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Assessment of heating and cooling related chapters of the national energy and climate plans (NECPs)

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Foreword

This work was carried out in the framework of an administrative arrangement between the European Commission's Directorate-General for Energy and the Joint Research Centre (JRC). Here, the JRC provides the Directorate-General for Energy with technical assistance, analysis and input to support the implementation of heating and cooling-related provisions of Directive (EU) 2018/2001 on energy from renewable energy sources and the implementation of Article 14 of Directive 2012/27/EU on energy efficiency.

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Abstract

National Climate and Energy Plans (NECPs) are a part of the Clean Energy for all Europeans package. They describe strategies and measures how the EU Member States intend to address energy efficiency, renewables, greenhouse gas emissions reductions, interconnections, as well as research and innovation. This report analyses the Member States' plans and measures related to renewable energy and energy savings in the heating and cooling (H&C) sector from 2020 to 2030.

Based on the information collected in the final NECPs, this report shows the status of the European H&C market and its development, as well as national actions to achieve the renewable and energy efficiency targets. Moreover, the report provides recommendations assisting the individual EU Member States and the European Commission with increasing the quality of the next NECPs.

Executive summary

Policy context

National energy and climate plans (NECPs) are part of the 'Clean energy for all Europeans' package. They describe strategies and measures through which the European Union Member States intend to address energy efficiency, renewable energy, greenhouse gas emission reductions, interconnections, and research and innovation. EU Member States were required to submit their final NECPs to the Commission by the end of 2019.

This report analyses Member States' plans and measures related to renewable energy and energy savings in the heating and cooling (H & C) sector from 2020 to 2030. Among other things, it analyses how Member States intend to meet the targets specified in articles of the renewable energy directive (RED II) and the energy efficiency directive (EED). For example, according to Article 23 of RED II, countries should report their annual increase in the share of renewable energy sources in the H & C sector and the role of waste heat and cold. With respect to efficient H & C, Member States are to communicate energy savings as required by Article 7 of the EED, as well as the current potential for the application of high-efficiency co-generation and efficient district heating and cooling (DHC) in accordance with Article 14 of the EED.

Main findings

The scope of the NECPs is large, and a clear and detailed overview of all sectors is challenging to provide for Member States. Member States addressed various areas related to the H & C sector in their NECPs, which allowed us to assess the status of the European H & C market and its development, as well as national plans and measures to achieve the renewable energy and energy efficiency targets.

All EU Member States' NECPs were analysed with regard to the H & C sector. Although significant efforts had been made to address this sector, there were also many aspects that had not been incorporated by all Member States, for example high-efficiency co-generation and efficient DHC. It was often stated that some information would be provided later, pending their respective analyses carried out in line with other directives, for example a long-term strategy for the renovation of buildings and potential for efficient DHC. Nevertheless, a significant amount of information could be extracted, which allowed the progress achieved to be made visible.

The final NECPs anticipated a share of renewable energy in the H & C sector of 23 % in 2020 and a share of 33 % in 2030 ([1]). All countries expect to see an increase in this period; however, their levels of ambition vary significantly. Nine countries meet the target set out in Article 23 of RED II of a 1.3 percentage point annual increase in renewables in the H & C sector. Only a few countries provided details about the constraints that caused them not to meet the objectives.

Biomass and heat pumps were the dominant renewable technologies in 2018. Biomass accounted for 81 % and heat pumps for 11 % of the final energy consumption from renewables in the H & C sector. The relative contribution of biomass among the renewable H & C technologies is expected to decrease by 2030. However, with a share of 66 %, it will remain the dominant technology in the EU-27 ([1]). The contribution from heat pumps was 11.3 Mtoe in 2018, and it is expected to increase to 21.1 Mtoe by 2030, thereby contributing 17 % of renewable H & C.

Projections for heat supply from DHC were often not provided. Increased use is envisaged in three countries (BE, LT, NL) and a decline is expected in six countries (CZ, DK, EE, PL, FI, SE). This decrease is mainly due to efficiency improvements in the building stock and district heating networks. Most countries that supplied data on the share of renewable energy in DHC met the target specified in Article 24 RED II of a 10 percentage point increase from 2020 to 2030.

([1]) Including 25 Member States of the EU. Data for Spain and Latvia are not included (no data found in the NECPs).

The contribution from waste heat in DHC systems today or in the future (Article 24 of RED II) was not detailed in any of the NECPs, although some countries mentioned that they intended to make use of that resource (e.g. FR).

Six Member States (CZ, EE, LU, PT, SI, SK) expect increased heat supply from combined heat and power (CHP)) in the period 2020–2030, whereas six countries (DK, DE, ES, NL, AT, FI) expect decreased heat supply from CHP. The mixed trends are due to different market conditions and national priorities.

