REDI4HEAT

Deliverable 2.1

Report: Renewable heating and cooling in the NECPs

Drafted by: Saverio Papa, Jeremie Geelen, Melanie Bourgeois

Date: 31/01/2024

Grant agreement No: LIFE27101077369

Project start date: 1st October 2022

Duration: 36 months

Co-funded by the European Union

Deliverable	
Work Package	WP2 – Assessment of NECPs and current initiatives on RES-HC
Tasks	T2.1 – Assessment of NCEPs and RHC support mechanisms T2.2 – Identification of main barriers and opportunities
WP Leader	Solar Heat Europe
Authors	Saverio Papa (SHE), Jeremie Geelen (BE), Mélanie Bourgeois (ENC)
Due date of deliverable	31/12/2023
Actual submission date	31/01/2024
Dissemination Level	PU
Type	Report
Number of Pages	65

Co-funded by the European Union

DISCLAIMER OF WARRANTIES

This project has received funding from the European Union's European Union's LIFE Clean Energy Transition LIFE-2021-CET-POLICY Programme under Grant Agreement No. LIFE27 101077369 (REDI4HEAT).

This document has been prepared by REDI4HEAT project partners as an account of work carried out within the framework of the EC-GA contract no. LIFE27101077369.

Neither Project Coordinator, nor any signatory party of REDI4HEAT Project Consortium Agreement, nor any person acting on behalf of any of them:

a) makes any warranty or representation whatsoever, expressed or implied,
   I. with respect to the use of any information, apparatus, method, process, or similar item disclosed in this document, including merchantability and fitness for a particular purpose, or
   II. that such use does not infringe on or interfere with privately owned rights, including any party's intellectual property, or
   III. that this document is suitable to any particular user's circumstance;

b) assumes responsibility for any damages or other liability whatsoever (including any consequential damages, even if the Project Coordinator or any representative of a signatory party of the REDI4HEAT Project Consortium Agreement has been informed of the possibility of such damages) resulting from your selection or use of this document or any information, apparatus, method, process, or similar item disclosed in this document.

Co-funded by the European Union

PROJECT PARTNERS

ADENE: Agencia para a Energia

BIO: Bioenergy Europe

CRES: Centre for Renewable Energy Sources and Saving Foundation

DENA: Deutsche Energie-Argentur Gmbh

EGEC: European Geothermal Energy Council

EHP: Euroheat & Power

EHPA: European Heat Pump Association

EIHP: Energetski Institut Hrvoje Pozar

SHE: Solar Heat Europe / European Solar Thermal Industry Federation

ENC: Energy Cities

KAPE: Krajowa Agencja Poszanowania Energii Spolka Akcyjna

TRI: Trinomics BV

Co-funded by the European Union

ABBREVIATION AND ACRONYMS

GHG: Greenhouse Gas

H&C: Heating and Cooling

Ktoe: kilotonnes of oil equivalent

NECP: National Energy and Climate Plan

REDI4HEAT: RED implementation for heating and cooling

TFEC: Total Final Energy Consumption

Co-funded by the European Union

TABLE OF CONTENTS

Co-funded by the European Union

Co-funded by the European Union

1. INTRODUCTION

Heating and cooling represents half of EU energy consumption. The decarbonisation of the sector is critical to achieve the EU legally binding targets of 55% reduction of GHG emissions by 2030 and climate neutrality by 2050, which are enshrined in the EU Climate Law. Furthermore, the uptake of renewable and efficient heating and cooling technologies reduces Europe's dependence on energy imports, especially from Russia, increasing energy security and contributing to the objectives of REPowerEU.

Nonetheless, fossil fuels remain by far the dominant energy sources for heating and cooling, while the share of renewables was only 23% in 2021 and is not increasing fast enough, despite the effects of the energy crisis triggered by the Russian invasion of Ukraine.

Therefore, it is of paramount importance that the European Union and its Member States step up their efforts to decarbonise heating and cooling. In this sense, the National Energy and Climate Plans (NECPs) and their ongoing revision are key to translate EU policies and targets into national legislation and concrete actions. Member States were due to submit the draft revision by June 2023 and receive feedback and recommendations by the European Commission by December 2023, with the final version due by June 2024.

The aim of this deliverable is to assess the initiatives planned in the NECPs for supporting and fostering the deployment of renewable heating and cooling solutions, with a particular focus on the five target countries of this project: Croatia, Germany, Greece, Poland, Portugal. The structure of the deliverable is the following: chapter 2 presents an assessment of heating and cooling, the uptake of renewable and efficient solutions in the sector, and the policy measures to promote it in all EU-27 Member States; chapter 3 presents a more detailed PESTEL analysis of the five target countries of the project, addressing political, economic, social, technological, environmental, and legislative factors; finally, chapter 4 is centred on the local dimension of the NECPs, which is investigated further and more thoroughly in D2.2 on Local initiatives for heat decarbonisation.

2. ASSESSMENT OF NECPs & SUPPORT MECHANISMS

2.1 Assessment EU Member States

Austria

The total final energy consumption (TFEC)for H&C amounted to almost 13,400 ktoe in 2018, 47 % of Austria's FEC. Estimated trajectories for FEC in the H&C sector show a decrease of almost 3 % from 2020 to 2030.

Co-funded by the European Union

The share of renewable energy in the H&C sector was 34 % in 2018, of which 87% from biomass. A further increase from 36.5 % in 2020 to 40.6 % in 2030 is expected.

High-efficiency co-generation and efficient district heating are already widely used in Austria. Yet, there are no projections for DHC or the RES share in DHC.

Main policies promoting RES in the H&C sector:

- A ban on oil-fired boiler installations in new buildings built after 2020.
- The replacement of oil heating systems in existing buildings. The target is to replace half of the existing 700 000 boilers by 2030. There is a direct subsidy programme called 'leave the oil bonus' with a total public budget of EUR 62.7 million.
- Phase-out of liquid fossil fuels in public buildings of the federal government and the *Länder* (owned and used) by 2030.
- A doubling of the renovation rate for the period 2020-2030.

Belgium

The TFEC for H&C was 18,679 ktoe in 2018, 51 % of the country's FEC. In the period 2020–2030, it is expected to decrease by 2 %.

The share of RES in the H&C sector was 8.2 % in 2018, and it is expected to be 11.3 % in 2030. Of the total increase in RES in the H&C sector, biomass accounts for 48 % followed by heat pumps at 42%, which will however experience the largest growth among RES in the H&C sector by 2030 (360%).

Heat demand in the district heating sector is expected to increase to 67 ktoe in Flanders. No targets were found in relation to district heating for Wallonia and Brussels.

Main policies promoting RES in the H&C sector:

- In the non-ETS, the focus is on industry, in which Belgium wants to replace fossil fuels by using heat pumps, green gas and electricity.
- Start to move away from heating oil by 2025 and from natural gas by 2030.
- Renovation and energy efficiency of buildings in all regions. These measures are supported by reduced tax rates on renovations. Grants and subsidies can also be used.
- Make more use of energy service companies and energy performance contracts.

Bulgaria

The TFEC for H&C was approximately 4,000 ktoe in 2018 (own calculation), 40% of the country's FEC. In the period from 2020 to 2030 trajectories show a decrease of almost 2 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 33.3 % in 2018 and it is expected to increase from 31.27 % in 2020 to 42.6 % in 2030. Biomass is the dominant technology, accounting for 88% of all renewables in the H&C and is expected to increase by 11% by 2030. There is also high

Co-funded by the European Union

geothermal potential in Bulgaria, which is expected to increase slowly until 2030, with several studies and analyses on geothermal potential and utilisation being commissioned.

There are no projections for DHC or for the RES share in DHC.

Main policies promoting RES in the H & C sector:

- Increasing the use of biomass in existing and new CHP plants and the promotion of the use of renewable energy in buildings.
- Using financial and legal measures with a focus on biomass and solar energy.
- Introducing policies addressing both energy efficiency and RESs.
- Renovation of the building stock with priority being given to energy efficiency combined with the use of RESs.
- Increasing the energy efficiency of DHC infrastructure through renovations and replacement of old heating systems.

Croatia

The TFEC for H&C was 3,253 ktoe in 2018, 48 % of the country's FEC. In the period 2020–2030, it is expected to increase by 8 %.

The share of RES in the H&C sector was 36.5 % in 2018 and it is expected to be 36.6 % in 2030, with basically no growth in renewables in H&C. Heat pumps are the dominant growing RES technology in H&C with 41%.

Heat demand in the district heating sector is expected to increase, but the heat sources are not specified. Croatia claims that it meets the requirements set out in Article 23 of RED II as it has more than 60 % of CHP in the district heating supply. The fuel source for the CHP is not specified though.

Main policies promoting RES in the H & C sector:

- CO_2 emission tax for non-ETS stationary sources emitting more than 30 tonnes of CO_2 annually.
- Covenant of Mayors programme, with the aim of reducing emissions by 40%.
- Implementation of measures related to the renovation of apartment buildings, single-family houses and public buildings with thermal insulation and replacement of heating systems.
- Increasing efficiency of heating systems by replacing steel pipes with insulated pipes and replacing individual boilers with CHP.

Cyprus

The TFEC for H&C was 501 ktoe in 2018, 27 % of the country's FEC. In the period 2021–2030, it is expected to increase from 583 to 604 ktoe.

Co-funded by the European Union

The share of RESs in the H&C sector was 36.7 % in 2018; it is expected to be at 32.6 % by 2021 and 39 % by 2030. The largest additional RES H&C technology contribution is from heat pumps, followed by solar thermal and then bioenergy.

Overall, DHC is expected to reach 6 ktoe, though its heat source was not discussed.

Main policies promoting RES in the H&C sector:

- Install heat pumps.
- Replace old heating equipment.
- Upgrade building envelopes.
- Install CHP in public buildings.

Czech Republic

The TFEC for H&C was approximately 14,000 ktoe in 2018 (own calculation), 52 % of the country's FEC. Estimated trajectories show a decrease of 7.7 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 20.7 % in 2018. It is expected to grow to 30.7 % by 2030. Biomass is the main renewable technology in the sector, accounting for 93% in 2020.

The energy consumption for DHC amounted to 2,133 ktoe in 2020. It is expected to decrease to 1,933 ktoe by 2030.

Main policies promoting RES in the H & C sector:

- Limited policies promoting RESs in the H & C sector, with a more focused approach on phasing out coal in the sector.
- Target to increase the heat supply from district heating by high-energy co-generation by 60%
- Natural gas is further promoted and seen as an alternative to coal.
- For households, there is a support scheme for the installation of gas condensing boilers.
- Supporting the transition from small heating systems to multi-fuel systems using locally available biomass, natural gas and other fuels, with gas as complementary fuel.
- Support scheme for the installation of heat pumps in buildings.
- Investment support scheme for CHP.

Denmark

The TFEC for the H&C sector amounted to 7.6 Mtoe in 2018, 48.13 % of Denmark's FEC. It is estimated it will decrease by almost 2 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 46.7 % in 2018. It is expected to increase from 54 % in 2020 to 60 % in 2030.

Co-funded by the European Union

The energy consumption for DHC accounted for 3,220 ktoe in 2018. It is expected to decrease to 2,996 ktoe by 2030. The share of RES in DHC was 55.1 % in 2017; it was projected to increase to 70.7 % by 2020 and 79.3 % by 2030.

Main policies promoting RES in the H & C sector:

- Economic incentive for electric heat pumps supporting individual households, companies, and district heating producers.
- An initiative to reduce the electrical heating tax to approximately DKK 0.15/kWh (2018 prices), effective from 2021.
- Supports the phase-out of both natural gas (primarily in the district heating sector) and oil boilers in the individual heating sector.
- A subsidy scheme to replace them with heat pumps in buildings outside the district heating and gas grids, with an annual budget of DKK 20 million over the period 2021–2024.
- Competitive support schemes for both building renovation and private enterprises. For the buildings, there is a specific list of energy efficiency measures that are granted. In the case of private enterprises, the subsidy scheme focuses on the savings in process energy. In both cases, the amount of subsidy depends on the energy saved.

Estonia

The TFEC for H&C amounted to almost 1.6 Mtoe in 2018, 49.6 % of Estonia's FEC. It is expected to decrease by approximately 3.02 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 53.7 % in 2018. It is expected to increase from 55.3 % in 2020 to 63 % in 2030. Biomass is the main renewable technology in H&C, accounting for 90.4% of renewables. Heat pumps covered the remaining 9.6% in 2020 but are expected to increase by up to 46% by 2030.

The energy consumption for DHC amounted to 625 ktoe in 2018 and is expected to decrease to 516 ktoe by 2030. The share of RES in the district heating supply was 51.6 % in 2017 and is expected to reach 80 % by 2030.

Main policies promoting RES in the H & C sector:

- Existing economic support measure for energy production from renewables and co-generation.
- Existing support for the transition from oil to renewable energy and energy efficiency improvements in the district heating network and boilers.
- Renovation of the country's building stock.
- Increasing the share of renewables in district heating supply.
- Direct subsidies for the thermal renovation of private, commercial, and public buildings, with an energy efficiency class of at least C.

Co-funded by the European Union

Finland

The TFEC for H&C amounted to almost 14.5 Mtoe in 2018, 54.6 % of Finland's FEC. It Is estimated to decrease by 3.2 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 54 % in 2018 and is expected to increase to 61 % by 2030. Bioenergy has a key role in the production of renewable energy, followed by heat pumps. Biomass is expected to increase by 11.5% from 2020 to 2030, while the share of heat pumps was 6.5% in 2020 and is expected to grow until 2025, then remain steady over the period 2025–2030.

Energy consumption by district heating amounted to 2,855 ktoe in 2018, which is almost 20 % of the total energy consumption for H&C. Almost 70 % of the district heat production was based on CHP in 2017. The share of RES in DHC was 40 % in 2018; it was projected to increase to 50 % by 2020 and 75 % by 2030.

Main policies promoting RES in the H&C sector:

- Legislation to phase-out coal in energy production by 2029. Finland is mainly using coal in CHP plants, and the latter will be replaced by heat-only boilers using biomass.
- Phase-out programme for the use of oil for heating by the beginning of 2030, with oil heating no longer being used in properties owned by the central and local governments after 2024.
- Heat pumps generating heat for district heating networks will be transferred to the lower category of electricity tax.
- Improvements in standards and subsidies for building renovation.
- More efficient utilisation of waste heat and voluntary energy efficiency agreement activities.

France

The TFEC for H&C was 61 200 ktoe in 2018, 40 % of the country's FEC. In the period 2020–2030, it is expected to decrease from 61.2 to 54.6 Mtoe.

The share of RES in the H&C sector was 21.8 % in 2018 and is expected to grow to 38.0 % by 2030. The 12% increase from 2020 to 2030 is 12 % would be 1 % below the indicative target set by Article 23(1) of the Renewable Energy Directive (RED2). Bioenergy accounts for the largest growth among RESs in the H&C sector, followed by heat pumps.

The share of RES for DHC is planned to increase by 1 percentage point annually. The potential waste heat sources from industry were identified as amounting to 0.86 Mtoe by 2035.

Main policies promoting RES in the H & C sector:

- The main measures are to continue strengthening the Heat Fund and make it more available for heat in non-economic activities.
- Low value added tax (VAT) on renewable heating equipment.
- Improve thermal performance of buildings.
- The use of energy saving certificates.

Co-funded by the European Union

Germany

The TFEC for the H&C sector amounted to more than 109 Mtoe in 2018, 49.1 % of Germany's FEC.

The share of renewable energy in FEC in the H&C sector was 13.6 % in 2018. According to scenarios with planned measures, it is expected to increase from 16 % in 2020 to 24.2 % in 2030. In Germany, biomass plays a key role in the production of renewable energy, followed by renewable municipal solid waste and heat pumps, and is projected to increase over the period 2021–2030. Other renewable sources (including solar thermal, geothermal, and ambient heat) are expected to grow as well and account for 7.5 % of the FEC for H&C in 2030.

There are no projections for the FEC by district heating or for the RES share in the district heating network. However, it is mentioned that the structure of district heating generation will change.

Greece

The TFEC for the H&C sector in Greece was 5 Mtoe in 2018, 30 % of the country's FEC.

The share of renewable energy in FEC in the Greek H&C sector was 30.18 % in 2018. It is expected to increase from 30.6 % in 2020 to 43 % in 2030. With a share of 60%, biomass is the dominant technology in this sector in 2018, followed by heat pumps with 21% and solar thermal with 18%. The use of biomass will only slightly increase over the period 2020–2030. Renewable heat will increase by almost 114 % until 2030. Renewable energy from solar thermal is projected to increase by 39% until 2030.

It is estimated that the amount of renewable energy in the DHC sector will decrease from 43 ktoe in 2020 to 39 ktoe in 2030. The technical and economic potential of RES in the DHC sector exists in specific areas in Greece where the conditions for geothermal energy and residual solid biomass are favourable.

Hungary

The TFEC for H&C amounted to almost 10.3 Mtoe in 2018, 53.9 % of Hungary's FEC. It is estimated to decrease by 11.3 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 18.1 % in 2018. It is expected to increase from 18.2 % in 2020 to 28.7 % in 2030. With a share of 92 %, biomass was the dominant technology in this sector in 2018. The use of biomass is expected to increase by almost 30% over the period of 2020–2030. Energy use by heat pumps is expected to rise by more than 400 % by 2030, but the share of heat pumps will remain rather low. Geothermal energy is projected to increase by 38 % over the same period.

There are no projections for DHC or for the RES share in DHC.

