Source Heat Pumps** (GSHP) or Geothermal Heat Pumps which use the relatively constant temperature of the ground or a groundwater source as a heat source;
- **Water Source Heat Pumps** (WSHP), which use a water body, such as a lake or river.

The suitability and performance of a heat pump depends on factors related to its location, such as climate, available heat sources, installation space and system sizing.

Solar Thermal technologies capture heat from the sun to heat water of other fluids which can be used for space heating, water heating or both. The systems absorb sunlight via solar collectors and a heat transfer medium, which circulates to a heat storage tank, ready for use. There are both **direct systems**, where water is circulated through the collectors and used for domestic purposes, and **indirect systems**, where a heat exchanger transfers heat from the collector fluid to the domestic water.

Biomass boilers or stoves combust organic materials to generate heat. These use sustainably produced biomass resources such as wood pellets, wood chips, agricultural residues, to generate heat. The question of sustainability often arises, as any biomass burned for heat is only renewable if it is

replaced by new trees and crops. The biomass pyramid should be applied to ensure that biomass is used for its highest value-added application, with waste woods prioritised for combustion.[7]

Biogas can be used to replace natural gas in gas boilers, however, it is not a direct drop-in replacement. Biogas composition is different to that of natural gas, containing impurities, moisture and particulate matter which can corrode and damage gas boilers. Only some boilers are therefore suitable to burn biogas, and many buildings would still need a new boiler installed, or at least new maintenance routines.

Renewables at Scale: District Heating & Cooling

District heating and cooling approaches distribute thermal energy from a central plant to multiple buildings or customers in a local area and can be powered by many of the renewable energy resources already discussed, including biomass, geothermal, or even waste heat from industrial processes, or a combination or sources.

District heating systems are particularly prevalent in Northern and Central European countries, including Sweden, Denmark, Finland, Germany, Austria, and Poland. Indeed, in Sweden, 60% of households are connected to district heating networks. Such systems usually use combined heat and power (CHP) plants to generate both heat and electricity, with hot water, or steam, circulated through insulated pipes buried underground. In each building, heat exchangers transfer the heat from the district heating network to the building's heating and hot water systems. In some cases, district cooling systems can also be integrated into the network, providing chilled water for air conditioning.

District heating and cooling systems have several benefits including higher energy efficiency by using CHP systems or making use of waste heat, as well as making cost savings for consumers through economies of scale, which bring down the cost of production. District heating also eliminates the need for individual heating equipment and maintenance, reducing the burden on end-users. A centralised team of maintenance professionals can also ensure consistent reliability and performance, with little to no downtime.

Good Practice 1 –

Renewable local district heating: Musikerviertel Ettlingen

In summer 2020, after two years of works, the District Heating System of the Musikerviertel of Ettlingen, Germany, was put into operation, providing renewable heat of around 6.5 million kWh per year to fifteen buildings; the vocational training centre, multiple-occupancy buildings (around 210 dwellings), and private multi-family houses (around 10 dwellings). It is fully powered by renewable energy resources, and since the buildings had previously been heated with individual natural gas boilers, it saw a reduction in carbon emissions of 85%. The heat is provided by a combination of renewable technologies; wood pellet boilers, a biogas boiler, and a solar thermal system. The project was implemented when the vocational centre, a large energy user, needed renovation, demonstrating that having a large, central customer can be a good starting point for developing district heating. So far, the connected buildings use 65% of the installed production capacity, with opportunity for more buildings to connect in future.

Interesting features: This practice is an excellent example of district heating, combining multiple renewable energy sources and achieving significant carbon emission reductions. Identifying a large, central heat provider is good practice for developing such projects.

Click here to find out more about this practice.

[7] See Policy Brief: Supporting local bioenergy development (2020)

Industrial symbiosis can also enable the provision of heat and cooling through collaboration between industries. Many industrial processes generate waste heat as a by-product. This waste heat can be captured and used in neighbouring industries or facilities that require heat for their operations. By implementing waste heat recovery systems, industries can reduce their energy consumption and emissions while providing a valuable heat source to other nearby businesses, including district heating companies.