Main policies promoting RES in the H & C sector:

- The green heat programme, which promotes the use of renewables like geothermal, biomass and waste; under this scheme large district heating areas are analysed.

Co-funded by the European Union

- Loan programme supporting investments in energy efficiency and renewable energy.
- Modernisation of district heating and construction of mini-heat plants.
- Increase in the energy efficiency of buildings.

Ireland

The TFEC for H&C amounted to almost 4.79 Mtoe in 2018, 38.4 % of Ireland's FEC. It is estimated to decrease by 12 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 6.5 % in 2018. It is expected to increase to 24 % in 2030. With a share of more than 74.2%, biomass was the dominant technology in 2020 and is expected to increase by 35.8% over the period 2021-20230. In second place, heat pumps accounted for 22.3% of RES H&C; their use is expected to increase by 541% from 2020 to 2030.

DHC is estimated, at most, at about 0.8 % of heat consumption. In addition, structural barriers arise from the nature of Ireland's dispersed settlement structure with a low population density.

Main policies promoting RES in the H & C sector:

- A target of 600 000 heat pumps installed over the period 2021–2030.
- A ban on the installation of oil boilers from 2022 and the installation of gas boilers from 2025 in all new dwellings. Progressively phase out oil and gas boilers in existing dwellings through a combination of incentives, information, and regulatory measures.
- Retrofitting social dwellings older than 40 years to a B2-equivalent Building Energy Rating.
- Improving the energy efficiency of the building stock, with a target of 500 000 existing buildings to be retrofitted to a B2 building energy rating or cost optimal by 2030.
- All new dwellings are be built to a NZEB standard from 1 November 2019. All new 'buildings other than dwellings' are to be built to a NZEB standard from 1 January 2019.
- One third of all commercial (including mixed-use) buildings are to have a B building energy rating (or carbon equivalent gains) by 2030.
- The Support Scheme for Renewable Heat, and the support scheme for heat pumps and roof solar panels. To increase energy efficiency in the building sector, Ireland provides grants to homeowners so that they can upgrade their homes with energy efficiency measures.

Italy

The TFEC for H&C was 55.5 Mtoe in 2018, 48 % of the country's FEC. In the period 2020–2030, it is expected to decrease from 53.2 to 44.4 Mtoe.

The share of RESs in the H&C sector was 19.2 % in 2018 and is expected to grow to 33.9 % by 2030. The increase from 2020 to 2030 is 13.3 %, which exceeds the yearly target of 1.3 additional percentage points set out in Article 23 of RED II. Biomass consumption is expected to increase overall

Co-funded by the European Union

(from 10,050 ktoe in 2018 to 11,000 ktoe in 2030) but decrease in the H&C sector. Most of the growth among RES H&C technologies comes from heat pumps (83 %), followed by solar thermal (14 %).

Main policies promoting RES in the H & C sector:

- Tax relief on renewable technologies in buildings.
- Mandatory integration of RESs in buildings.
- White certificates.
- Renovation of buildings.

Latvia

The TFEC for H&C amounted to almost 2.46 Mtoe in 2018, 56.3 % of Latvia's FEC (128).

According to the Eurostat SHARES tool, the share of renewable energy in FEC in the H&C sector was almost 56% in 2018. This share is expected to increase to 57.6 % in 2030. Biomass was the dominant technology in the sector and is expected to remain so also in the future.

The share of RES in DHC was 46.7 % in 2018 and is projected to increase to 58.4 % in 2030, meeting the requirement of the RED to increase the share by 1 percentage point annually. In 2018, district and local heating produced 709 ktoe of thermal energy. Solid biomass is the dominant source (93.5%).

Main policies promoting RES in the H & C sector:

- Energy reduction in buildings by increasing energy efficiency.
- Mobilise EU financial support to develop new regional district heating networks and renovate existing ones in cities with an existing or planned heat grid intensity above 2 MWh/m.
- Develop economic incentives for final consumers to connect to the district heating network.
- Update legislation that limits the installation of new fossil fuels in district heating
- Building thermal energy consumption for heating is more than 30 % lower than in 2020.
- At least 2 000 residential multiapartment buildings and at least 5 000 private homes will be renovated between 2020 and 2030. This also includes the installation of RES technologies (non-emission technologies) and a connection to the district heating network.

Lithuania

Lithuania's TFEC for H&C amounted to 2.6 Mtoe in 2018, 45.06 % of the country's FEC. It is projected to increase by 8 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 45.6 % in 2018. It is expected to increase to 67.2 % in 2030. With a share of 98.4 %, biomass was the dominant technology in this sector. Biomass for heating (district heating and decentralised heaters) has increased by 9 % from 2018 to 2020 but is expected to decrease slightly over the periods 2020–2025 and 2025–2030.

Energy consumption by district heating amounted to 915 ktoe in 2020, 29.4 % of the total energy consumption for H&C. District heating plays a key role in the overall decarbonisation of the H&C

Co-funded by the European Union

sector. The share of renewable energy in the total district heating sector must reach 90 % by 2030. Since the centralised cooling energy supply network is not developed in Lithuania, residential and commercial houses typically use decentralised cooling systems. The theoretical annual energy demand for cooling is estimated at 5–6 TWh.

Main policies promoting RES in the H & C sector:

- Thermal renovation of multifamily buildings by 2030.
- Thermal renovation of public buildings.
- Replacement of 50 000 inefficient boilers each year with heat pumps or efficient district heating.
- Modernisation of the district heating network.
- Promoting the construction of new CHP plants and the retrofitting of both old heating boilers and the heat transmission network.

Luxembourg

The TFEC for H&C amounted to 1.1 Mtoe in 2018, 25.1 % of Luxembourg's FEC. Estimated trajectories for FEC in the H&C sector show a decrease of almost 30 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 8.8 % in 2018. It is expected to increase from 13.7 % in 2020 to 30.5 % in 2030. With a share of 91%, biomass was the dominant technology in this sector in 2018. According to Luxembourg's NECP, the contribution of biomass will increase over the period 2020–2030. The amount of energy contributed by heat pumps was 8.17 ktoe in 2020. It is estimated that this will increase by almost 136 % by 2030. Solar thermal generated 4.99 ktoe in 2020 and will increase by almost 224 % by 2030.

It is estimated that the amount of renewable energy in DHC will increase from 50.6 ktoe in 2020 to 58.2 ktoe in 2030.

Main policies promoting RES in the H & C sector:

- Financial support (two main programmes: the prime house support programme and climate loans for residential buildings).
- Improved information policy (e.g. updated restriction map via Geoportal).
- The NZEB construction standard for new residential buildings has been in force since 2017 and will be extended in the short term to ensure 100 % renewable energy coverage.
- Promotion of the renewable technologies including the introduction of the taxation of heating oil and an attractive support programme for oil heating exchange (to guarantee that the tax measure is socially fair).
- Support for biomass has mainly been used in the CHP sector in recent years. For large installations (> 20 MW), RED II provides sustainability criteria for the use of biomass.

Co-funded by the European Union

Malta

The TFEC for the H&C sector was 78.2 ktoe in 2018, 11.6 % of Malta's FEC. It is estimated to increase of almost 12.4 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 23.4 % in 2018. Heat pumps, with a share of 61 %, were the most-used technology, followed by solar thermal with 27%. According to the projections, renewable energy from heat pumps will increase by almost 62 % from 2020 to 2030. Solar thermal is expected to remain stable between 2020 and 2025, then decrease until 2030, while the use of biomass should remain stable.

There is no DHC in Malta. In view of the low share of heating demand, Malta envisages the role of H&C networks to remain marginal over the next decade.

Main policies promoting RES in the H & C sector:

- Measures targeting solar water heaters (SWHs), heat pump water heaters (HPWHs) and waste-to-energy plants, with the aim of increasing Malta's RES share in the H & C sector.
- Educational and awareness-raising campaigns to encourage households to invest by highlighting the benefits of SWHs/HPWHs.

Netherlands

The TFEC for H&C was 27 000 ktoe in 2018, 54 % of the country's FEC. In the period 2020–2030, it is expected to decrease from 25.5 to 24.5 Mtoe.

The share of RES in the H&C sector was 5.9 % in 2018 and is expected to grow to 13.0 % by 2030, well below the indicative target of 13 additional percentage points from 2020 to 2030 indicated in the Renewable Energy Directive (RED2), Article 23 (now revised). Biomass consumption is expected to decrease from 3 310 ktoe in 2020 to 3 200 ktoe in 2030. Geothermal and heat pumps account for the largest growths among RES in the H&C sector.

Heat demand in the district heating sector could increase by about 500 ktoe according to the Climate Agreement. However, the regions decide their own strategies, so it is uncertain if that amount will be reached. The potential waste heat sources from industry were identified as amounting to 1.2 Mtoe, but the amount that will be realised has not been specified.

Main policies promoting RES in the H&C sector:

- New houses cannot be connected to the gas network from 2020, and 1.5 million homes should have switched from gas by 2030.
- NZEB houses are required from 2021.
- VAT tax reduction for investments in energy efficiency.
- Increased energy tax on natural gas and reduction on electricity.

Co-funded by the European Union

Poland

The TFEC for H&C amounted to almost 37.7 Mtoe in 2018, 50.3 % of Poland's FEC. Estimates for FEC in the H & C sector show a decrease of almost 11 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 14.55 % in 2018 and is expected to grow to 28.4 % in 2030. With a share of 97.4 %, biomass was the main renewable technology in the sector in 2018; its use is expected to increase by 7.7 % by 2030, compared to 2020. Heat pumps and solar energy are expected to increase largely by 2030, compared to 2020, by 195 % and 371 % respectively.

DHC energy amounted to 2 670 ktoe in 2015. The share of RES in the DHC sector was 2 % in 2015 (coal made up 90 %) and is projected to increase to 29 % by 2030. The country's goal was to increase the share of renewable energy in DHC to 47 % by 2020 and is to increase this share to 72 % by 2030.

Main policies promoting RES in the H&C sector:

- Revised regulations to increase energy efficiency standards for boilers and thermal insulation and promote the use of RES for new buildings and buildings undergoing renovation.
- Modernisation of heating plants and CHP plants. There is a new support mechanism for high-efficiency co-generation and systemic change in the district heating sector.
- Development of energy-efficient district heating and low-carbon district heating.

Portugal

The TFEC for the H&C sector was almost 6.2 Mtoe in 2018, 36 % of Portugal's FEC. Estimated trajectories for FEC in the H&C sector show a decrease of 7.4 % from 2020 to 2030.

The share of renewable energy in FEC in the H&C sector was 41.2 % in 2018; in the draft revised NECP it is projected to increase to 47% by 2030 (up from the previous target of 43% but still short of the binding target set by article 23 of the revised Renewable Energy Directive). Bioenergy is the dominant renewable in the sector and its consumption is expected to remain stable until 2030. Energy supplied from heat pumps and solar thermal remains constant over the next decade, whereas renewable gases are expected to play a greater role by 2030.

Portugal does not expect to deploy district heating networks.

Main policies promoting RES in the H&C sector:

- Promotion of RES-H&C systems, such as solar thermal systems, renewable boilers, and hybrid systems combining two or more technologies.
- Promotion of the uptake of more efficient technologies, including ventilation, combustion, heat recovery and industrial cooling.

Co-funded by the European Union

Romania

The TFEC for the H&C sector amounted to more than 13.6 Mtoe in 2018, 54.5 % of Romania's FEC.

The share of renewable energy in FEC in the H&C sector was 25.4 % in 2018 and is expected to increase to 33 % in 2030.

According to the WAM scenarios, the amount of renewable energy used in district heating, with geothermal energy as a source, is projected to increase from 31 ktoe in 2016 to 45 ktoe in 2030.

Main policies promoting RES in the H & C sector:

- From December 2020, new buildings must be NZEBs. Following the amendment of the law on the energy performance of buildings, the definition of 'nearly zero-energy building' has been modified to increase the share of RESs in primary energy consumption from 10 % to 30 %.
- The Green House Plus programme supports heat pumps and solar thermal installations.
- Promoting high-efficiency co-generation.
- Modernise, renovate, and extend the district heating system. There is a multiannual financing programme for supporting investments.
- Promoting energy efficiency in the residential sector (through thermal renovation of the building envelope and heating system).

Slovakia

The TFEC for H&C was 6 062 ktoe in 2018, 53 % of the country's FEC. In the period 2018–2030, the FEC in the H & C sector is expected to decrease by 18.8 %.

The share of RES in the H&C sector was 10.6 % in 2018 and is expected to grow to 19.0 % by 2030. The biomass FEC is expected to grow by 23% until 2030, accounting for 48% of the total increase in RES in the H&C sector. Heat pumps are expected to have the largest growth among RES-H&C technologies, accounting for 32% of the total increase in RES in H&C.

The measures for H&C focus on getting rid of fossil fuels and improving the energy performance of buildings. Main policies promoting RES in the H & C sector:

- Converting to biomass and biogas fuels for CHP.
- Support households in investing in renewable heat generators, such as solar thermal equipment, biomass boilers and micro-CHP plants.
- Increase energy efficiency in enterprises.
- Reduce energy intensity in buildings.

Co-funded by the European Union

Slovenia

The TFEC for the Slovenian H&C sector was 1.86 Mtoe in 2018, almost 36 % of the country's FEC.

The share of renewable energy in FEC in the H&C sector was 31.61 % in 2018. It is expected to increase from 36.4 % in 2020 to 41.4 % in 2030. With a share of 89.9 %, biomass was the dominant technology in the H&C sector in 2018, but it is expected to decrease over the period 2020–2030. Renewable energy from heat pumps amounted to 78 ktoe in 2020. This is estimated to increase by almost 46.15 % until 2030. Renewable energy from solar thermal amounted to 12 ktoe in 2020 and is projected to increase by almost 42 % until 2030.

The FEC in district heating was 213 ktoe in 2017 and is expected to decrease to 178 ktoe by 2030.

Main policies promoting RES in the H & C sector:

- Banning of heating oil in new constructions since 2021
- Banning of the sale and installation of oil boilers fired to come in effect in 2023.
- Define energy poverty in the sectorial legislation and lay down an obligation to periodically measure it (estimates of the numbers of energy-poor households in the country).
- Develop a mapping tool with databases to support local planning.

Spain

The TFEC for H&C amounted to 30.17 Mtoe in 2018, 33.6 % of Spain's FEC.

The share of renewable energy in FEC in the H&C sector was 17.5 % in 2018 and is expected to increase from 18 % in 2020 to 31 % in 2030. With a share of 79.3 %, biomass was the dominant technology in this sector, followed by heat pumps (14.1 %). The contribution of heat pumps is expected to increase from 629 to 3 523 ktoe over the period 2021–2030. Projections for other renewable technologies were not provided.

The FEC in district heating and cooling networks in Spain was approximately 42.5 ktoe in 2017, 0.15% of the TFEC in the H&C sector. There are no projections for DHC or for the RES share in DHC.

Main policies promoting RES in the H & C sector:

- Revision of the minimum requirements of heating equipment in new and renovated buildings.
- Renewal of the installed solar thermal parks, high-efficiency ambient energy equipment, the retrofitting of biomass equipment with high performance, geothermal installation and NZEBs, through direct subsidies, fiscal incentives; elimination of indirect subsidies for fossil fuels.
- Mechanisms for the promotion of H&C networks (implementation of Article 14 of the EED; implement a mechanism that informs the final customer about energy efficiency and RESs in DHC through energy certification of buildings and thermal installations legislation).
- Financial support for energy efficiency investments to increase the energy performance of buildings, along with the building performance certificate. This measure seeks to achieve 4 755.9 ktoe of cumulative final energy savings over the period 2021–2030.

Co-funded by the European Union

- Support energy efficiency in cold-generating equipment and air-conditioning installations in the tertiary sector and public infrastructure. This measure seeks to achieve 3 350.4 ktoe of cumulative final energy savings over the period 2021–2030.

Sweden

The TFEC for H&C was 14 700 ktoe in 2018, 42 % of the country's FEC. In the period 2020–2030, it is expected to increase from 16 to 17 Mtoe.

The share of RES in the H&C sector was 69 % in 2018, and it is expected to grow to 72 % by 2030. Biomass consumption is expected to increase from 9 500 ktoe in 2020 to 10 700 in 2030, contributing for 82% of the total increase in RES in H&C. Heat pumps account for the largest growth among RES in the H&C sector with 17 % during the period 2017–2030.

Heat demand in the district heating sector is expected to decrease by 300 ktoe, despite 700 ktoe for new customers. This is due to lower heat consumption from existing customers. There are no targets for new networks in Sweden, but district cooling is expected to increase from 86 to 258 ktoe.

Main policies promoting RES in the H & C sector:

- Taxes on energy and CO2 emissions, and subsidies are used to correct for market failures.
- Rural support programme for farmers and small businesses.
- Support energy efficiency measures in industry.
- Support the renovation of rental apartments.