Passive Houses, Nature-Based Solutions

Although not the core focus of this brief, it is important to also mention the role of energy efficiency, passive houses and nature-based solutions for providing heating and cooling solutions. Passive houses are designed to minimise the need for heating systems, through advanced design principle and building techniques. This includes a combination of highly insulated building envelops, with high quality doors and windows to minimise heat transfer, as well as ventilation with heat recovery to ensure a consistent supply of fresh air, while also avoiding heat loss.

Nature-based solutions can also be integrated to manage temperature. Passive solar design aims to make maximum use of solar heat to directly heat space, via large south facing windows, for example, which get maximum sunlight. Green roofs and walls can provide additional insulation by reducing heat transfer, and urban greenery and tree canopies can be used for shade and cooling. Landscaping can also be used to minimise the movement of cold air, acting as a windbreak.

These approaches are mainly suitable for new builds, and less for building renovations, so cannot overcome the main thrust of the challenge for decarbonising heat, but the principles will need to be mainstreamed in the long-run as part of the net-zero push.

Energy Management

Both new builds and refurbishments can also be fitted with energy management systems to automate heating and cooling, and to monitor consumption. This helps to both steer behaviour and avoid human error. It is particularly useful for larger buildings with multiple users.

Good Practice 2 – Replacing cooling-heating systems during COVID-19

Iasi Municipality, in Romania, took advantage of low-occupancy of its main administrative public building during the COVID-19 pandemic to implement building renovation works, including upgrading its heating and cooling system. Old air conditioning systems were replaced with a centralised heating and cooling system with a digital management platform for efficient functioning. This platform means that functioning hours, as well as upper and lower temperature limits, are centrally controlled and consumption is monitored to reduce demand. The building was also insulated to prevent heat loss. The costs of the works amounted to around 115,000 EUR and were implemented in six months; after one year of operation, energy consumption had decreased by almost 20%.

Interesting features: This practice represents a good example for its combination of measures in reducing energy for heating. As well as the new installations, the control platform and energy efficiency measures contribute to the reduction of carbon emissions.

Click here to find out more about this practice.

Challenges for decarbonisation

The heating and cooling sector presents several significant challenges for decarbonisation. Firstly, the main method for heating households varies across Europe, depending on factors such as geographic location, climate, energy infrastructure, and cultural preferences. The sector relies on a **diverse range of energy sources and infrastructure** from fossil fuels like natural gas, oil and coal, to traditional biomass heating. These heating fuels have well established infrastructure and are deeply imbedded in existing heating systems, requiring significant changes in infrastructure, technology and consumer behaviour.

The **decentralised and fragmented nature** of the sector adds additional complexity, with individual heating systems in residential, commercial, and industrial buildings making it difficult to implement centralised decarbonisation strategies. Each building has different heating and cooling requirements, meaning a one-size-fits-all approach is not suitable for either technical or policy interventions. The **long lifespan of heating infrastructure and technologies** also hinders the adoption of low-carbon technologies for the simple fact that they are not frequently replaced. Upgrading or replacing heating infrastructure is often expensive and disruptive, posing challenges for homeowners, businesses, and public authorities.

Heating and Cooling demand is of course **highly seasonal**, with peak demand in colder months, complicating the integration of intermittent renewables. Additional storage and flexibility solutions are required to match these variable demand and supply patterns. **Affordability and consumer acceptance** are also key concerns, with upfront costs for renewable heating systems such as heat pumps or district heating being higher than traditional fossil fuel-based systems. People can often hold a bias against renewable heating technologies, believing they will not be as effective as fossil fuel systems, and with low awareness of available technologies and their performance.

While policies for supporting uptake of renewable electricity technologies are now advanced, **policies for renewable heat are lagging behind**. A lack of supportive policies and financial incentives, inconsistent regulations, and low awareness currently discourage investment in decarbonisation measures. It will be crucial to develop renewable heating and cooling roadmaps, invest further in research and innovation, and provide targeted support to overcome the identified barriers.

European Legislation and Support

While heating and cooling had been considered in previous iterations of the EU's energy policy, new impetus and focus came with the 2016 EU Strategy on Heating and Cooling, which recognised the significant contribution of the sector to carbon emissions and established the need for specific considerations in the energy framework. The EU has set ambitious carbon reduction targets and has several strategies and agendas for reaching them, which include heating and cooling technologies. The Energy Efficiency Directive, the Renewable Energy Directive and the Energy Performance of Buildings Directive provide the backbone of the decarbonisation effort for heating and cooling sector, pieces of legislation which have been revisited in recent years to increase ambition.

In 2015, the EU and its Member States, became signatories to the Paris Agreement, and committed to limiting global warming to well below 2°C.[8] In this framework, the EU has adopted a comprehensive climate and energy framework to reduce emissions by 55% by 2030 (from a 1990 base level).[9] Initial targets were set in 2018 for a 40% reduction in greenhouse gas emissions, a 32% share of renewables in final energy use, and a 32.5% improvement in energy efficiency. These ambitions have been

[8] European Commission, Climate Action – Paris Agreement
[9] European Commission, Climate Action – 2030 Climate and Energy Framework

increased in the framework of the **European Green Deal**, which also set long-term targets for climate neutrality by 2050 with the **European Climate Law** and increased the reduction target for greenhouse gas emissions to 55% by 2030. This in turn was supported by the Fit for 55 package, updating the climate and energy framework; given their prevalence in Europe's energy use and carbon emissions, this framework gives a significant focus to heating and cooling in its various initiatives.

Under the Energy Governance Directive, Member States were required to develop integrated National Energy and Climate Plans (NECPs) setting out a ten year view for meeting energy targets, and also develop National Long-Term Strategies, with a thirty-year perspective, for achieving net-zero emissions. Both must take account of the heating and cooling sector, reporting on estimated trajectories for renewables use, as well as expected energy efficiency improvements. They needed to also include policies and measures for achieving targets.

The Renewable Energy Directive sets national targets for renewable energy use, and Member states are encouraged to develop policies and measures to stimulate the deployment of renewable heating systems in residential, commercial, and public buildings. This includes promoting energy-efficient buildings, supporting the retrofitting of existing buildings with renewable heating technologies, and integrating renewable heat in building codes and standards. Under the current revision, the RED will be strengthened to increase the legally binding target for renewables from 32% to 42.5%, but aiming for 45%. This will include a new target for Member States to increase their national share of renewables by 1.1% per year for heating and cooling.[10] A target of 49% renewable energy in buildings will also be established. According to the European Environmental Agency this would require the share of renewable energy in district heating to increase by 2.1% per year and see doubling of the deployment rate of heat pumps to 10 million units p.a. by 2027.[11]

Under RED, Member States are encouraged to establish renewable heating and cooling support policies and frameworks, such as **renewable heat obligations** which set a minimum percentage of heating to be provided by renewable energy, and **renewable heat incentive schemes**, with financial payments for renewable heat generation. Transposition into national law is often highly controversial as currently demonstrated by the public outrage about the new heating law proposal in Germany.

The Energy Efficiency Directive focuses on improving energy efficiency across various sectors, including heating and cooling. It requires public authorities to play an exemplary role in energy efficiency and renovate their buildings to set deadlines and standards. It also sets the requirement for efficient district heating and cooling as being a minimum of 50% renewable energy, 50% waste heat, 75% cogenerated heat, or a 50% combination of these sources. The 2021 recast proposed a framework for National Heating and Cooling Planning, to be synchronised with the timeline of the NECPs. Member States will also encourage regional and local authorities to prepare local heating and cooling plans, at least for those with 50,000 inhabitants or more. This will enable households to understand if or when they will be able to connect to district heating, or if they must instead depend on private heat sources, particularly heat pumps.

The Energy Performance of Buildings Directive sets out minimum requirements for new buildings, including a necessity to consider technical, environmental, and economic feasibility of low-carbon technologies, including decentralised energy generation, cogeneration, district heating, and heat pumps. The 2021 recast will make 'energy efficiency first' a principle in law and give further incentive and support for one-stop-shops and renovation passports.

While current EU renewable heating is primarily based on biomass, this is a sometimes-controversial topic with much debate on bioenergy sustainability, with a political focus increasing for other

[10] Interreg Europe Policy Learning Platform – More ambitious EU Renewable Energy Targets agreed
[11] European Environment Agency – Decarbonising heating and cooling — a climate imperative

technologies. Given the megatrend for electrification, the Commission has identified heat pumps as a major opportunity for renewable heat, using renewable electricity to bring ambient heat to a usable temperature. As such, the revised EPBD will be accompanied by a **Heat Pumps Action Plan** which will look to overcome challenges of financing, industrial production capacity, and skills, to significantly bring down the investment cost for households and communities.