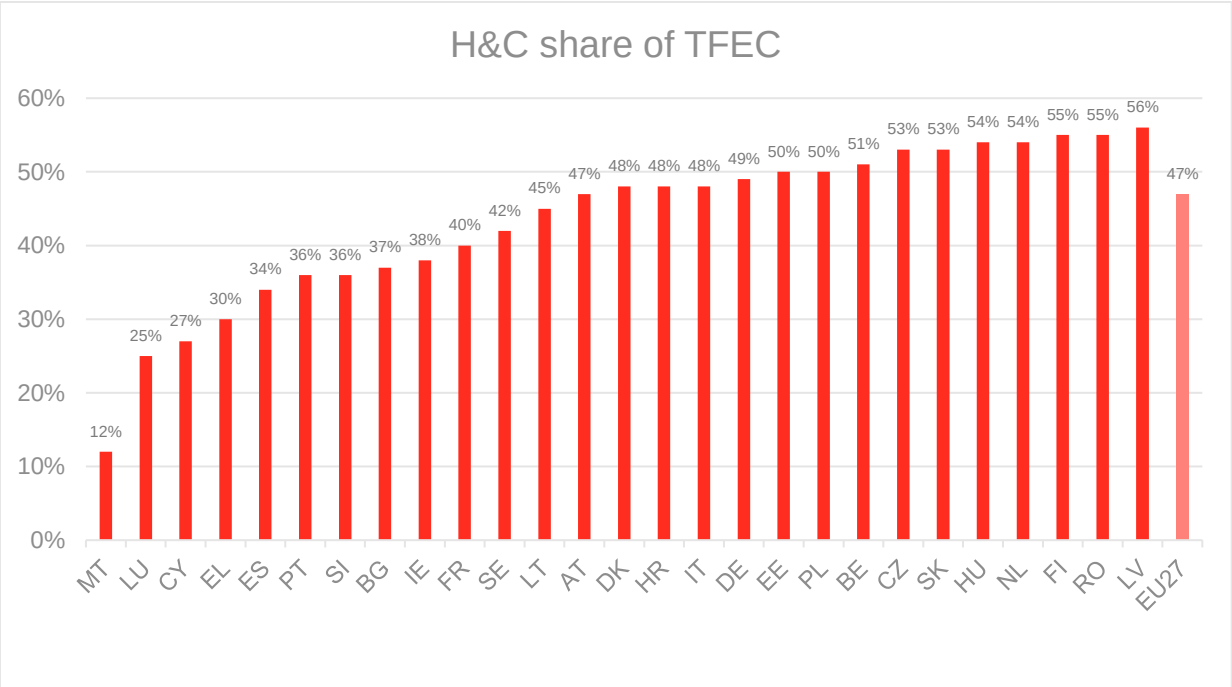
2.2 Main findings

Thanks to the general assessment of heating and cooling in all EU Member States presented in subchapter 2.1, it was possible to draw some main findings about renewable heating and cooling in Europe. These findings are summarized below.

1. **H&C is half of the energy consumption in the EU and in most Member States.**

Heating and cooling represent half of EU energy consumption, with most EU countries above 40% and only three exceptions below 30% (Cyprus, Luxembourg, and Malta). Therefore, the decarbonisation of the sector should be a priority to achieve the ambitious targets set in the EU Climate Law, namely a 55% net reduction of GHG emission by 2030 and climate neutrality by 2050.

Co-funded by the European Union

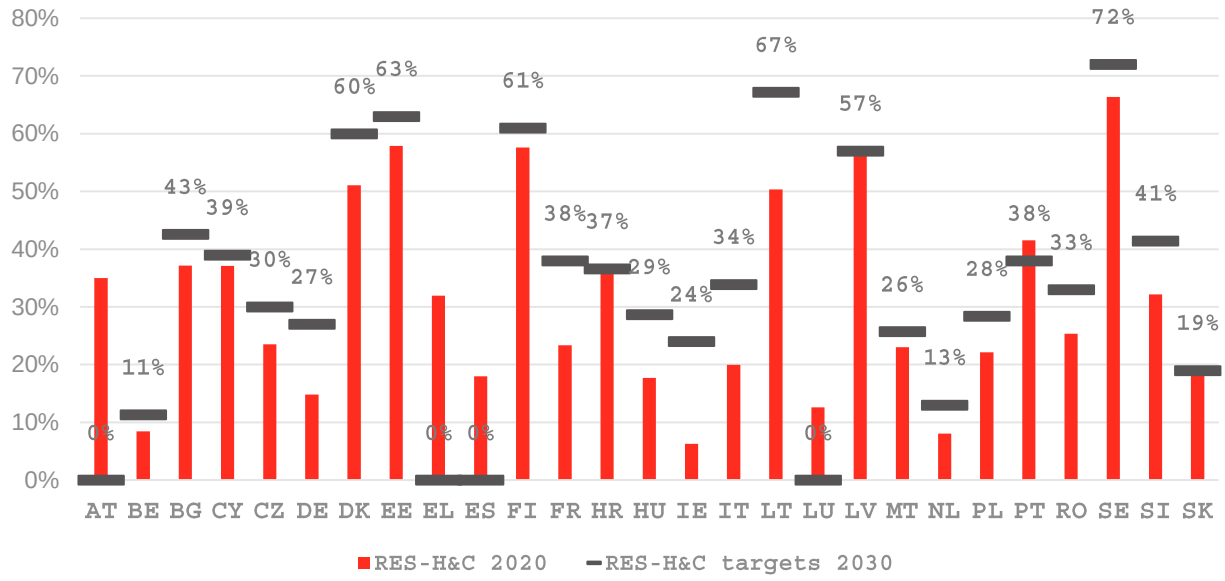


2. Renewable penetration in H&C remains low and mostly limited to biomass.

The graph below shows the share of renewable energy in EU Member States in 2020 vis-à-vis the targets set for 2030. Importantly, not all Member States set a sectoral target for renewable energy (the ones with no target are indicated with a 0%); following the latest revision of the Renewable Energy Directive, such sectoral target will become mandatory, as required by article 23.

Three aspects are worth mentioning: first, EU countries show a very limited penetration of renewables in the sector; second, the 2030 targets are very unambitious and often reflect a business-as-usual scenario; third, biomass is by far the dominant renewable source in the sector, which explains the high renewable penetration in countries like Sweden, while the other renewable heating and cooling technologies remain largely untapped.

Co-funded by the European Union



3. The decarbonisation targets for H&C lack ambition.

The decarbonisation of heating and cooling should be a top priority for EU, national, and local policymakers, considering it represents the lion share of Europe's energy consumption. Furthermore, the energy crisis triggered by Russia's invasion of Ukraine has highlighted that we must accelerate the uptake of renewable and efficient solutions, particularly in the heating and cooling sector, to achieve energy security, affordability, and decarbonisation. However, the sector is still dominated by fossil fuels, despite the availability of several mature renewable and energy efficient solutions, including biomass, geothermal, solar thermal, heat pumps, and district heating.

The European Commission addressed this issue with the proposal to revise the Renewable Energy Directive that was tabled in July 2021, with several new or revised provisions on heating and cooling. Notably, a proposal for binding national targets for renewable energy in H&C by 2030 was presented and adopted with the final text published in October 2023. While the binding nature of the target is important, the target itself (0.8 additional percentage points per year between 2021 and 2025, 1.1 between 2026 and 2030) remains disappointingly low.

Likewise, we noted a general lack of ambition in the 2030 national targets for the share of renewable energy in heating and cooling, which often reflect a business-as-usual scenario. The draft revisions of the NECPs seem to confirm this trend. While the energy crisis and the political efforts to reduce EU dependency on Russian fossil fuels seem to have triggered a significant increase in the renewable targets in electricity and transport, while this increase is significantly more modest for H&C.

Co-funded by the European Union

4. **NECPs lack dedicated and coordinated actions on H&C**

In general, NECPs tend to focus on matters that are directly in the hands of central governments. This is detrimental to heating and cooling, which has a strong local dimension and requires the active engagement of local authorities. As a result, most NECPs also dedicate limited space and specific measures to the sector. In fact, the parts on H&C are often scattered and split between the chapters on the renewable energy and energy efficiency dimensions, as well as significantly shorter than the sections on electricity, renewable gases, or transport.

A stronger link between the NECPs and the Comprehensive Assessments on efficient Heating and Cooling required by the Energy Efficiency Directive should be established, in line with the revised text of article 25 of the EED. This would help provide a more holistic approach of the national actions undertaken to decarbonise the heating and cooling sector, which is overall missing in many draft revisions of the NECPs submitted so far.

3. IN-DEPTH ASSESSMENT OF TARGET COUNTRIES

Greece

Political

The global financial crisis of the late 2000s had a devastating effect on Greece. In June 2023, the conservative party of New Democracy party won the elections, credited with the return of the Greek economy to stability and growth, after a severe debt crisis and three international bailouts.

Greece's energy and climate policy focuses on energy security, improving economic competitiveness and protecting vulnerable consumers[1]. Greece has achieved most of its 2020 energy and climate targets, with the objective to achieve net zero emissions by 2050. A comprehensive overview of these policies is provided in two key documents: the National Energy and Climate Plan (2019)[2][3]

At the time of writing this report, the draft update of the NECP (2023)[4] was submitted by Greece. The final update, after considering the Commission recommendations, is expected in June 2024. Therefore, this report considers the 2019 final version, which includes the binding targets so far. The final version is expected in June 2024 and it will be considered at a later stage of the project.

Greece has seen a reduction in the share of fossil fuels in its energy supply, mainly because of decreasing use of lignite for electricity generation. From 2005 to 2021, the share of lignite-fired

[1] IEA Energy Policy Review Greece 2023
[2] Greek NECP 2019
[3] Ministry of Civil Protection and Climate Change Law 4936
[4] Greek draft updated NECP

Co-funded by the European Union

generation fell from 60% to 10%, driving down the carbon intensity of electricity generation. From 2010 to 2021, the share of fossil fuels in energy supply fell from 90% to 82% of total energy supply.

Greece's energy policy focuses on electrification, renewable energy, and investments in electricity infrastructure (interconnections, island connections, upgrade domestic transmission and distribution capacity). Regarding buildings, there is an enormous energy saving potential, due to the old building stock.

The holistic policy framework developed by Greece to meet the 2030 share of renewables, decentralisation, energy communities and self-consumption, constitute a good practice[1]. However, additional efforts are needed considering that the Greek energy sector is still largely dependent on fossil fuels, most of which are imported.

As reported in the NECP 2019[5] and the Comprehensive Assessment[6], key targets for 2030 include:

- 40% reduction in GHG emissions compared to 1990.
- 35% share of RES in final gross energy consumption.
- 43% share of RES in heating and cooling.
- 38% increase in energy efficiency.
- Annual energy renovation in government buildings should cover 3% of the total surface area.

Especially for buildings, the NECP 2019 included stricter building codes, incentives for thermal renovations, upgrading heating and cooling systems and appliances. The main measures are:

- The installation of oil boilers will no longer be allowed from 2025, and from 2030, oil for heating will have to contain at least 30% by volume of renewable liquid fuels.
- An Energy Performance Certificate (EPC) must be issued when a building is built, purchased, rented or after a major renovation. Yet only 38% of residential buildings had an EPC in 2021.
- Every public building built after 2019 and all buildings (public and private) built after 2021 have to be nearly zero-emission buildings (nZEB).
- Since 2011, new buildings are required to cover at least 60% of the energy needs for hot water with solar thermal or any other renewable energy source proven more efficient than solar thermal.
- Since 2010, according to the Energy Efficiency Building Regulations, a PV generator on the roof is only allowed if a solar water heater system is already in place.
- The 2019 NECP includes a renovation target of 60 000 dwellings per year from 2021 to 2030, which would achieve cumulative energy savings of 7.3 Mtoe (306 PJ) and create over 22 000 new full-time jobs. As Greece has around 4.8 million buildings, reaching 100% net zero buildings by 2050 requires a notably higher renovation rate of around 150 000 buildings per year[1]
- For industries, the measures are limited to energy demand audits.

[5] HAEE - Greek Energy Market Report 2021
[6] Greek Ministry of Energy & Climate Change Comprehensive Assessement NECP 2021

Co-funded by the European Union

The draft revision of the Greek NECP [7] published in November 2023 include higher targets:

- 54% reduction in GHG emissions compared to 1990 levels (previously 40%).
- 45% share of RES in final gross energy consumption (previously 35%).
- 46% share of RES in heating & cooling (previously 43%).
- 44%-49% increase in energy efficiency (previously 38%).

In addition, specific measures for heating and cooling are outlined, including:

- the energy upgrade of the building stock: The annual share of renovation in residential buildings will increase to 1.4% in 2030 (from 0.8% today) and will reach 1.7% in 2050, contributing to the renovation of 43% of residential buildings.
- the promotion of heat pumps:17% of residential buildings are expected to meet thermal needs by heat pumps by 2030 and 91% by 2050.
- the promotion of energy efficient heating and cooling systems and in particular, solar thermal systems and heat pumps.
- the mixing of 12-15% biomethane in the natural gas transmission system.

Economic

Greece is the 53rd largest in the world and the 16th largest economy in the European Union[8], with a nominal Gross Domestic Product (GDP) of $239.3 billion per annum or $22,59 per capita. Average inflation is estimated at 6.1% in 2022, but this is expected to decelerate in 2023, settling at an average of 1.2% in 2023. Greece holds the Eurozone's highest ratio of public debt as share of its GDP, reaching a record 213.1% in 2020. In 2022 the public debt decreased at 166% and forecasts expect further reduction[9].

Greece was still facing and recovering from the impacts of the debt crisis when COVID-19 hit, but the country's recovery was much stronger than expected. Due to COVID-19, the GDP shrank by 9% in 2020, but rebounded by 5.9% in 2022 experiencing a significant increase in exports from €40 billion in 2021 to €54.7 billion in 2022, as well as investments from 12.0% to 13.3%[10].

According to IMF[11], achieving the NECP targets requires a substantial boost in green investment during 2020-2030, estimated at € 43.8 billion (over 20% of 2021 GDP). Climate policies are expected to disproportionately affect vulnerable groups (rural, low-income households and low-skilled workers), posing challenges to the already weak social protection system. Indeed, the coverage of social protection is relatively poor, while spending on social assistance is one of the lowest in the Eurozone.

Therefore, social protection should be reformed to assist the green transition and in the context of climate change adaptation measures. The IMF[11] recommends introducing a new carbon tax in non-

[7] Greek draft updated NECP
[8] Economy of Greece - Wikipedia
[9] HAEE - Greek Energy Market Report 2021
[10] Greek Economy - Enterprise Greece
[11] IMF Selected Issues Paper, 2022, IMF - IS GREECE'S SOCIAL PROTECTION SYSTEM FIT FOR THE GREEN TRANSITION?

Co-funded by the European Union

ETS sectors (Emissions Trading System) and gradually increasing it over time to finance targeted transfers and green investment. This will help achieve climate goals while also supporting growth and protecting vulnerable groups during the green transition.

Specific incentives for renewable and more efficient H&C

Greece provides an income tax deduction for investments in heating and cooling systems using solar thermal, biogas, biomass, geothermal and heat pumps (air, water and ground-source). The deduction is 10% of qualifying project costs up to a maximum of 3,000€[1]. Under the 2016 Development Law, subsidies and tax breaks are also available for investments in solar thermal, biogas, biomass, geothermal and heat pumps (air, water, and ground-source) built by private enterprises or social co-operatives. There are minimal project costs ranging from 50,000€ for social co-operatives to 500,000€ for large enterprises[1].

Programs supporting renewable and more efficient heating and cooling included:

- "Recycle & Change Thermosiphon"[12]. This programme provides incentives for replacing electrical thermosiphons with a solar thermosiphon.
- "Recycle-Change Device"[13]. Greek households can receive a subsidy to replace up to three old electric appliances with new ones, including air conditioners, refrigerators, or freezers.
- 'Saving at home' programs[14]. It provides interest-free loans and grants for the installation of renewables and energy efficiency measures.
- 'SAVE' programs for Local Authorities.
- "ELECTRA" program[15], with a budget of EUR 670 million for 2022 to 2026, topped up with EUR 250 million of private investments. It finances the renovation of the whole building, aiming to improve energy efficiency and reach class B and reduce energy demand by 30%, with the mandatory appointment of an energy manager.

Sociocultural

In Greece, the social protection system is weak and spending on social assistance is one of the lowest in the Eurozone. The pandemic has further highlighted the importance of addressing social assistance gaps. Key measures would include simplification and addressing tax evasion among self-employed workers.

Income inequality remains higher than the eurozone average, with sizeable income gaps between socio-economic groups, most notably by educational attainments, degree of urbanization, and age. Climate policies could disproportionally affect consumption of vulnerable groups. Ambitious reforms and an effective use of carbon tax revenues are needed to make the green transition more growth friendly. In general, the commitment to climate-friendly policies is encouraging, but should be complemented with social protection reforms to assist the green transition.

[12] allazothermosifona.gov.gr
[13] allazosyskevi.gov.gr
[14] Save at home 2023
[15] HLEKTRA program

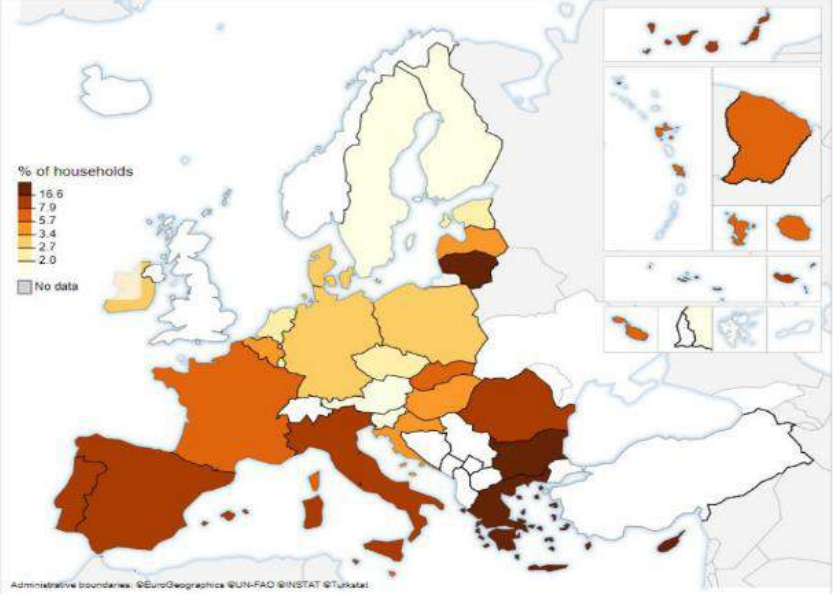
Co-funded by the European Union

Public awareness

Since the publication of the Greek EPBD, many public awareness campaigns, communication campaigns, and general publicity through the media have happened. This is reflected in the wide deployment of RES in heating and cooling and the annual sales of heat pumps and solar thermal systems. Indicatively, Greek solar thermal market experienced positive development, with 18% growth in 2021 and 17% in 2022. This is remarkable, considering the after covid era.