European Funding

A number of funds are available at the European level for supporting the energy transition, including the transition to sustainable heating and cooling. These include new instruments set up in recent years in response to the twin-shocks of COVID-19 and the Russian invasion of Ukraine, as well as to provide funds for the implementation of the European Green Deal. These include NextGenerationEU, the Recovery and Resilience Facility (RRF), and the Just Transition Mechanism.[12]

The Recovery and Resilience Facility is one of the cornerstones of NextGenerationEU, aiming to recover from the COVID pandemic. Each Member State has produced a Recovery and Resilience Plan, a roadmap of reforms and investments to make their economies greener, digital and more resilient. Many member states have included plans to phase-out outdated heating systems, for replacement by renewable and district heat.[13] For example,

- The Austrian plan put forward the Renewable Heating Law (approved in 2023) to phase out oil by 2035 and gas by 2040. RRF investments will focus on supporting private households to replace fossil-fuel heating devices with heat pumps, biomass and district heating.
- Czechia targets investments towards modernising district heating distribution networks, as well as reskilling the workforce for energy efficiency construction and renovation.
- Denmark is investing in replacing oil burners and gas furnaces through the expansion of district heating grids and providing support to households to convert to heat pumps.
- In the Netherlands, a subsidy scheme will be created for households to install heat pumps, solar boilers, thermal connections, and insulation.
- Slovenia will establish a fund for energy renovations and implement a legal ban on the installation of heating oil, fuel oil or coal boilers.

Good Practice 3 – RRF Subsidies for Renewable Heating

As part of the COVID recovery programme, the Finnish Government including phasing out oil heating in residential buildings as part of the country's Recovery and Resilience Plan, and the country wants to be free of oil heating by 2030. Specifically, it has designated funds for converting residential building heat systems from fossil-based heating to energy efficient heating. Available subsidies are up to 4,000 EUR when converting from oil heating to a water or air heat pump, or connecting to district heating, or up to 2,500 EUR when converting to other renewable heat systems. By January 2022, almost 18,500 applications and been submitted, with 37.6 million EUR granted.

Interesting features: The upfront cost of renewable heating and cooling systems can be high, and subsidies can help to encourage investment until markets mature. The clear strategy for zero oil heating by 2030 also sends the signal that households must act.

Click here to find out more about this practice.

[12] EU funding possibilities in the energy sector
[13] Recovery and Resilience Scoreboard: Thematic analysis, Energy efficiency in buildings

REPowerEU was launched in response to the Ukraine war, with Member States integrating a dedicated chapter into their Recovery and Resilience Plans.[14] As well as the funds remaining under the RRF – 225 billion EUR at launch of REPowerEU – Member States can also transfer up to 12.5% of their Cohesion funds and European Agricultural Funds for Rural Development to the RRF.

European Structural and Investment Funds (ESIFs), particularly the European Regional Development Fund and the Cohesion Fund, can also be used to establish grants and financial instruments under Policy Objective 2, 'a greener, low-carbon Europe', specifically the priority, 'promoting renewable energy in accordance with Directive (EU) 2018/2001'.[15]

Direct project funding from the European Union is available under **Horizon Europe** and the **LIFE Clean Energy Transition** programme. Horizon Europe funds research and innovation in low-carbon energy, with heating and cooling topics under Cluster 5, 'Climate, energy and mobility'.[16] The LIFE sub-programme has one billion EUR available over 2021-2027 to facilitate the transition towards an energy-efficient and renewable energy-based economy by funding co-ordination and support actions.[17]

Initiatives & Platforms

The **Renovation Wave** is an initiative of the European Commission aimed at accelerating the energy renovation of buildings. It was launched in October 2020 as part of the European Green Deal to double the annual energy renovation rate of buildings in the EU. The goal is to renovate at least 35 million buildings by 2030, which includes residential, public, and commercial buildings. It emphasises the mobilisation of public and private investments to support building renovations. It aims to unlock funding through various financial instruments such as the European Structural and Investment Funds (ESIFs), the European Investment Bank (EIB), the Just Transition Fund, and the InnovFin Energy Demonstration Projects. Additionally, the EU Recovery and Resilience Facility provides financial support for building renovations as part of the post-pandemic recovery efforts.