Energy Poverty

Greece has particularly high levels of energy poverty due to low incomes and high energy needs stemming from old energy-inefficient housing**Error! Bookmark not defined.**.



Map of inability to keep home adequately warm indicator, 2021.[16]

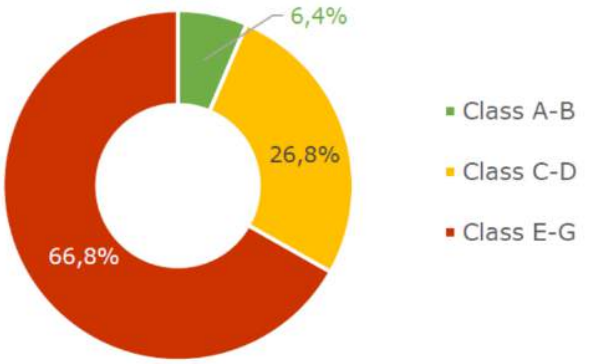
Building stock

65% of the country's buildings were constructed prior to 1980[17], with practically no thermal protection systems, such as insulation and double glazing. Meanwhile, the strong increase in living space per person has also contributed to increase the energy demand per person. Finally, the high penetration of air-conditioning use in recent years has increased the absolute consumption levels of the building sector and the country's peak electrical power loads. Greece's building sector is responsible for roughly one third of total CO_2 emissions and around 36% of total energy consumption. According to a recent Greek Energy Market Report[9], 42% of the total building stock is constructed

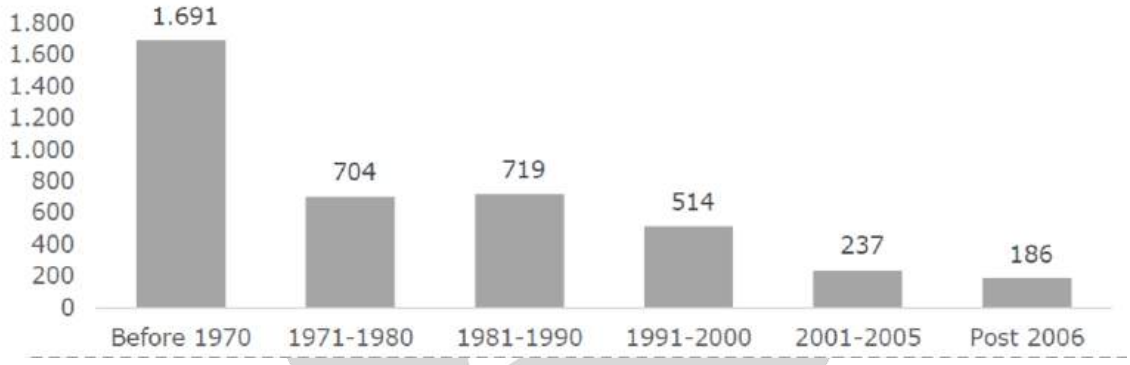
[16] Energy poverty Advisory Hub 2022, National Indicators – Insights for a more effective measuring
[17] Greece Climate-Adapt europa.eu

Co-funded by the European Union

before 1970, and as a consequence, residences present poor energy performance, with almost 67% of the households being classified in the lowest energy performance categories.



Households' energy performance, 2015-19[9]



Greek building's construction date distribution, 2020[9]

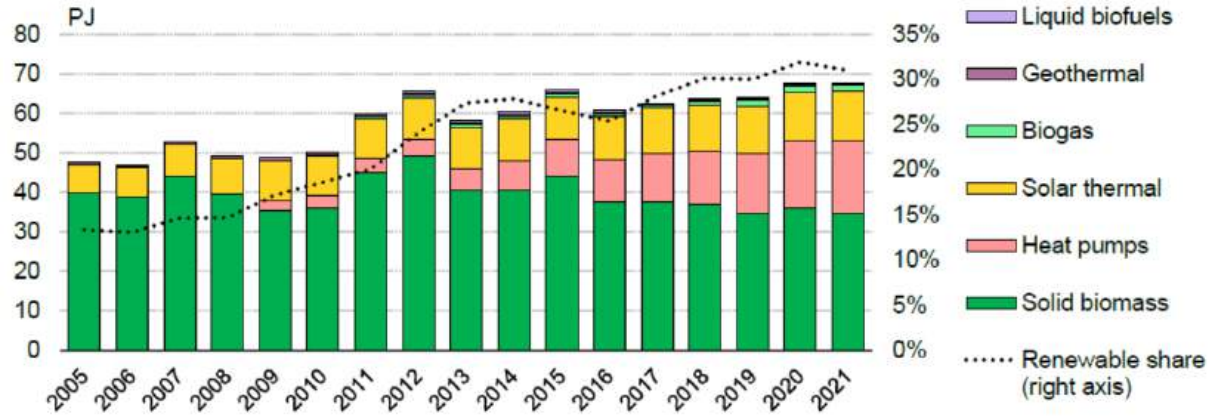
Technological

From 2007 to 2021, electricity was the main source of energy in buildings (50% in 2021), playing an important role in residential buildings (36%) and almost monopolising energy demand in service sector buildings (83%). The second-largest source of energy for buildings was oil (21% in all buildings, 27% in residential buildings). Bioenergy and waste supplied 12% of energy to buildings, natural gas 11%. Solar thermal covered 5.1% of energy demand in buildings, the highest share among IEA member countries, thanks to continued policy support for this technology. District heating covers only 0.6% of buildings' energy demand and coal 0.1%.

Especially for the residential sector, most of the energy (56.2%) is used for space heating, which is largely provided by diesel and biomass fired boilers and only 4.3% is used for cooling[1].From 2010 to 2021, renewable heating and cooling increased from 50 PJ to 67.5 PJ and from 19% to 31.1% of total heating and cooling demand. This growth was driven mainly by increased use of heat pumps (from 3 PJ to 18.3 PJ) and some increase in solar thermal (from 10 PJ to 12.7 PJ) and biogas (from 0.1 PJ to 1.4 PJ). The use of solid biomass for heating and cooling declined from 45 PJ in 2011 to 34.7 PJ in 2021.

Co-funded by the European Union

However, solid biomass still accounts for the largest share of renewables in heating and cooling (51.4% in 2021), followed by heat pumps (27.1%), solar thermal (18.8%), and biogas (2.1%). Greece has the highest use of solar thermal heating in the IEA, as it covers 5% of demand in buildings, compared to the IEA average of 0.6%.



Renewable energy in heating and cooling in Greece, 2005-2021[1]

The trajectory for RES-HC technologies outlined in the 2019 NECP was the following: by 2030, there would be 900 ktoe biomass, 500 ktoe solar thermal, 470 ktoe from heat pumps, for a total of 1870 ktoe. The draft revised NECP published in November 2023 introduces some significant differences (table page 73), namely: 930 ktoe from heat pumps, 750 ktoe from biomass, 600 ktoe from solar thermal, 80 ktoe from RFNBOs, for a total of 2350 ktoe. It is worth noting that by 2050, further increases in RES-H&C by 2050 are projected to come predominantly (if not almost entirely) from RFNBOs, which should grow from 80 ktoe in 2030 to 1200 in 2050, with the other RES remaining stable or slightly declining.

Biogas & Biomass

According to Eurostat data in 2021, the use of biomass in the heating and cooling sector in Greece corresponded to 868 ktoe, or close to 54% of the total renewable heating and cooling mix of the country. Out of this bioheat, the largest share can be attributed to households as direct consumption (646 ktoe, or around three quarters of the bioheat produced) followed by industry (130 ktoe, around 15%). Solid biomass is the predominant renewable energy source for residential heating and is currently used in the form of firewood (in older appliances), pellets (primarily in the northern part of the country) or agrobiomass, mainly as residues connected to the olive industry in the south of the country. In the Greek industrial field, several sectors are already relying on biomass for high temperature heat, such as Cement, lime and non-metallic minerals industries. Finally, biomass also plays a part in some agricultural applications like greenhouses heating, mainly thanks to a smart and circular use of bio-based resources.

District heating in Greece is relatively limited, with 5 installations across the country, but mostly relying on fossil fuels like natural gas or lignite. Due to the country's climate, there are currently no

Co-funded by the European Union

major discussions about expanding district heating networks in Greece, but the existing fossil powered installations will have to change their fuel source according to the Greek phase out plan. Those could be adapted to cofire biomass in the short term and be fully transitioned to renewable biofuels as time goes on.

There are no major provisions in the Greek NECP when it comes to the biomass sector and considering its important role in the residential sector (more than half of the renewable heat), this represents somewhat of a missed opportunity, since there is room for improvement through appliance refurbishment, among others.

Heat Pumps

The electricity demand in Greece in 2021 was 51 TWh (residential buildings 35%, service sector buildings 32%, industry 32%) and the peak load happened in August and was 10.5 GW. In 2021, the electricity covered 50% of total energy demand from buildings: 36% for residential buildings and 83% for service sector buildings. According to IEA, these figures reflect a relatively higher use of air conditioning and the notable cooling demand, especially in the tourism industry.

Wide electrification, which includes the deployment of heat pumps as a key pillar of the renovation strategy, is expected to increase the share in energy demand in the residential sector to 47% in 2030 and to 81% in 2050. Support measures for the electrification of energy demand are taken, such as financial support (subsidies, loans, tax breaks) for the electrification of heating and cooling demand (including heat pumps) in buildings and for renewable electricity generation in buildings.

Solar thermal

Greece is a global leader in solar thermal, which covered 5% of building energy demand in 2020, compared to the IEA average of 0.6%. According to an IEA report[18] Greece is among the top 5 countries by installed capacity per 1,000 inhabitants in 2023. Greece solar thermal market has experienced positive development, with 18% growth in 2021 and 17% in 2022. In 2021, the installed capacity in operation was 3,606 MW_{th}, representing 5,152,200m^2 of solar thermal collectors' area.

Solar thermal market in Greece started 40 years ago, when all households had electric water heaters for the domestic hot water. Today, the Greek solar thermal industry is an export champion[19]: The total collector area sold to customers abroad tripled from 200,000 m^2 to 600,000 m^2 in only 10 years. Greek manufacturers took advantage of opportunities around the world while demand for their cost-competitive and reliable products also grew at home. According to the SHC Market and Industry Trends in 2020[20], some factors that helped the Greek solar thermal industry are:

- Well-established supply chain: Several collectors and tank manufacturers were set up during or after the energy crises in the mid-1970s; the national solar thermal industry association EBHE was founded as early as 1979.

[18] IEA SHC || Solar Heat Worldwide (iea-shc.org)
[19] Export champions from Greece offer good value for money | Solarthermalworld
[20] IEA SHC || SHC Market and Industry Trends (iea-shc.org)

Co-funded by the European Union

- Government support: In the 1980s, the Greek government launched campaigns promoting solar thermal systems and offered incentives, such as a reduced VAT rate and low-interest loans, to drive demand, which resulted in a large number of installations.
- Early adopter of standards and certification: Greece's industry pioneered efforts to establish and support European Committee CEN TC 312 on solar thermal systems and components. So far, the EBHE-supported CEN TC secretariat has always been headed by experts from Greece. Meanwhile, over 100 Greek products have been Solar Keymark-certified. This corresponds to about 10 % of all active licenses in the Solar Keymark product database.
- High home ownership rate: In all, 75 % of flats and homes in Greece are privately owned. Greek families invest heavily in their own houses, aiming at a high degree of autonomy. This also includes adding hot water lines, which they are hesitant to share with neighbours.

Geothermal

There is a significant potential for geothermal energy in Greece but only for electricity generation, especially on some of the Aegean islands (e.g. Milos, Lesvos, Kimolos) and the North-Eastern part of the mainland. The national target for geothermal electricity is 100 MW by 2030[21].

District heating

Limited information exists for district heating in Greece. There are a few district heating systems in Greece and, due to Mediterranean climate conditions, this technology is not expected to gain significant growth in the forthcoming years.

R&D funding

The gross domestic expenditure on energy R&D is expected to reach 0.13% of GDP by 2030 (0.06% in 2017), but there is no specific policy document addressing how this will be achieved. Analysis of the R&D funding for 2014-2020 shows a distribution of small amounts of funding across many projects; the average funding is estimated at 180,000€ per year per project. This amount can only support desk research and not large-scale demonstration projects of high TRLs.

According to the NECP 2019, R&D in energy efficiency should focus on new building materials and elements, heat pumps and digitalisation, while R&D in industry should focus in energy-efficient heating and cooling, heat and refrigeration recovery and integration of systems. R&D in renewable energy should focus on solar thermal energy for electricity generation, heating and cooling, bioenergy (biosolids, bioliquids, biogases and bioenergy intermediates) and deep geothermal energy.

Legal

The policy landscape in Greece regarding heating and cooling include:

- The National Energy and Climate Plan NECP, adopted in 2019, is the main document defining the mitigation measures to achieve Greece's 2030 emissions reduction target and drive the country to a net zero energy system.

[21] National Energy and Climate Plan 2019 (page 276)

Co-funded by the European Union

- Greece's National Climate Law, adopted in May 2022, sets targets to reduce total GHG emissions by 55% by 2030 and by 80% by 2040 (versus 2005).
- Greece's National Long-term Strategy[22] details emissions reduction pathways that aim to support the EU wide 2050 net zero emissions target. Measures for the building sector provide incentives for thermal renovations and upgrading heating and cooling systems.
- The National Recovery and Resilience Plan[23] was adopted in 2021, with a total budget of €2.7 billion; it supports, among others, the green transition through investments of €1.3 billion in the energy-efficient renovation of more than 100,000 buildings, including low-income households.
- The Energy Efficiency Obligation Scheme (EEO)[24] was adopted in 2017. Obligated parties are electricity, gas, oil products suppliers or retailers whose market share is higher than 1%. The number of obligated parties was 35 in 2022. Obligated parties are awarded certificates (white certificates) for verified energy savings and must achieve certified energy savings according to annual targets.
- 2021 Action Plan to Combat Energy Poverty. It provides a framework for energy upgrades of residential buildings of energy-vulnerable households.
- 2017 Regulation on the Energy Performance of Buildings. This is the main document defining the requirements and parameters for the calculation of the energy performance of buildings and the issuing of the Energy Performance Certificate.

More in detail, legal measures supporting the decarbonisation of heating and cooling include:

- Mandatory installation of solar thermal systems in new residential buildings.
- Ban on the installation of oil-fired heating systems from 2025.
- Energy Performance Certificates as behavioral measure.
- From 2011, biomass boilers are allowed to be installed in Athens and Thessaloniki. There was a ban on their installations in those two city centers from 1993.
- According to F gas regulations, the allowed refrigerants are R32, HFO mixes, non-synthetic refrigerants (carbon dioxide, HC, R290 and και R600)
- Private companies must submit an annual Environmental Footprint Report.
- The minimum performance level for new buildings and renovations is indicated in the Energy Performance in Buildings Directive[25].

[22] Greece Long-Term Strategy 2020
[23] Greece's recovery and resilience plan (europa.eu)
[24] Greece Energy Efficiency Obligation Scheme 2017
[25] KENAK TOTEE 20701-1/2017

Co-funded by the European Union

Environmental

According to the IEA Climate Resilience Policy Indicator report[26], Greece will face increasing temperatures throughout the 21st century. According to Greece's risk assessment report[26], higher temperatures are expected to present electricity supply risks. Warming can not only reduce the efficiency of thermal power plants but increase their need for cooling water. Rapid rises in peak electricity demand for cooling during extreme heat events may prompt failures, as happened in 2017 and 2021 when escalating power demand during heatwaves resulted in several power outages despite Public Power Corporation (PPC) preparation efforts.

Greece's National Adaptation Strategy NAS[27] was adopted in 2016 and defines the goals, priorities for climate adaptation and lists possible adaptation measures for all environmental and socio-economic sectors. The National Adaptation Strategy will be implemented through 13 Regional Adaptation Action Plans, that are applied to the individual Regions and are expected to be endorsed in 2023.

Greece's non-ETS emissions (transport, buildings, agriculture, waste and non-energy intensive industry) are subject to a 2020 target under the EU Effort Sharing Decision (ESD) and a 2030 target under the EU Effort Sharing Regulation (ESR). In combination, the ETS, ESD and ESR aim for a 20% reduction in EU-wide GHG emissions by 2020 and a 40% reduction by 2030 (both versus 1990 levels). In 2020, 43% of Greece's GHG emissions were covered by the ETS and came primarily from electricity generation (63% of ETS emissions) and industry (36%)[1].

Croatia

Political

The political situation in Croatia is overall stable. The government is led by a centre-right coalition since 2016 (two terms). In 2024, the parliamentary, presidential, and European elections will take place.

The energy portfolio is currently managed by the Ministry of Economy and Sustainable Development (MoESD), but it has been allocated to different Ministers over the years, with negative impacts in terms of continuity of the energy policy. Nonetheless, the technical staff have ensured a certain degree of stability.

The H&C sector is mostly neglected compared to other sectors (electricity, gas, oil, transport etc.). This is mainly because H&C (mostly heating) relies on individual systems, and several district heating systems are often viewed as communal activity, with lower tariffs mainly supervised by Government and the Regulatory Agency. While there are several laws regulating heating and cooling, they only cover portions of whole sector, such as the Law on Renewables and High Efficiency Cogeneration and the Law on Heat Energy Market.

[26] IEA Greece Climate Resilience Policy Indicator
[27] Greek National Adaptation Strategy bankofgreece.gr

Co-funded by the European Union

Specific policies in the H&C sector

The Croatian energy mix has a high share of renewables, mainly due to hydropower in the electricity sector (though other renewables are steadily growing) and solid biomass in heating and cooling sector. The draft revision of the Croatian NECP defines new, ambitious targets for RES in all sectors, including H&C, where the 2030 RES target is increased from 38.1 % to 47.1 %.

Table 2-1. Indicative national targets for RES shares until 2030

RES share, %	Achieved 2021	Targets 2030
In the gross final consumption of energy	31,7	42,5
In the final consumption of electricity	53,5	73,6
In the final consumption of energy for heating and cooling	38,0	47,1
In the final consumption of energy in transport	7,1	21,6

Solid biomass will remain the dominant source, although it is expected to decrease, while other sources will see steady increase in use. Also, there is a noticeable trend towards using RES, alongside high efficiency cogeneration, in centralized heating systems.

Table 2-4. Estimated contribution of RES technologies in heating and cooling

ktoe	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Gross final RES for heating and cooling	1.285,1	1.292,9	1.300,7	1.308,5	1.316,3	1.324,1	1.337,8	1.351,5	1.365,2	1.408,3
Solar energy	17,1	19,4	21,8	24,1	26,5	28,8	31,2	33,6	35,9	38,3
Solid biomass	1.154,4	1.127,9	1.101,4	1.074,9	1.048,4	1.021,9	995,4	968,9	942,4	915,8
Gaseous and Liquid biofuels	0,0	2,4	4,8	7,2	9,7	12,1	14,5	16,9	19,3	21,7
Geothermal energy	5,0	7,0	9,1	11,1	13,2	15,2	17,3	19,3	21,4	23,5
RES Heat	108,7	136,1	163,6	191,1	218,6	246,1	273,5	301,0	328,5	356,0
Hydrogen	0	0	0	0	0	0	5,9	11,8	17,7	53,1

In the NECP, there are two specific measures related to RES-H&C:

- OIE-5: Use of RES for thermal purposes, with the objective of providing financial incentives for the development of RES projects for thermal needs, which is strongly linked to the use of geothermal sources and biomass in individual projects.
- OIE-6: Use of RES in centralized and closed thermal systems, with the objective of enabling an increase in the share of RES in DHS by using available sources such as shallow and deep geothermal, solar energy and water energy (via heat pumps).

Co-funded by the European Union

Co-funded by the European Union

Economic

The main trends in macroeconomic indicators during 2021 are highlighted below:

- In terms of GDP per capita, with 17,240 € Croatia is third last among EU countries, surpassing only Bulgaria and Romania, and with a similar GDP per capita as Poland and Hungary.
- After a sharp drop following the outbreak of the COVID-19 pandemic, the Croatian economy started to recover in the second half of 2020 and continued in 2021. The GDP reduced by 8.1% in 2020, yet it grew by 13.1% and 6.2% in 2021 and 2022 respectively, thus exceeding the pre-pandemic level.
- The strong recovery of economic activity and favorable fiscal achievements led to a reduction in the public debt to GDP ratio, from 87.3% at the end of 2020 to 79.8% at the end of 2021.
- Inflation accelerated noticeably in Croatia in 2021, from an average of 0.1% in 2020 to 2.6% in 2021 and to 10.8% in 2022. As a consequence, long-term interest rates also increased and reached 2.7% in 2022.
- In 2023, Croatia joined the Eurozone.

Specific economic measures to incentivize renewable and more efficient H&C include:

At national level, financial support to RES-H&C is doomed to the sporadic public calls from the Croatian Fund for Environmental Protection and Energy Efficiency. The Fund subsidises RES and energy efficiency interventions in different sectors (residential, industry, etc.). However, there are no dedicated calls for H&C. The funding rate ranges from 40% to 80% depending on the area, usually with a maximum amount depending on the technology. Over the last two years, the following public calls were published:

- Call published in April 2022, funding RES in the residential sector (family houses) with a planned allocation of 100,000,000 HRK (approx. 13,333,000 EUR).
- Call published in October 2022, funding RES in residential sector (family houses) with a planned allocation of 95,000,000 HRK (approx. 12,608,000 EUR).

These public calls are limited to family houses. The eligible technologies are biomass boilers, heat pumps, solar thermal systems and photovoltaic systems. Although there is no available data on exact distribution of funds on specific technology, it can be estimated that most of the budget is spent on photovoltaic systems, leaving RES heat technologies behind.

Similar subsidy programmes are sporadically available from counties and municipalities, mostly in cooperation with local energy agencies. However, there is no clear and precise data on these actions.

Co-funded by the European Union

Sociocultural

The overall expected benefits for society (taking into account externalities) are positive, and result in a lower overall social cost. The main challenge of the implementation and the pace of the changes is the need for high investments that can pose a significant challenge for certain segments of the economy and/or customers. A limiting factor of an accelerated transition may be the ability of the economy, society and individuals to participate in the processes in a timely manner, due to large initial investments, regardless of the fact that the transition processes bring long-term benefits to society and the environment.

The education system should become a leader in promoting the principles of low-carbon development. Therefore, this is a priority activity of the Low-Carbon Development Strategy, more important in the long run than any type of technical measure. In the period from 2021 to 2030, education on sustainable development and climate change in Croatia will be developed, funded and implemented. Also, in the period until 2030, awareness of climate issues will grow systematically, and on the other hand, new skills will need to be taught to meet the challenges of the transition to low-carbon development. Thirdly, low-carbon practical solutions will need to be built into social life, production, consumption and development management in the direction of increasing sustainability.

The implementation of the Low-Carbon Development Strategy should establish better coherence and synergies of policies at state and local levels. Activities are increasingly shifting to independent activities of local governments and cities. More ambitious initiatives, such as carbon neutral islands, cities and the like, should be supported. It is especially important to connect the activities carried out within the international initiative "Covenant of Mayors", the concept of "smart cities" and "smart islands" and innovative platforms. At local level, the mitigation and adaptation measures to climate change are linked, and the synergy of resource use is the strongest.

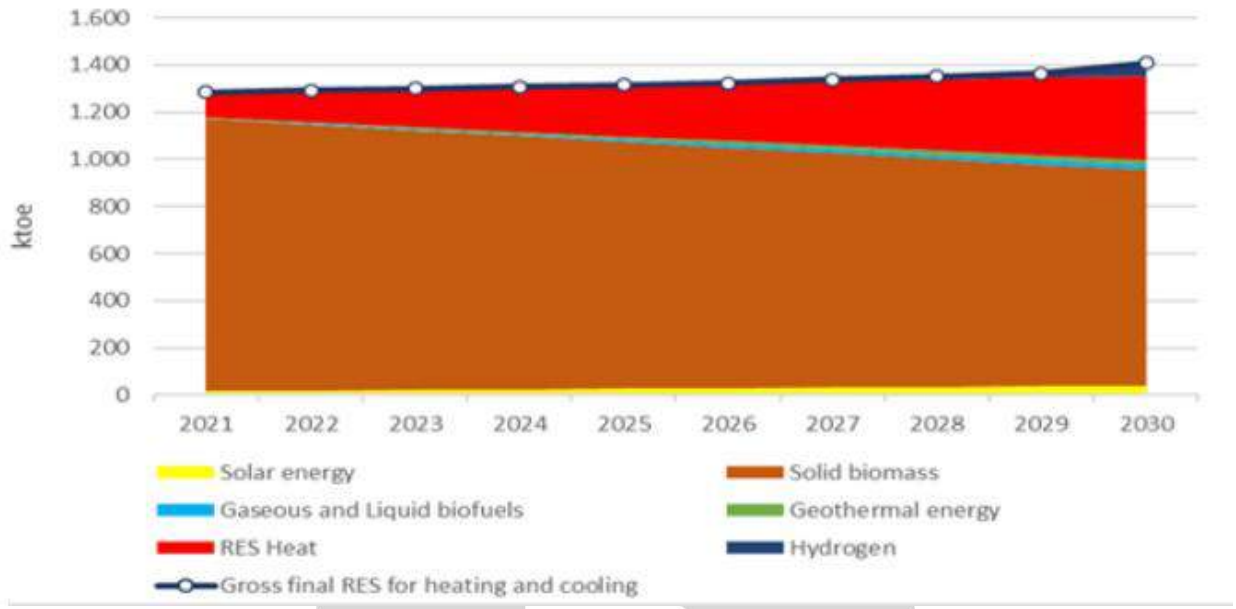
According to analyses of household consumption, almost 20% of households in Croatia spend significantly more than 10% of total personal consumption expenditure on energy (electricity, gas and solid fuels). It is necessary to link the programs for the implementation of individual energy policy measures and the application of new technical and technological solutions with measures to reduce energy poverty.

Technological

Croatia is divided into three climate zones (continental, mountain, and coastal climate); traditionally, rural areas and family houses rely on firewood for heating purposes, while urban areas and multiapartment buildings use either natural gas or centralized heating systems. In coastal areas, electricity is used for heating purposes (mostly via air heat pumps).

The Croatian NECP foresees an increase in RES for heating and cooling, mostly through solid biomass (although with decreasing trend), heat pumps, and geothermal energy.

Co-funded by the European Union



-Estimated contribution of RES technologies for H&C sector

The biggest share of heating consumption in households is covered via **biomass boilers** and wood stoves (~45%), followed by natural gas boilers (20%) and electrical (resistance) heaters, which means that most of heating is covered by renewable energy. Nevertheless, combustion of forest biomass is usually inefficient and uncontrolled, resulting in high particle emissions.

Therefore, the National Energy Climate Plan foresees a reduction of biomass and an increase in the use of heat pumps. In Croatia, **heat pumps** potential is still untapped, and the market is dominated by air-to-air heat pumps, used mainly for cooling and for heating in the coastal region. In continental Croatia, heat pumps are installed in refurbished and newly built buildings. One of the biggest challenges for heat pumps installations are relatively high investment cost (compared economy standard) and relatively low energy tariffs. Nevertheless, the increase of natural gas prices has shifted some citizens to technology change. Heat pumps are usually incentivized with annual investment subsidies.

District heating in Croatia has relatively small share ~10% and is based on natural gas CHP. Around 80% of the total DH demand is in the City of Zagreb, while 90% of the total DH demand is covered by the national DH company. DH decarbonization is one of the measures of the Croatian NECP, while the most promising technology is **deep geothermal**, which exploration is one of measures financed through Resilience and Recovery Facility (RRF) Plan. Besides new geothermal wells, there are existing ones which can be utilised in DH systems, such as those in Zagreb.

Co-funded by the European Union

Legal

Key laws and plans on heating and cooling in Croatia include:

- Energy Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050; adopted in 2020, it defines the vision for the energy sector and the transition to low-emission energy system.
- Low-Carbon Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050.
- Climate Change Adaptation Strategy until 2040 with an outlook on 2070.
- Integrated Energy and Climate Plan (NECP) for the period 2021-2030; adopted in 2019 and currently under revision, it defines the actions to achieve the 2030 targets.
- Act on Renewable Energy Sources and High Efficiency Cogeneration; adopted in 2021 and amended in 2023, it transposes REDII into Croatian Legislative.
- Heat Energy Market Act; adopted in 2013, with the latest amendment in 2019, it defines the rules for the heat energy market (mainly centralized systems).
- The National Recovery and Resilience Plan 2021-2026.
- Geothermal Potential Development Plan of the Republic of Croatia by 2030, adopted in 2023.

The Republic of Croatia is a member state of the European Union (EU) since 1st July 2013 and its energy and climate legislation is aligned with the relevant *Acquis Communautaire*. Also, the Republic of Croatia is a party to the UN Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol – The Protocol to the United Nations Framework Convention on Climate Change and the Paris Agreement to the United Nations Framework Convention on Climate Change, Dec. 12, 2015, T.I.A.S. No. 16-1104. and regularly submits greenhouse gas inventory reports as well as national reports to the Secretariat of the Convention.

The 7th National Report of the Republic of Croatia under the UNFCCC was published in 2018. In addition to the information on GHG emissions, it also contains conclusions on the current situation and trends of environmental, economic, and social developments, as well as recommendations for improving the implementation of environmental protection and sustainable development policies. Emissions of major pollutants into the air (SO2, NH3, NOX, NMHOS) compared to the baseline year 1990 show a general downward trend. Emissions of GHG are decreasing.

There are 4 key strategies that address decarbonization. **The Energy Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050**[28] (hereinafter referred to as the Energy Development Strategy) is an obligation under the Energy Act. The Energy Development Strategy defines the optimal energy mix and development projects with the aim of ensuring the energy independence of the Republic of Croatia, with particular emphasis on strengthening renewable energy generation. Also, special attention is paid to security of supply, sustainability, and competitiveness of the energy system. All the above aligns with the EU Directives' objectives in terms

[28] Energy Development Strategy

Co-funded by the European Union

of reducing consumption, reducing greenhouse gas emissions, sustainability of energy development, competitiveness of the energy the system and a positive investment environment.

The Long-Term Strategy to Encourage Investment in the Renovation of the National Building Stock of the Republic of Croatia by 2050[29] is crucial for the use of renewable energy sources in buildings, which, through the nZEB request for new buildings and the renovation of existing buildings, includes the obligation to cover a substantial portion of primary energy for the building by using renewable energy sources at the location of the building or in its immediate vicinity.

The third strategic document for decarbonization is **the Low-Carbon Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050**[30] (hereinafter referred to as the Low-Carbon Development Strategy). The preparation of the Low-Carbon Development Strategy and the Action Plan for its Implementation for a period of five years is an obligation under the Act on Climate Change and Protection of the Ozon Layer. The Draft of the Low-Carbon Development Strategy was prepared in 2017, when it was submitted for public debate, and refers to the sectors of energy, industry, transport, general consumption, agriculture, waste, and land use. The final adoption of the Draft of the Low-Carbon Development Strategy was postponed and aligned with the Energy Development Strategy and the Croatian Parliament, adopted in 2021. One of the objectives within the decarbonization dimension is also adaptation to climate change, which is elaborated **in the Climate Change Adaptation Strategy in the Republic of Croatia until 2040 with an outlook to 2070** with the action plan (hereinafter referred to as the Adaptation Strategy[31]. The Adaptation Strategy was adopted by the Croatian Parliament in 2020.

The key document for the energy efficiency dimension is the **Long-Term Strategy to Encourage Investment in the Renovation of the National Building Stock of the Republic of Croatia by 2050**, which promotes the need to invest in the building stock. The long-term strategy was adopted in December 2020 and aligns the reconstruction goals with the NECP in the light of demographic trends and activities of the construction sector, with noticeable trends of accelerated abandonment of the existing, inefficient buildings, with the gradual growth of new construction. The building energy renovation rate in the period until 2020 amounted to 0.7% per year, and the Strategy defines a gradual increase through the period 2021 – 2030 to 3%, with a ten-year average rate of 1.6%. An important element is the introduction of additional measurable indicators of energy renovation of buildings, which will strengthen the process of conversion of the stock into nearly zero-energy buildings, i.e., climate neutral. The dimensions of energy security and the internal energy market have been elaborated within the framework of the Energy Development Strategy.

The national strategies relevant to the dimension of research, innovation, and competitiveness are the **Strategy of Education, Science and Technology**[32] and the **Smart Specialization Strategy** until

[29] Long-Term Strategy to Encourage Investment in the Renovation of the National Building Stock
[30] Low-Carbon Development Strategy
[31] Climate Change Adaptation Strategy
[32] Strategy of Education, Science and Technology

Co-funded by the European Union

2029, the adoption of which is expected during the 2nd quarter of 2023. These strategies also contribute to research, innovation, and competitiveness in sectors relevant to the energy transition.

The key objectives outlined in the **Integrated Energy and Climate Plan**[33] are the reduction in GHG emissions by 2030, the increase of the share of RES in the gross final energy consumption and the increase in energy efficiency. The objective of reduction in greenhouse gas emissions for the Republic of Croatia for 2030 is set by Directive (EU) 2023/959 of the European Parliament and of the Council of 14th March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low carbon investments, Decision (EU) 2015/1814 and Regulation (EU) 2023/857 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/842 on binding annual GHG emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement, and Regulation (EU) 2018/1999, separately for participants in the emissions trading system (ETS sector) and for non-trading sectors (non-ETS sectors).