The **European Technology Innovation Platform on Renewable Heating and Cooling** (ETIP-RHC) brings together stakeholders from the biomass, geothermal, solar thermal and heat pump sectors to define a common strategy for use of sustainable heating and cooling technologies.

The Role of Regions & Local Authorities

Regional and local authorities play a crucial role in supporting the uptake of renewable heating and cooling technologies, helping to overcome challenges specific to their own context. They need to reflect, for example, the availability of renewable resources, local climate conditions, available infrastructure and infrastructure requirements, and specific heating and cooling needs of the community. It must also take account of factors such as cost-effectiveness, system efficiency, and environmental impact.

Interreg Europe projects have identified many good practices related to renewable heating and cooling which can demonstrate innovative projects, or support for heating and cooling. Some of those good practices will be presented throughout this section.

Firstly, local authorities can launch **awareness campaigns** to educate the public, businesses, and institutions about the benefits of renewable heating and cooling and their cost-effectiveness, environmental advantages, and long-term energy savings. This can also include sharing information on upcoming installations, such as potential upcoming district heating systems, or highlighting renewable

[14] Guidance on Recovery and Resilience Plans in the context of REPowerEU
[15] Common Provisions Regulation (EU) 2021/1060, ERDF & CF Regulation (EU) 2021/1058
[16] Horizon Europe, Cluster 5: Climate, Energy and Mobility
[17] LIFE Clean Energy Transition Sub-programme

resources in the area and how they can be accessed. Information platforms can provide accessible resources to help citizens make informed decisions, as well as connect individuals and businesses with local installers and suppliers. These resources could be provided via One Stop Shops, as encouraged under the EED.

More in-depth **education and training actions** can also be implemented for homeowners, building developers, and professionals in the construction and energy sectors. Training and workforce development can ensure there are skilled professionals capable of designing, installing, and maintaining systems, implemented in co-operation with local educational bodies and local industry.

Public authorities can lead the way by renovating their own heating and cooling systems, as well as implementing **demonstration projects** to raise awareness and illustrate the benefits, as well as kick-starting local industry to adapt to new technologies via public procurement. This includes, for example, working to transition existing district heating systems to renewable energies.

Good Practice 4 – From Stump to Boiler: Bioenergy Educational Environment

The Lapland Education Centre (REDU), in Rovaniemi, Finland, is a vocational education provider, owned by six municipalities, and co-funded from their own budgets and state subsidies. It operates an educational district heating plant to provide an educational environment that can develop the professional skills needed by employees in the bioenergy production chain. This education covers the full value chain, 'from stump to boiler', with students from different departments learning skills along the value chain from harvesting to energy production. This helps to overcome a major barrier to sustainable heat production in so far as, usually, strict safety regulations mean that students cannot do apprenticeships at energy production plants. Instead, the training is provided partly in short-term teaching periods, with periods working in a real-life district heating plant. Graduates from the programme are in full employment and have been able to use these skills to improve the efficiency and lifetime of local district heating plants.

Interesting features: This practice covers the full bioenergy value chain providing all the skills needed to run a bioenergy district heating system. Such an approach could be used in other regions and be adapted to any locally available renewable energy resource, helping to create jobs as well as self-sufficiency.

Click here to find out more about this practice.

Good Practice 5 – Geothermal heating & cooling at the Regional Parliament of Andalusia

The Regional Parliament of Andalusia, Spain, meets its heating and cooling requirements via very-low enthalpy geothermal energy, using a heat pump that exchanges energy water-to-water, with an underground, shallow waters reservoir. Heat is extracted from the waters in winter, and re-injected in summer, when cooling is required. This solution provides energy savings and lower carbon emissions compared to standard heating, ventilation and air conditioning

systems, and provides thermal comfort year-round. As the heat source is underground, the temperature remains stable and is not affected by extreme temperatures, compared to air source heat pumps.

Interesting features: This practice demonstrates a public authority taking a lead in using innovative heat technologies, and taking advantage of available local resources, in this case, the underground water reservoir. It also demonstrates a non-intrusive renovation of a heritage building, with the building dating back to 1546.

Click here to find out more about this practice.

Offering **financial incentives** is an effective way to the uptake of renewable heating and cooling technologies. These can be grants, subsidies, or tax credits (depending on available competencies) to individuals, businesses, and organisations that install or retrofit their systems with renewable technologies, to offset the higher upfront costs associated with sustainable heating systems, over fossil-fuel systems (see Good Practice 3, from Finland for such an example).