Indicator	Target
Reduction in greenhouse gas emissions for the ETS sector, compared to 2005	-50,2 %
Reduction in greenhouse gas emissions for non-ETS sectors, compared to 2005	-16,7 %
Share of RES in gross final energy consumption	42,5 %
Share of RES in final energy consumption in transport	21,6 %
Primary energy consumption (total energy consumption without non-energy consumption)	340,9 PJ (8,14 Mtoe)
Final energy consumption	274,2 PJ (6,55 Mtoe)

The **Act on Renewable Energy Sources and High Efficiency Cogeneration**[34], adopted in 2021 and amended in 2023, transposes the Renewable Energy Directive into Croatian law. By promoting renewable energy sources and high-efficiency cogeneration, the obligation of the climate goals for the Republic of Croatia to reduce GHG emissions according to the distribution of the reduction obligation is achieved, and the interests of the Republic of Croatia in the field of energy, established in the Energy Development Strategy of the Republic of Croatia until 2030 with a view to the year 2050, are realized.

Heat Energy Market Act[35], adopted in 2013, with last amendment in 2019 defines rules for heat energy market (mainly centralized systems), regulates measures for a safe and reliable supply of thermal energy, thermal systems for the use of thermal energy for heating and cooling, conditions for obtaining a concession for the distribution of thermal energy, i.e. a concession for the construction of a distribution network, rules and measures for a safe and reliable activity of production, distribution

[33] Croatian draft NECP
[34] Act on Renewable Energy Sources and High Efficiency Cogeneration
[35] Heat Energy Market Act

Co-funded by the European Union

and thermal energy supply in thermal systems and measures to achieve energy efficiency in thermal systems.

The Croatian Recovery and Resilience Plan is harmonized with national strategic development documents, as well as with European priorities focused on the digital and green transition based on the modernization of the economy and society in relation with greater investment in innovation and new technologies. The priorities have been transferred into the binding framework of the Recovery and Resilience Mechanism, which determines that more than 20% of the approved funds should be directed to digital transformation through investments and reforms, whilst a minimum of 37% of the funds should be directed to green transition and fight against climate change. One of the main objectives of the National Recovery and Resilience Plan is accelerating the economic growth of all areas of Croatia.

The **Geothermal Potential Development Plan of the Republic of Croatia by 2030**[36] – adopted May 2023 – with Strategic study on the environmental impact[37]. The Plan is aligned with the Energy Development Strategy of the Republic of Croatia until 2030 with a view to 2050 and aims to realise the potential of geothermal energy as of domestic renewable source for electricity as well as heating and cooling.

Environmental

Croatia is divided into three climate zones (continental, mountain, and coastal climate). Traditionally, in urban areas buildings use either natural gas or centralized heating systems (CST), while in rural areas single-family houses are more common and rely on firewood for heating purposes. Heating, especially CST, is often viewed as utility service and for political reasons, the cost of heat has been kept low. Solid biomass is dominant in rural and underdeveloped areas, where the housing stock is relatively old and with low energy performance (insulation, windows). In these areas, buildings are unlikely to be renovated by their owners, as the population is generally older and has lower income, with high rates of emigration and depopulation. In coastal areas, winters are relatively mild, and electricity is used for heating purposes instead of gas. There is a very low consumption of heating oil, which has been replaced with gas, electricity, or modern biomass in the last decades.

As shown in the table below, in 2019 woody biomass (45.3%) had the highest share in households, followed by electricity (24%) and natural gas (20.6%). District heating stood at a mere 4.9%. The household sector uses also fuel oil (2.33%) and liquefied petroleum gas or LPG (2.19%).

[36] Geothermal Potential Development Plan

[37] Strategic study on the environmental impact

Co-funded by the European Union

Table I.3: HOUSEHOLD SECTOR – Distribution of total final energy consumption by energy product according to the Eurostat method, 2019

HOUSEHOLD SECTOR									
Energy balance for 2019 – Eurostat	Electricity	DHS	Natural gas	Fuel oil	LPG	Woody biomass	Solar energy	Lignite	TOTAL
Total final energy consumption [1 000 toe^3/a] *	533.6	109.6	459.1	51.8	48.7	1 007.9	10.8	2.9	**2 224.4**
Total final energy consumption [GWh/a]	6 205.77	1 274.65	5 339.33	602.43	566.38	11 721.88	125.60	33.73	**25 869.77**
Share [%]	*23.99*	*4.93*	*20.64*	*2.33*	*2.19*	*45.31*	*0.49*	*0.13*	***100.00***

* 1 000 toe = 11.63 GWh

On the contrary, in the service sector, electricity (62.64%) had the highest share, followed by natural gas (25.35%). The share of energy delivered by district heating systems was only 4.47%. Of the fossil fuels used in addition to natural gas, the service sector uses fuel oil (3.34%) and LPG (1.66%). The share of renewable energy delivered amounted to a total of 2.54%, with the share of woody biomass standing at 1.51%, solar energy at 0.56% and geothermal energy at 0.47%.

Table I.4: SERVICE SECTOR – Distribution of the total final energy consumption by energy product according to the Eurostat method, 2019

SERVICE SECTOR									
Energy balance for 2019 – Eurostat	Electricity	DHS	Natural gas	Fuel oil	LPG	Woody biomass	Solar energy	Geothermal energy	TOTAL
Total final energy consumption [1 000 toe^4/a] *	516.00	36.80	208.80	27.50	13.70	12.40	4.60	3.90	**823.70**
Total final energy consumption [GWh/a]	6 001.08	427.98	2 428.34	319.83	159.33	144.21	53.50	45.36	**9 579.63**
Share [%]	*62.64*	*4.47*	*25.35*	*3.34*	*1.66*	*1.51*	*0.56*	*0.47*	***100.00***

* 1 000 toe = 11.63 GWh

Germany

Political

Heating and cooling represents more than half of Germany's energy consumption and around 80% of heating demand is currently met with imported fossil fuels, such as gas and oil. Biomass accounts for the largest share of renewable energies in heating (66.5% equivalent to 200.549 GWh, 2022 Statista).

Germany is aiming for greenhouse gas neutrality by 2045, with the Climate Protection Act. On the way to achieving this, emissions are to be reduced by 65% by 2030 compared with 1990. Germany's current coalition agreement (2021-2025) also sets the goal of 50% climate neutral heat by 2030. The

Co-funded by the European Union

buildings sector has missed the GHG reduction goal for 2022 but has reduced GHG emissions by 6 million tons or 5.3% in comparison to the previous year[38].

The 2023 Renewable Heating Act, which will be implemented by the Building Energy Act (GEG) starting in 2024, mandates a 65% RES heat share for all new heating system installations and aims to achieve this with an extensive subsidy program, supporting mainly heat pumps and the expansion and decarbonisation of district heating[39].

	2025	2030 (2019 NECP)	2030 (2023 draft revision)
Share of RES in final energy consumption for H&C	20,5 %	27%	The trajectories for the sectoral share of RES in electricity, H&C, and transport will be submitted with the final revision.
Indicative trajectory for the share of RES in heating networks	25%	30%	50% RES and waste heat by 2030

A share of renewables of 24-32% (depending on the transformation pathway) must be achieved in the buildings sector by 2030 to meet the energy and climate goals (see Section 2.2.i of the NECP).

The 2019 NECP outlines several goals:

- GHG emissions: reduction of at least 55% by 2030 compared to 1990 levels.
- Renewables in gross energy consumption: 30% by 2030.
- Renewables in gross electricity consumption: 65% by 2030.
- Primary energy consumption: reduction of 30% by 2030 and 50% by 2050 compared to 2008 levels (Energy Efficiency Strategy EffSTRA).

Other national goals include:

- Climate neutrality by 2045.
- Increase of renewable heat and unavoidable waste heat to at least 50% by 2030.

The amendment to the Building Energy Act (GEG) adopted in 2023, which will enter into force on 1st January 2024, sets a timeline for mandatory municipal heat planning as well as a requirement for newly installed heating systems in housing development areas to operate with a share of renewables of at least 65%. According to the German government, the switch to renewables is open to all technologies. When installing or replacing a heating system, owners are free to choose among various solutions: Connection to a heating network, electric heat pump, direct electricity heating, biomass heating, hybrid heating (combination of renewable heating and gas or oil boiler), heating based on

[38] Climate Protection Act
[39] Renewable Heating Act

Co-funded by the European Union

solar thermal energy, and "H2-ready" gas heating, i.e., heating that can be converted to 100 percent hydrogen[40]. Accordingly, the federal subsidy for efficient buildings (BEG) is now being amended and is scheduled to enter into force together with the GEG on January 1, 2024.

Since 2016, a national efficiency label for old heating installations has been employed. The following table[41] shows the expected total amount of final energy saving through this measure:

	Annual new (PJ/year)										Cumulative (PJ)
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2021 to 2030
gross	1.56	1.61	1.61	0.9	0.39	0.12	0.08	0.08	0.08	0.08	19.31
net	0.70	0.72	0.72	0.41	0.18	0.05	0.04	0.04	0.04	0.04	8.69

Economic

Energy prices (gas and coal) in Germany have risen sharply over the past two years, despite a reduction in the cost of heating oil. The investment in RES heat technologies is on a rise and national financial support mechanisms are implemented and in planning (GEG amendment).

In 2021, the government introduced CO_2 pricing for emissions generated in the heating sector through the combustion of fossil fuels (BEHG, Fuel Emissions Trading Act). The auction price for the issuance of new allowances for Germany in 2023 was €89.09/ton CO_2[42]. The national CO_2-price is relatively low and so far, gives no relevant motivation to switch to renewable heat generators. The Fuel Emissions Trading Act (BEHG) has three phases:

- 2021-2025: introductory phase with allowances at fixed prices (2023: 30€/ton CO_2).
- 2026: beginning of auctioning phase with price corridor.
- afterwards: auctioning with free pricing.

The federal subsidy for efficient buildings (BEG) is currently being amended to ensure financial support for switching to heating with renewables in the form of grants, loans, or tax incentives. The revised programme will be available in 2024 with co-financing rates up to 70% (capped at 30 000 euros). All applicants can receive a basic subsidy of 30% of the investment costs. Households in owner-occupied housing with a taxable annual income of less than 40,000 euros receive an additional 30% subsidy (income-related bonus). There is also a climate speed bonus of 20% until 2028 for the replacement of old heating systems, which is reduced by 3 percentage points every 2 years from 2029. The bonuses are cumulative up to a maximum subsidy of 70%.

In addition, a supplementary loan for heating replacement and efficiency measures is now available from the state-owned KfW, with reduced interest rates up to an annual household income of 90,000 euros. Other energy-related renovation measures will continue to be subsidized with a 15% (20% if an individual renovation roadmap is available) investment cost subsidy.

[40] https://www.bmwsb.bund.de/SharedDocs/pressemitteilungen/Webs/BMWSB/DE/2023/09/geg.html
[41] Integrated National Energy and Climate Plan, 2019, p. 223
[42] dena, 2023, Update Klima und Energie

Co-funded by the European Union

Therefore, many support programs exist, despite requests for further incentives and special support for low-income households. It is not easy to keep track of all funding opportunities, which is why there is a high demand for accessible information. The main funding programmes are:

- EEG (RES Act) amendment
- Federal Assistance for Efficient Buildings (BEG)
- BEW (Funding Programmes for efficient district heating grids)
- Relief packages: heating cost and energy price allowance, abolition of EEG-levy
- Energy transition campaign by BMWK and funding programs for homeowners, businesses, and municipalities
- Climate and Transformation Fund (KTF)
- Energy efficiency strategy

Sociocultural

Germany is a Federal Republic and therefore the implementation of a heating and cooling transition depends on the effective cooperation between local, regional, and national government levels. Communal governments and actors are key players in coordinating a strategy for GHG-neutral and economical heat supply systems. Together with energy suppliers, housing companies and private owners a municipal heat planning must be implemented. In some federal states, like Baden-Württemberg, a municipal heat planning is already mandatory. The current GEG amendment would make municipal heat planning mandatory by 30 June 2026 for municipalities with more than 100,000 inhabitants and by 30th June 2028 for municipalities with less than 100,000 inhabitants.

A Heat Planning and Decarbonization of Heat Networks Act (WPG) is currently being developed. In the realization of this strategic process, municipalities encounter the following central obstacles: legal framework conditions, staff shortage, complex and lengthy approval processes, lack of expertise, financial support as well as opposition by the public and decision makers[43].

Public opinion/awareness

The public awareness and acceptance of is overall high, with 80-90% of German citizens support the German energy transition ("*Energiewende*")[44]. However, the increase in consumer prices and energy poverty risks can trigger public and political opposition, making the uptake of RES technologies in heating and cooling heavily dependent on the newest GEG amendment and further price developments.

Building stock

In 2021, there were 19.4 million residential buildings in Germany. The number of residential buildings, non-residential buildings, dwelling units and living space per person increased. The

[43] Difu & Umweltbundesamt, 2022, Kurzgztachten Kommunale Wärmeplanung
[44] Hake et al., 2015

Co-funded by the European Union

number of social housing units has decreased continuously since 2006: from 2.1 million units to 1.1 million in 2019[45].

Energy poverty

The risk of energy poverty (more than 10% of net income spent for energy bills), excluding government assistance packages, increased from 14.5% (2021) to 25.2% (2022)[46]. National policies pay due attention to this aspect with financial support.

Technological

Renewable heat technologies, as well as energy efficiency technologies that enable the use of renewables in heat supply are generally available on the market and include bioenergy, solar thermal, geothermal, heat pumps, and district heating and cooling[47]. However, their uptake is still slowed down by several obstacles, including regulations, costs, and lack of skilled labour.

The GEG and buildings funding programs are open to different technologies. The NECP formulates the following: "in addition to the biomass boilers that have been dominant up until now a continued increase in demand for heat pumps is forecast on account of the improvement in energy standards". Furthermore, it predicts a dramatic change in the structure of district heating in the next few years: "Due to the phase-out of coal-fired power generation, the majority of district heating produced by coal cogeneration plants will disappear by 2030. The major drivers behind the expansion of the use of renewable energies for district heating are the various types of funding available through the Renewables Bonus in the Cogeneration Act, through the investment grants in the Market Incentive Programme and through the Heating Networks 4.0 programme as well as its expansion to include funding for existing networks (federal funding for efficient heating networks)" [48].

Overall, the NECP 2019 projects a mild increase in the use of biomass and renewable waste in the period between 2020 and 2030 (from 13 to 14 Mtoe), while other renewable energy sources are expected to experience a more robust growth, from 2 to 6 Mtoe[49].

Biomass boilers are broadly available, and 14 million boilers have been installed in Germany as of 2023. The implementation of biomass boilers is supported by the BEG. The percentage of solid biomass is decreasing, but still accounts for the biggest share, followed by gaseous, liquid and waste biomass[50].

Heat pumps are expected to play an essential role in the German renewable heat mix. The technology is widely available, and an increased production has been registered. However, more information and support programs are needed to facilitate the implementation. Currently, the main obstacles are long

[45] DENA GEBÄUDEREPORT 2023.
[46] Growing risk of energy poverty
[47] https://www.duh.de/themen/energie-klima/klimaschutz-in-gebaeuden/erneuerbare-waerme/
[48] Integrated National Energy and Climate Plan, 2019, p. 44
[49] Integrated National Energy and Climate Plan, 2019, p. 45
[50] Heat from renewable energies

Co-funded by the European Union

delivery times and lack of skilled labour. The German industry is committed to high increase of capacities and production rates. Heat pumps are already installed in every third new building today. This number is expected to increase in the coming years, as the amendment to the German Renewable Energy Act stipulates a share of at least 65% renewable energy in new buildings in new development areas as of 2024.

Solar thermal is widely deployed in Germany, with 15.5 GW_{th} of installed capacity in 2022[51]. In the Climate Action Plan scenario, the 2019 NECP foresees that solar thermal production will grow from 900 ktoe in 2020 to more than 2000 ktoe by 2030. While the residential market remains the main segment, the use of solar thermal in district heating and industrial processes is growing rapidly.

Geothermal energy only accounts for 4% of renewable energies in Germany[52]. Currently, there are only 42 deep geothermal plants in Germany with very limited capacities[53].

Heat storage has just recently become the focus of attention. More development on the market is expected in the near future. However, more support for integrating technology combinations with heat storages is needed. In Germany, latent heat accumulators, sensible heat accumulators (currently most advanced technology) and thermochemical heat accumulators are available.

Legal

Germany has introduced a **National Climate Law (KSG)** in 2019, which outlines and maps the path to climate neutrality. Following the ruling of the Federal Constitutional Court in April 2021, and with a view to the European climate target for 2030, the German government presented the amended Climate Protection Act in May 2021, which entered into force on August 31, 2021. The Act also set a maximum threshold for emissions in the building sector (predominantly fossil fuels used for H&C).

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Yearly emissions (million toe)	118	113	108	102	97	92	87	82	77	72	67

Following the Russian invasion of Ukraine, the German government launched a revision of the Building Energy Act (GEG), which sparked a long and heated national debate, and intervened to lower energy prices through regulation and financial support, including:

- Natural Gas-Heat Emergency Assistance Act (EWSG) for December 2022.
- Bills for electricity, gas and heat price brakes came into force on December 24, 2022.
- For citizens and small and medium-sized enterprises, the gas price brake applies since March 2023 (covering Jan/Feb retroactively). 80 percent of natural gas consumption will be capped at 12 cents/kWh. For heat, the capped price is 9.5 cents/kWh.

[51] Solar Heat Markets In Europe - Solar Heat Europe
[52] ZDF Heute
[53] https://www.geothermie.de/aktuelles/geothermie-in-zahlen.html

Co-funded by the European Union

In terms of regulation, there are several laws supporting the deployment of RES in H&C. Nevertheless, a comprehensive legislative instrument regulating the H&C market and incentivizing the uptake of RES is missing and there is no national heat market, but rather local monopolies of DHC providers. Heat prices are widely unregulated and there is no transparent pricing policy in Germany.