The **regulatory framework**, meeting requirements of the EPBD and EED, can set renewable energy targets, implement building codes, and streamline permitting processes for renewable heating and cooling systems. Heating and cooling needs to be thoroughly implemented into local energy planning and transition strategies, identifying the region's energy needs, identifying suitable technologies and resources, and aligning incentives and policies for a holistic transition, considering storage and energy management issues. This also requires frequent **monitoring and evaluation** of performance to make necessary adjustments and improvements.

As set out in the new Energy Efficiency Directive, this can also include a **Heating and Cooling Plan.** These plans could be set out in collaboration with gas and electricity DSOs/TSOs, utilities, citizens organisations and the private sector, and set out a clear target for decarbonisation of any district heating systems, as well as a roadmap for replacing fossil fuel boilers. The aim is to demonstrate the importance of the demonstrate, focus policy initiatives on this end-goal, and encourage action by households and businesses.

Energy communities, wherein energy generating technologies are co-owned by citizens and community organisations, are of increasing importance in the transition. While we often think of energy communities for electricity generation, under the RED they can also generate heat, to be distributed by district heating. Local authorities can play a role in supporting their development by providing project development assistance, setting an enabling framework, developing local networks, and acting as an end-consumer for the generated heat. For more on this, see the policy brief, 'Empowering Citizens for Energy Communities'.

Good Practice 6 – Firewood District Heating Community Network in Lucinges

The municipality of Lucinges in Auvergne-Rhône-Alpes, France, has installed a firewood district heating network to supply six municipal buildings, 57 collective housing units, five single-family homes, and two businesses, with renewable heat. The municipality requested that the project be financed with at least 40% local funds, and contracted ForestEner, specialists in community energy, to devise the project, including a financial model based on citizen funds. The project was also designed to make use of local biomass, from no more than 30km away. As well as

participating as financial stakeholders, citizens can also participate in governance of the network. The new system generates enough heat for 110 households and replaced fifty oil-fired boilers.

Interesting features: This practice demonstrates that renewable district heating can be implemented even in a region with no history of its use. Citizen involvement from an early stage helps to build the collective commend needed for such a system, and pooling households with public and private buildings is also a good approach.

Click here to find out more about this practice.

Finally, in this framework, local and regional authorities can foster **partnerships** with local businesses, energy suppliers, energy communities, research institutions, and industry to create a supportive ecosystem for renewable heating and cooling, bringing them all on board with a regional vision. This can lead to knowledge sharing and co-creation, and the development of local value chains. At the national and international level, authorities can also build links with regions and businesses that have expertise missing from the home region, share good practices and approaches, and build common projects.

Good Practice 7 – Växjö Energi – 100% fossil free production of heat and power

In Växjö Municipality, Sweden, the utility Växjö Energi produces 100% fossil-free district heating and cooling, as well as electricity, from renewable biofuel from local forestry wastes and residues, such as branches and treetops. This is combusted at the Sandviksverket Combined Heat and Power (CHP) plant. Starting in 1974 with an oil-fired co-generation unit, the company already began producing some heat and energy from forestry in the 1980s, with a new biofuel-direct CHP plant put into action in 2015. As well as using no fossil-fuel in its energy generation, the company also uses fossil-free vehicles for all of its logistics. The transition of the utility reflects the municipality's own goal to be 100% fossil-fuel free by 2030.

Interesting features: This practice demonstrates the need for long-term vision, set between both utilities and local government, as well as making use of available renewable resources that can boost the local economy.

Click here to find out more about this practice.

Recommendations & Key Learnings

- Heating, in particular, is a major contributor to Europe's carbon emissions and will require dedicated action for decarbonisation. Much policy support has been given to renewable electricity uptake; specific instruments and policies are now needed for heat;
- Apply the principle of **'energy efficiency first'**. A main thrust of policy should be to increase the **thermal insulation** of buildings, and to make use of passive building technologies. This reduces the overall investment required for heating and cooling systems;
- Local heating and cooling strategies, as proposed under the revised EED, are to be encouraged; **individual households and businesses need to be aware of what is coming** to be able to make their own decisions. Setting targets shows clear direction of travel, as in Växjö, to bring actors on board;