The building permits and local zoning plans are criticized to be unnecessarily complicated, especially at local and municipal level. There is a high demand for simplifications, for example distance regulations for heat pumps and legal permits for the RES technology implementation.

Environmental

Since measurements began in 1881, 14 of the 19 warmest years in Germany were after the turn of the last millennium; the two warmest years were 2022 and 2018[54]. As temperatures increase because of climate change, there will be a strong growth in demand for cooling systems combination systems providing both heating and cooling.

In Germany, the energy sector accounts for almost 35% of Germany's GHG emissions. Heating and cooling represent more than half of Germany's energy consumption and around 80% of heating demand is currently met using fossil fuels such as gas and oil. Furthermore, heating and cooling buildings and hot water supply was responsible for 18% of CO_2 emissions in Germany in 2021. Annually, this amounts to more than 150 million tons of CO_2 (including emissions from the generation of district heating and electricity for heating purposes)[55]. Therefore, increasing the uptake of renewables and energy efficient solutions in heating and cooling is critical to achieving climate targets.

Poland

Political

Poland is going through a series of elections, with the Parliamentary elections that took place on 15 October 2023, followed by local elections in April 2024, the EU elections in June 2024, and the presidential elections in the spring of 2025. This means a continuous election campaign, which disrupts consistent and efficient policy making on climate and energy. Consequently, strategic documents such as the NECP update, DSR, the Energy Policy for Poland until 2040 (PEP2040) or the Heat Development Strategy are significantly delayed.

Gas is no longer treated as a transitional fuel and the issue of coal is not seen so sharply. At the same time, biomass, particularly agricultural biomass, seems to be an important element in the transformation of the heating industry. Overall, the investments and interventions needed for energy transformation, including the modernization of energy infrastructure and district heating, building

[54] dena, 2023, Update Klima und Energie
[55] BDEW

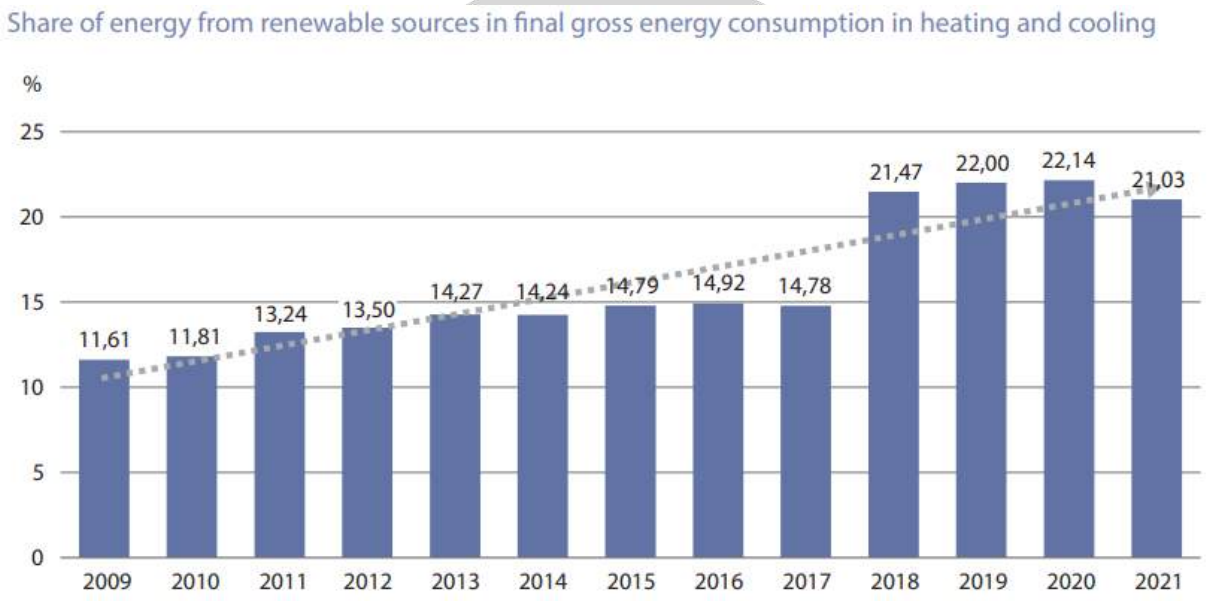
Co-funded by the European Union

energy efficiency programs and others consideration of implementation capacity and availability of specialized personnel.

Renewable heating and cooling

Article 23 of the Renewable Energy Directive II (now replaced by the revision adopted in October 2023) set an annual increase in the share of heating and cooling from RES of at least 1.1 percentage points as an average calculated for the periods 2021-2025 and 2026-2030, in relation to the share of renewable energy in the heating and cooling sector in 2020. Accordingly, the PEP 2040 published in 2021 set a target of 28.4% for the share of RES in the Polish heating sector in 2030 (which complies with the revised RED).

In 2020, the share of RES in the heating sector currently stood at about 22%, including both district heating and individual heating. In district heating, it was about 10%, of which 97-98% was from biomass.



Development of green and efficient district heating systems

In 2018, only 20% of Polish district heating and cooling networks met the requirements to be considered energy efficient. In 2030, at least 85% of the networks with a capacity of more than 5MW shall meet these requirements. Heat needs should be covered primarily through district heating. If connecting to a district heating network is not possible, efforts should be made to use individual sources with the lowest possible emissions. In 2015, 61% of households in urban areas were connected to district heating networks; the goal is to gradually increase this rate and reach 70% of households in 2030[56].

[56] Integrated National Energy and Climate Plan, 2019, p. 31-37

Co-funded by the European Union

Economic

Poland has been steadily increasing its level of public debt for several years, which is nonetheless at 49.1% of the GDP (average level in the EU27). Inflation remains high, and while external factors are expected to reduce it, the continuation of current domestic policies will not allow it to fall below 6% YoY in the coming years. The level of investment is not at a satisfactory level. In addition, KPO (Recovery and Resilience Facility) funds continue to be suspended. At the same time, due to the large increase in prices, the scope of feasible work is being reduced by about 25-30% compared to the original provisions. This may give rise to concern that some aspects of the energy transition, e.g. increasing the share of RES in H&C, will lose priority in the dimension of distributed and local actions.

The latest revision of the Renewable Energy Directive introduces new obligations to increase the share of renewable energy in the heating sector. Being managed and planned at local level, the transition in heating and cooling will require investments by local governments, whose financial condition does not always guarantee the provision of financial surpluses for investment needs. Possible forms of financing include grants, repayable instruments, guarantee funds.

There are several specific economic measures to incentivize renewable and more efficient H&C.

1. In 2019, the National Environmental Protection and Water Management Fund launched additional programs related to RES, such as:

- Energy Plus (PLN 4,000 million) for projects aimed at reducing the negative impact of businesses on the environment, including RES deployment.
- District Heating pilot (PLN 500 million) for projects aimed at reducing the negative impact of district heating companies on the environment, including RES deployment.
- Agroenergy (PLN 200 million), for projects reducing the negative environmental impact of agricultural activities, including RES deployment.
- Polish Geothermal Plus (PLN 600 million) to increase the use of geothermal resources.

2. "White Certificates"

Energy efficiency certificates confirm energy savings resulting from the implementation of an energy efficiency improvement project. An energy efficiency certificate can be obtained for an activity (or group of activities of the same type) resulting in an annual saving of not less than 10 tons of oil equivalent (toe). The system of white certificates supports projects such as: insulation of industrial installations; reconstruction or renovation of a building with technical installations and equipment; modernization or replacement of lighting, equipment and installations used in industrial processes or in energy, telecommunications or IT processes, local heating networks and local heat sources.

3. Thermo-modernization and Renovation Fund

The primary purpose of the Fund is to provide financial assistance to thermos-modernization and renovation projects. Beneficiaries include residential buildings, collective residences, and social housing, commercial buildings, public buildings, local heating networks. The co-financing rate is 26% of the cost of the thermo-modernization project (31% when it includes RES generation).

Co-funded by the European Union

4 "Clean Air" investment support program

The "Clean Air" program was launched in 2018 and is financed by the National Environmental Protection and Water Management Fund. It promotes energy efficiency interventions and the replacement of polluting heating systems with a budget of PLN 103 billion until 2029.

5. Tax incentives, such as the exemption from excise taxes for renewable energy or the tax credit for owners of single-family homes that switch to renewable sources or highly efficient cogeneration.

Sociocultural

Building stock

The national building stock consists of more than 14.2 million buildings, more than 40% of which are single-family dwellings. The data shows a wide variation in the energy efficiency of buildings.

Category	Number of buildings (thousands)
Multi-family residential buildings	553
Single-family residential buildings	5,604
Public utility buildings	420
Production, commercial, warehouse buildings	5,116
Other non-residential buildings	2,491
Total	14,184

Structure of buildings in Poland as of 1.01.2020

There are two specific areas of interest in terms of RES application in heating. One is district heating, which includes District Heating Enterprises (PEC), where the influence of residents on the solutions used is very small and modernization decisions are made based on economic and regulatory considerations. The second one is single- and multi-family buildings. On the one hand, residents benefit from several programs supporting the transition to renewable sources, but on the other hand they raise concerns about the cost of operating these sources. For example, in the Polish climate, air source heat pumps do not provide coverage of heating needs in case of strong negative winter temperatures, an additional peak source may be needed. A large number of buildings still have solid-fuel sources and the first choice for retrofitting is usually gas boilers. Replacing solid and gas fuel sources with heat pumps is therefore dependent on solutions for the price of electricity to power the heat pumps.

Co-funded by the European Union

Public opinion/awareness

In general, when considering the **purchase of RES and efficient H&C systems**, those with incomes below high are guided by considerations on both the upfront investment (price, possible subsidies) and the operation (cost of fuel/energy, service, durability). The more difficult and less obvious the assessment, the less tendency to upgrade. People suffering from (or close to) energy poverty understandably do not consider upgrading to RES H&C at all.

The role of local (municipal) authorities to improve the **air quality** is understood and expected by local communities. On the basis of the Law "Environmental Protection Law", in the case of zones where air quality standards are not met, the provincial board prepares a draft air protection program. Since the main source of air pollution is heating in the residential sector, the corrective measures identified in the air protection programs consist primarily of replacing solid fuel heating equipment with environmentally friendly alternatives and increasing the efficiency of buildings. As of March 2021, 31 air protection programs were being implemented in the country in all 16 provinces. The deadline for their implementation was set for the end of 2026.

Energy poverty

In 2022, the Energy Law was amended to include a definition of energy poverty. In Poland, energy poverty disproportionately impacts the following vulnerable groups: residents of single-family houses, occupants of older buildings constructed between 1946 and 1960, residents of large-sized buildings with surface areas ranging from 91 to 120 m^2, inhabitants of rural areas, people with disability[57].

"Poland's Energy Policy until 2040" aims to reduce energy poverty to 6% by 2030. However, Poland lacks a comprehensive, unified strategy to tackle energy poverty, despite substantial funding allocated for energy efficiency measures pensions, large families with five or more children, and families relying on social benefits.

Technological

Biomass (and waste heat) accounts for almost 90% of the share of RES in H&C and will continue to perform well in households, as well as cogeneration. It has the great potential considering the large availability in Poland and the technical and economic parameters of the installation. Biomass should be preferred in areas close to biomass generation (rural areas, timber industry basins, municipal waste sites) to minimize the environmental cost of transportation.

Geothermal energy is currently at a relatively low level, but an upward trend is expected. Determining geothermal potential requires a lot of money with a high degree of uncertainty, but its exploitation can determine the development of an area. Investment planning in conjunction is

[57] CEE Bankwatch Network, Tackling energy poverty in EU Member States, June 2023

Co-funded by the European Union

managed by Geotermia Polska, a company owned by the National Environmental Protection and Water Management Fund, which should carefully select, prepare and subsidize geothermal projects.

Heat pumps are becoming increasingly popular in households and have great potential, though low temperatures in winter can affect the efficiency of air-source heat pumps. The combination with other renewable technologies can increase their efficiency and lifetime.

With 2.4 MW_{th} of cumulative installed capacity in 2022, Poland is the 6th biggest European market for **solar thermal.** The 2019 NECP highlights that "in addition to the economic benefits, the widespread use of solar collectors has a positive impact on the environment and public health. This is due to the fact that collectors are an economically interesting alternative for households that are not connected to district heating and obtain heat energy from domestic installations fuelled by low-quality coal or burnt waste"[58]. In the NECP, the projected generation capacity of solar thermal grows from 45 ktoe in 2015 to 426 in 2030 and 564 in 2040 [59].

Several EU and national funding programs support the transition of Polish district heating networks:

- **Modernization Fund.** At least PLN 6.5 billion for generating units and network digitalization.
- **Reconstruction and Resilience Facility (RRF) KPO.** EUR 300 million for generating units with capacities below 50 MW.
- **Support system for high-efficiency cogeneration:** up to PLN 30 billion for high-performance cogeneration generating units.
- **Priority program "New Energy"**: PLN 2.5 billion for the entire program, which covers also innovative technologies in district heating.
- **Energy Transformation Fund**: at least comparable to the Modernization Fund, primarily for generation units.

In terms of renewables penetration, the ECP scenario presented in the 2019 NECP saw a doubling from 14.5% in 2015 to 28.4% in 2030, reaching 31.5% and 34.4% in 2035 and 2040 respectively[60].

Legal

Poland has a wide set of regulations on heating and cooling, in line with EU directives. The challenge is to constantly update the regulatory framework, while ensuring consistency. In addition, regulations are introduced to mitigate the impact of these changes on consumers and businesses due to the energy crisis.

For new buildings, the most important document affecting the application of RES is the WT2021 Technical Guidelines, which limit the annual primary energy consumption of designed buildings to

[58] Integrated National Energy and Climate Plan 2019, p. 232
[59] Integrated National Energy and Climate Plan 2019, p. 183
[60] Integrated National Energy and Climate Plan, 2019, p. 301

Co-funded by the European Union

70 kWh/m^2. This requirement cannot be met without covering, at least partially, the energy demand for heating with RES.

Environmental

Polish climatic conditions make heating the dominant part of the H&C area. In Poland, the average value of the heating index from 1979 to 2020 was 3513 degree-days. During this period, our country's heating demand fell by 23.6 percent. The average cooling index was at 14.85 degree-days.

The share of fossil fuels in energy generation in Poland is still very high. The reduction of CO_2 and particulate emissions is a priority for environmental and health reasons. To this end, the transformation and decarbonisation of H&C is critical. The National Program for Reduction of Air Pollution sets Poland's commitments to reduce several air pollutants in the periods 2020-2029 and 2030-onwards.

Likewise, the NECP 2019 outlines measures to reduce GHG emissions in the heating sector, as well as in construction. One of the main measures is the gradual increase in energy standards and thermal insulation, as well as increasing the use of renewable energy sources for newly constructed buildings and buildings undergoing renovation. At the same time, a strategy is being developed for the renovation of the national stock of residential and non-residential buildings, both public and private.

Portugal

Political

Portugal is committed to achieving carbon neutrality by 2050. Accomplishing this goal implies reducing GHG emissions by more than 85%, compared to 2005, and ensuring a carbon sequestration capacity of around 13 million tonnes. To this end, the Government has set several targets, such as: Accelerate the implementation of the 2030 National Energy and Climate Plans and the 2050 Carbon Neutrality Roadmap, promoting regional roadmaps for carbon neutrality, developing five-year carbon budgets, define methodologies for assessing the legislative impact on climate action, and removing administrative constraints that create disproportionate context costs without environmental added value.

Portugal, as a few other MSs, stands out in the **renewable heating and cooling sector**, as to have already reached its 2030 targets. The target established for 2030 corresponds to 38% of renewables in heating and cooling, but it has been surpassed already. In 2020, the percentage of renewables in the mix represented 42% of the total.

The total final energy consumption (TFEC) for the H&C sector was almost 6.2 Mtoe in 2018, 36% of Portugal's Final Energy Consumption (FEC). Estimated trajectories for FEC in the H&C sector show a decrease of 7.4 % from 2020 to 2030.

Regarding different technologies for H&C, biomass and heat from cogeneration correspond to almost 90% of the supply from renewables. Energy supplied from heat pumps and solar thermal is projected

Co-funded by the European Union

to remain constant over the next decade, whereas renewable gases are expected to represent a 3 % share of the RES supply by 2030. Overall, 54 % of the total bioenergy (biomass, heat from co-generation and renewable gases) was used in the H&C sector in 2020. The bioenergy consumption in this sector is expected to remain stable until 2030.

The NECP outlines several measures to promote the uptake of renewable energy in heating and cooling (action strategy 3.3), as well as in specific sectors such as industry (action strategy 7.1). The 2019 version referred to promoting the replacement of heating and cooling equipment with systems using RES, such as solar thermal, biomass and heat pumps. The draft revision published in 2023 also mentions two new measures, which are promoting efficient use of H&C systems through consumer information, participation and aggregation, and developing a national action plan for heat pumps.

Economic

In Portugal, the energy transition will require more than 25 billion euros of investment in the next decade. Therefore, a set of legal and planning instruments must be mobilized to achieve an effective reduction of emissions, while promoting investment, employment, and innovation.

By 2030, Portugal should double renewable energy generation and achieve a target of 49% renewables in gross final energy consumption (previously 47%), reaching 85% in electricity (previously 80%), 47% in heating and cooling (previously 38%), and 23% in transport (previously 20%).