- Local authorities are also encouraged to develop **district-level heating and cooling action plans** for new greenfield developments and existing built-up areas. Facilitating renewable district heating solutions is then the role of the municipal administration.
- Comprehensive **heating and cooling strategies are expected to become mandatory for settlements of more than 50,000 people**. Although this may not come into force for some years, it is already time to start laying the groundwork with policy-makers to highlight possible solutions;
- A wide range of resources and technologies are available to fit to any local context. Biomass or biogas boilers, heat pumps, solar thermal and combined heat and power are widely applicable;
- **Heat pumps, powered by renewable electricity, will be a key heating solution for individual households**. Investment costs remain quite high at present, so financial subsidies or other incentives may be needed to boost installation rates;
- The Recovery and Resilience Fund and REPowerEU provide significant opportunities for decarbonising the heating and cooling sectors. As in Finland, Czechia, Austria and others, **investments can be directed towards replacement of fossil fuel technologies**;
- **District heating** provides highly efficient heating and cooling and can be powered by a number of renewable resources, from biomass to geothermal energy, or a combination of renewables. For regions with district heating systems already, switching to renewable energy is a priority. For regions without, an analysis of renewable heat potential may reveal significant opportunities. Working with a large consumer as a first customer can help to kick-start a project, as in Ettlingen;
- The transition will require **new skills and competences**. As with REDU, it is necessary to collaborate with education and training providers to develop new regional industries. Dialogue with education centres and businesses can identify weaknesses;
- Public authorities can take a lead and use their **procurement power** to kick-start the transition and demonstrate new technologies;
- **Renewable energy communities** will have a key role to play for heat generation. Set an enabling framework and targets, as in Lucinges, to stimulate their development. For more, see 'Empowering Citizens for Energy Communities'.
- **One-Stop-Shops** are already promoted under the EED for promoting energy efficiency investments. OSS should of course also consider renewable energy technologies, including renewable heat. They may provide advice, as well as financial support, directly to households, for example through Energy Performance Contracting or access to financing. These can also find the most optimal mixture of energy efficiency improvements, passive and nature-based approaches, and investments in new technologies. See 'Supporting energy renovation of private households through One-Stop-Shops', for more.

Does your region need support in defining new instruments and strategies?

The Policy Learning Platform, provides several services to the regional policy community, including on-demand Expert Support via a helpdesk, matchmaking service and peer reviews:

- At the Policy Helpdesk, Policy-makers may submit their questions to our helpdesk to receive a set of resources ranging from inspiring good practices from across Europe, policy briefs, webinar recordings, information about upcoming events, available European support and contacts of relevant people, as well as recommendations on matchmaking and peer review opportunities.
- A Matchmaking session is a thematic discussion hosted and moderated by the Policy Learning Platform and designed around the policy needs and questions put forward by the requesting public authority or agency. It brings together peers from other regions in Europe to present their experiences and successes to provide inspiration on overcoming regional challenges.

- Peer Reviews are the most deep and intensive of the on-demand services, bringing together peers from several organisations for a two-day working session to examine the specific territorial and thematic context of the requesting public authority of agency, discuss with stakeholders, and devise recommendations.

Sources and further information

European Commission Documents

- European Commission – Renewable space heating under the revised Renewable Energy Directive (2022)
- European Commission – Overview of markets and regulatory frameworks under the revised Renewable Energy Directive (2022)
- European Commission – Renewable cooling under the revised Renewable Energy Directive (2022)
- European Commission – Policy support for heating and cooling decarbonisation (2022)

Other Publications

- Aalborg University – Towards a decarbonised heating and cooling sector in Europe: Unlocking the potential of energy efficiency and district energy (2019)
- ETIP RHC – 2050 vision for 100% renewable heating and cooling in Europe (2019)
- European Environmental Agency – Decarbonising heating and cooling — a climate imperative (2023)
- European Environmental Agency – Greenhouse gas emissions from energy use in buildings in Europe (2023)

#LowCarbon #Heating
#Cooling #RenewableEnergy
#EnergyTransition

Interreg Europe Policy Learning Platform on Low-carbon economy

Thematic experts:
Simon Hunkin, Katharina Krell
s.hunkin@policylearning.eu; k.krell@policylearning.eu

https://interregeurope.eu
July 2023

Interreg Europe
European Union | European Regional Development Fund