There are specific measures to incentivize renewable and more efficient H&C currently in place:

- **Programa de Apoio a Edifícios mais Sustentáveis (PAES)**. Designed in the framework of the Resilience and Recovery Plan, it funds the acquisition/replacement and installation of renewable H&C and hot water production systems (class A+ and higher).
- **Vale Eficiência.** Designed in the framework of the Resilience and Recovery Plan, the main goal is to improve thermal comfort in households with vulnerable families. It funds the acquisition and installation of renewable H&C and hot water production systems (class A+ and higher).
- **Programa de Apoio à Renovação e Aumento do Desempenho Energético dos Edifícios de Serviços.** Aimed at supporting the renovation and energy performance improvement of existing services buildings, which funds the acquisition and installation of renewable H&C and hot water production systems.

Sociocultural

The perception that winter is shorter and milder than in the past encourages the use of low-cost measures to tackle the cold, thus holding back investment in equipment and building renovation that improve thermal comfort. On the other hand, the perception that heat waves tend to become more frequent and severe due to climate change leads the population to purchase equipment that helps tackle heat at home. However, due to family's low income, the preferred options are often cheaper solutions that do not require renovation works at home, nor the need for technical advice.

Co-funded by the European Union

At local level, municipalities and energy agencies can play a relevant role by promoting citizens' energy literacy and offering technical support through one-stop shops.

Public awareness:

In general, the public is open to energy transition (prioritizing RES for H&C) but lacks energy literacy and knowledge of renewable and efficient solutions, as well as on the impact caused of the energy transition, especially on the citizen's day to day life.

Energy poverty:

Energy poverty is widespread in Portugal, which is in the top 5 of EU countries for the "Inability to keep home adequately warm"[61]. Portugal is finalising its national strategy to tackle energy poverty. The following table presents the main targets defined in the Long-term National Strategy to Combat Energy Poverty 2021-2050.

INDICATOR	BASELINE	2030	2040	2050
Inability to keep home adequately warm (% households)	17,4A% (1,8 MP) [INE, 2020]*	10% (≈1 MP)	5% (≈500 KP)	<1% (<100 KP)
Share of energy expenditure in income (> 10% total income) (Nr. households)	1.202.567 (≈3,0 MP) [INE, 2016]*	700.000 (≈1,75 MP)	250.000 (≈625 KP)	0
Living in houses with issues related to indoor humidity, mould and infiltrations | (% population)	24,4% (≈2,5 MP) [Eurostat, 2019]	20% (≈2,0 MP)	10% (≈1,0 MP)	<5% (<500 KP)
Living in houses with lack of comfort conditions in the Summer (% population)	35,7% (≈2,5 MP) [Eurostat, 2012]	20% (≈2,0 MP)	10% (≈1,0 MP)	<5% (< 500 KP)

*INE - Statistics Portugal
MP - Millions of Persons | KP - Thousands of Persons

Building stock:

Based on data on the energy performance certificates (EPCs) issued between 2014 and 2020 (1,3 million EPCs, which represents only a fraction of the building stock), a mere 12.3% of accommodations qualify as very efficient (efficiency class A and A+), while around 70% of certified dwellings have an efficiency class C or less, as illustrated in the following bar chart. Furthermore, two-thirds of buildings still lack energy performance certificates at all.

[61] Energy Poverty National Indicators (European Commission), p. 38

Co-funded by the European Union

Energy performance of the building stock based on the energy certificates issued up to 2020 [Source: ADENE, Buildings National Energy Certification System, 2020]

In general, the national stock of existing buildings does not provide adequate living conditions for all its occupants, namely thermal and acoustic comfort, and good indoor air quality. The analysis performed in the framework of the Long-Term Strategy for Building Renovation in Portugal confirmed that, exception made for multi-family buildings built after 2016, all buildings present a comfort category IV, which means that, currently, the existing building stock provides some thermal discomfort in more than 95% of the hours of the year.

Technological

Energy consumption for space heating and cooling has a relevant weight on the energy bill. In the residential sector, the aim is to increase the thermal comfort of households, focusing on passive insulation, sun protection and ventilation solutions, and continuing with the trend towards electrification of the heating and cooling sector and the use of renewable energy sources. To promote the efficient use of renewable energy in heating and cooling systems, the following action measures are envisaged:

- Promote the renovation of heating and cooling systems from renewable energy sources: Encourage the replacement of outdated heat and cold production systems with more efficient and renewable energy systems. Electrification of heating and cooling by promoting the procurement and use of heat pumps for AQS and ambient air heating and cooling in buildings. [Planned date: 2020-2030]
- Promoting efficient use of heating and cooling systems through consumer information, stimulating consumer participation in aggregation for demand participation through heating/cooling systems. Large consumers of heat/cold. [Planned date: 2023-2027]
- Development of a National Action Plan to accelerate the uptake of heat pumps in buildings and industry, in the framework of the EU Heat Pumps Action Plan. [Planned date: 2023-2025]

The draft revision of the Portuguese NECP published in June 2023 quotes: “As regards the heating and cooling sector, the share of fossil fuel consumption at sectoral level is expected to decrease, as energy efficiency measures and electrification of consumption are stepped up. In this context, it will be possible to increase the share of renewable energy use through increased use of renewable

Co-funded by the European Union

biomass and gases. It should be noted that Portugal is one of the countries of the European Union where it may not be possible to increase the share of renewable energy sources by 1.3 % or 1.1 % per year in the heating and catering sector, in accordance with Directive (EU) 2018/2001. However, given that renewable gases, such as biomethane and renewable hydrogen, are expected to play a greater role by 2030, this outlook could change in the short to medium term. It should also be noted that, for the first time, it was possible to count the total contribution of heat pumps in gross final energy consumption, so that, at the modelling level, it was possible to include in this Plan data on heat pumps to the same extent as they were accounted for in the calculation of the contribution of renewable energy to gross final energy consumption in the heating and cooling sector, which explains the evolution compared to historical developments (2005-2018) and projections for this sector.

The two figures below illustrate the trajectory for the share of RES in gross final energy consumption and H&C by 2030, according to the draft NECP revision.

In view of the scenario envisaged for the evolution of the heating and cooling sector in Portugal, the table below shows the expected development broken down by technology and energy source for the 2030 horizon in order to meet the targets set for this sector.

Co-funded by the European Union

(ktoe)	2025	2030
Biomass	1 135	1 230
Heat pumps	813	854
Heat from thermal solar	154	209
Heat from cogeneration	569	498
Renewable gases	41	174
TOTAL	**2 713**	**2 965**

Heat pumps are present, both as stand-alone solutions and in combination with other RES technologies (i.e. solar thermal), but they still represent a small fraction of the market. In terms of challenges, heat pumps are still an expensive solution, they need space for indoor and outdoor units, and the poor thermal insulation of buildings may limit their applicability.

Solar Thermal has a strong presence, especially in single family houses. In multi-family it is still not a conventional solution since the infrastructure should be adapted. The use of solar thermal is indirectly incentivised by the national obligation for new buildings and large renovations to have a share of renewable energy produced locally. For existing buildings, especially multifamily, the installation procedures can be challenging, also from an administrative point of view.

Biomass boilers and heat recovery systems are present but not a widespread solution. The biomass availability and technology costs can be a bottleneck.

Geothermal is almost residual, mostly due to the high cost.

R&D priorities under the Portuguese strategy don't encompass the assessment of the need to build new **district heating and cooling** infrastructure supplied by renewable energy sources.

Legal

Portugal has a wide range of sectoral instruments in climate action and energy, which have effectively delivered on EU and international commitments. In this context, the 2030 National Energy and Climate Plan, approved by Council of Ministers Resolution No 53/2020 of 10 July, the Carbon Neutrality Roadmap 2050 (RNC 2050), approved by Council of Ministers Resolution No 107/2019 of 1 July, and the Basic Climate Law, approved by Law No 98/2021 of 31 December, are noteworthy. In addition, the National Programme for Spatial Planning Policy (PNPOT) and the Circular Economy Action Plan (CEAP), which embody the three main axes of environment and climate action policy, should be mentioned in cross-cutting terms.

Specifically on heating and cooling, the main sectoral policy instruments at national level that are currently in place or in the final phase of implementation are:

Co-funded by the European Union

- National Energy and Climate Plan 2030, with a dedicated line of action on promoting efficiency and the integration of renewable energies in heating and cooling systems (action 3.4).
- 'Decarbonize Public Administration', which promotes the adoption of energy efficiency *easy win* solutions and/or incorporation of renewable energy;
- 'Promote professional training aimed at the energy efficiency sector', with new training approaches for specialized technicians in the energy efficiency and renewable energy sectors.
- 'Promote the integration of distributed production and self-consumption of energy and energy communities'.
- The Recovery and Resilience Plan, which invests in "Energy Efficiency in residential buildings".
- The Long-Term Strategy for Building Renovation.
- Law of the Great Options for 2022-2026: First strategic challenge "Climate change" covers increasing renewable energy production, resource sustainability, sustainable mobility.
- Decree-Law No. 101-D/2020 establishes the requirements applicable to buildings towards improving their energy performance and regulates the Building Energy Certification System.
- Decree-Law No. 162/2019 sets the legal framework for self-consumption and RECs.
- Decree-Law No. 15/2022 regulates the National Electricity System.

Environmental

In Portugal, the upward temperature trend, as observed since the 1970s across all regions (rate of 0.3°C per decade) is projected to occur throughout the 21st century, such that the country's average annual temperature in 2100 under a high-greenhouse gas emission scenario could be up to 4°C higher than during 1971-2000. This temperature increase is expected to be especially pronounced during the summer, with more very hot days (daily maximum temperature above 35°C) and tropical nights (daily minimum above 20°C) and longer heat waves, especially in the northern countryside, raising the risk of forest fires.

These temperature changes will likely affect Portugal's energy supplies, particularly of electricity. According to the National Climate Change Adaptation Strategy's energy sector report, rising temperatures and more frequent heatwaves could reduce thermal power plant generation efficiency and availability as well as power grid efficiency and maximum transmission. Furthermore, more frequent extreme heat events could interrupt thermal power generation by raising the temperature of cooling water.

Also, annual precipitation is projected to continue decreasing across the country, despite higher amounts in December and January, more frequent and intense precipitation events, and higher exposure to flooding. These changes in precipitation may also affect the energy sector, in particular Portugal's hydropower production capacity. Therefore, the climate resilience of the energy sector is

Co-funded by the European Union

a priority area in Portugal's climate change adaptation policies, which is outlined in the 2015 National Climate Change Adaptation Strategy[62] and the National Climate and Energy Plan.

4. THE ROLE OF LOCAL AUTHORITIES

This section looks at the local dimension of the national climate and energy plans to analyse the extent to which the local dimension, the role of local authorities and technical and financial support programmes are highlighted in the NECPs, in particular in the measures relating to decarbonisation of the heating and cooling sector.

The method used is a quantitative analysis of the number of times the words "local", "municipality", "city", "local authority", "Covenant of Mayors", "SECAP" or "SEAP" are used in the NECPs. This was followed by a qualitative analysis of the measures relating to the decarbonisation of heating and cooling and the passages containing the key words searched for.

Croatia

The Croatian draft update NECP (2023) covers the local dimension fairly well in general and addresses it in particular in the context of increasing the production of renewable energies and encourages municipalities to make Sustainable Energy Actions Plans (SECAPs) and join the Covenant of Mayors. The local level is mentioned in the context of spatial planning to define renewable energy potential and to determine urban areas where heating networks can be built. These measures (OIE-2 Spatial planning requirements for using RES and OIE-6 Use of RES in centralized and closed thermal systems), although at local level, do not specify if municipalities are key actors of the implementation.

There has been an improvement between the 2019 plan and the 2023 plan in the mention of local authorities in the section relating to decarbonisation of the heating and cooling sector. Nevertheless, the Croatian plan makes very little mention of the financial resources allocated to the cities to implement these measures and does not propose any measures on human capacity in the cities, apart from a programme for more regional energy agencies, which remains a very good point already mentioned in 2019 NECP.

[62] National Climate Change Adaptation Strategy

Co-funded by the European Union

Portugal

The Portuguese draft updated NECP (2023) takes much greater account of the local and regional dimension of the energy and climate transition than the 2019 version of the plan. It includes a new measure to "encourage municipal climate action plans" and develop a national network of cities for this purpose, as well as stressing the importance of local agencies and local associations and cooperatives.

Local authorities have a clear role to play in the production of renewable energy, particularly in relation to citizen energy communities, transport and reducing GHG emissions on their territory. The role of municipalities is mentioned in the measure concerning the decarbonisation of public buildings at national, regional, and local level. Municipalities will join the energy efficiency barometer, which will enable the stock of buildings to be analysed and should benefit in the same way as other administrations from tax and budgetary advantages to encourage investment. Apart from this measure on building, there is no mention of the role of municipalities and the local level in measures relating to heating and cooling, nor of local heating and cooling planning.

Greece

The Greek 2019 NECP says very little about the role of local authorities in its strategy. This is mentioned in relation to adaptations and transport, but no mention is made of measures concerning RES in the heating and cooling sector. Nevertheless, municipalities and regions are expected and supported to draft and implement Action Plans for Sustainable Energy and the Action Plans for Energy Efficiency of Buildings which scope may cover the decarbonisation of the public buildings stock. There are no measures on strategic local planning for heating and cooling, nor any mention of technical or financial support for this sector decarbonisation.

The Greek draft update NECP (2023) was submitted on 3 November 2023[63] and again, it did not provide much information on the role of local authorities. It only states that the local authorities are required to-implement municipal plans to reduce net greenhouse gas emissions to achieve a target of at least 10 % for 2025 and 30 % for 2030 compared to the base year 2019.

Germany

The German 2019 NECP is highlighting the role of cities in decarbonising public buildings and heating systems. These include an important funding programme for public buildings and energy efficiency projects. No mention is made of the need to increase the share of RES in the sector in conjunction with local authorities. Also, there is no mention of strategic and spatial planning by local authorities for heating and cooling.

The 2023 draft update of the German NECP is not available at the time of writing the deliverable, however it seems that this vision of local strategic planning is more present in the laws on building and heating planning being negotiated. Note also that the federal organization of Germany leaves an

[63] https://commission.europa.eu/publications/greece-draft-updated-necp-2021-2030_en

Co-funded by the European Union

important place for the Land to administer the obligations of local authorities and the technical and financial support in their own regional strategies.

Poland

The 2019 Polish NECP (the 2023 draft update NECP was not available at the time writing the deliverable) takes well into account the importance of the local level in implementing measures. Municipalities are mentioned in particular for transport and adaptation issues and for the "stop smog" programmes, which support the most vulnerable households. There is no mention of the Covenant of Mayors, or of related plans such as SECAPs, but a mention of climate adaptation plans.

As for heating and cooling, the generation of renewable heat is recognised as being local in nature, and local governments should be supported in investing in and developing it via municipal utility companies. In addition, the Thermal Modernisation and Renovation Fund proposes to provide state aid to local governments for projects to reduce the efficiency of buildings and district heating networks and to replace fossil fuels with renewable energy. Local authorities therefore play a role as an intermediary with local populations, but also as a player in projects concerning public assets at local level.

However, the technical and financial resources seem to remain limited, in particular there is no mention of the skills of local authorities. In the NECP, there is no mention of the planning and strategic role of local authorities to decarbonise heating sector in their territory. However, the Polish Energy Law details in art 19 and art 20 the energy supply plans that local authorities have to submit. These plans are however mainly focused on the supply aspects and do not offer a strategic and spatially targeted vision to decarbonize the heating and cooling across its entire territory.

Summary of findings

The importance of the local level in the NECP is very uneven depending on the countries analysed. Overall, the role of the local level is well recognized for issues related to transport and adaptation to climate change, but very little for the decarbonization of heating and cooling sector. Note, however, that several programs focus on the decarbonization of local public buildings in the new versions of the NECPs.

When their role is recognized, municipalities are seen as a link in the implementation chain, but not an actor in strategy and planning at the local level to decarbonize the heating and cooling sector. Some countries mention financial programs for local authorities, but others do not mention technical or financial support. The question of the competence of local administration staff is not mentioned elsewhere in any NECP.

The Report “Local initiatives for heat decarbonization”, drafted as part of the LIFE RED4HEAT project, proposes going further on the link between local and national planning, and analyses local best practices for decarbonizing the heating and cooling sector.

Co-funded by the European Union

5. CONCLUSIONS

The aim of this report was twofold: first, assess the status of renewable heating and cooling in the EU-27, including the available support policies and measures; second, perform a more detailed analysis of five target countries (Croatia, Germany, Greece, Poland, Portugal) based on political, economic, social, technological, environmental, and legal factors (PESTEL analysis). Furthermore, the local dimension and involvement of local authorities in the NECP process was considered in chapter 4, though the topic is investigated more in depth in D2.2.

The main findings were that heating and cooling represents half of EU energy consumption and approaches or exceeds 50% of the national final energy consumption in most Member States, while the uptake of renewables remains relatively low compared to the power sector and mostly limited to biomass, which is the dominant renewable source in the sector. Nonetheless, the analysis of the NECPs showed a worrying lack of ambitious targets as well as adequate national policy and funding measures in the sector.

In terms of involvement of the local level in the definition of such policies, the situation varies considerably from country to country. However, considering that heating and cooling is planned and managed mostly at municipal level, the engagement of cities and local authorities in defining the sectoral policies must be generally stepped up, as well as the dedicated resources in terms funding, knowledge, skilled workforce.

Co-funded by the European Union