The most common policy concerns achieving energy savings through better insulation of buildings. Overall, 20 Member States have measures for building renovation. Measures related to phasing out fossil fuels in the heating sector were put forward by eight Member States. Measures for greater use of waste heat were presented by seven Member States. Measures concerning the efficiency and RES in industrial H&C processes were not often specified. The policies and measures in the H & C sector were often incomplete and did not set out the amount of savings that would be achieved or the amount of emissions that would be avoided.

Regarding investment requirements for the H & C sector, investments in building renovation are most prominent in many countries, followed by investments in the centralised energy supply (district heating network, CHP and modernisation or installation of renewable decentralised heating systems (e.g. heat pumps). Sources of financing were mostly not provided per measure.

Key conclusions and recommendations

The key conclusions and recommendations are listed below for the attention of the European Commission and EU Member States. The recommendations aim to enhance the quality of future NECPs, in terms of compliance with the governance regulation and the implementation of RED II and the EED, while helping to enhance their planning value and providing clear directions and seamless integration with the long-term objectives on renewable energy and energy efficiency. The recommendations are not obligatory for the European Commission or the Member States, but suggestions for improvement, and are solely the views of the authors of this study.

Conclusion 1. The ambition to increase the share of renewables in the H & C sector is often lower than that in the power sector. The objectives of Articles 23 and 24 of RED II are not met in many NECPs. Moreover, most of the plans did not provide explanations about the constraints that caused the Member States not to meet the targets.

- **Recommendation 1.1.** For the next NECPs, it is essential for countries not meeting the targets for the share of renewable energy in the H & C sector to increase their level of ambition, given the important role of this sector in fulfilling the EU's climate and energy goals.
- **Recommendation 1.2.** Some NECPs did not describe the technologies that are intended to be used to meet the targets. In the next NECPs, it is advised that the contribution from the renewable H & C technologies with the largest share be provided.
- **Recommendation 1.3.** Five NECPs present plans to phase out fossil fuels to decarbonise the H & C sector. These plans could serve as best practice examples for other countries so that they can reach carbon neutrality by 2050.
- **Recommendation 1.4.** The next NECPs could be improved by explaining constraints to justify the underachievement of targets. Only a handful of Member States discussed such limitations for the H & C sector.

Conclusion 2. The potential use of waste heat and cold is often overlooked. Seven Member States described measures enabling and promoting the use of waste heat from industry, whereas only four NECPs presented an intention to increase the use of waste heat.

- **Recommendation 2.1.** Member States should increase their efforts to systematically identify, describe and quantify sources of waste heat and cold. The comprehensive assessments to be performed in accordance with Article 14(1) of the EED could provide the framework. In addition, measures to exploit waste heat and cold should be explored.

Conclusion 3. In some NECPs, it was assumed that co-generated heat from CHP could be counted as waste heat to meet renewable H & C targets.

- **Recommendation 3.1**. The Commission should clarify the definition of waste heat and cold and how to account it towards the heating and cooling targets in Articles 23, 24 of the RED II.

Conclusion 4. In total, 14 NECPs presented information on the potential for high-efficiency co-generation (high-efficiency combined heat and power (HECHP)). Seven expect to see a decrease and seven anticipate an increase in heat consumption from HECHP.

- **Recommendation 4.1.** The Commission should analyse why the increased use of HECHP was successful in some countries and not in others. Is it due to different incentives, market conditions, etc.?
- **Recommendation 4.2.** Use the next comprehensive assessment under Article 14(1) of the EED to reassess the importance of HECHP.

Conclusion 5. The measures related to renewables and energy savings in the H & C sector are, in most cases, provided with limited description. A better description of such measures would help understanding their impact on reaching the targets.

- **Recommendation 5.1.** All measures presented would significantly improve in quality if a description, anticipated energy savings or emission reductions, years of implementation, and planned investments were provided.

Conclusion 6. Cooling is addressed by only six NECPs, although its importance is expected to grow in the future.

- **Recommendation 6.1.** Member States are encouraged to increase their focus on the cooling sector.

Conclusion 7. Data collection and completeness for H & C could be improved. The target year for the estimated trajectories was not 2030 in all cases.

- **Recommendation 7.1.** Improve data collection procedures at Member State level for technology contributions, waste heat, process heat, CHP.
- **Recommendation 7.2.** Clarify which time frame and target year the NECPs should cover.
- **Recommendation 7.3.** Ensure the usage of the Annex I of the Energy Governance ([2]), since it clarifies which data should be provided. In addition, the template could be expanded to cover more data.

Conclusion 8. The timing of some directives and the timing of the NECPs are not aligned, which often led Member States to claim that some information was missing but that it would be updated soon, for example their long-term strategy for the renovation of buildings and comprehensive assessments related to Article 14 of the EED, which were due by the end of April 2020 and December 2020, respectively.

- **Recommendation 8.1.** It would benefit future NECP assessments if important outputs of directives could be prepared in time to provide an input to the next NECP. The Commission could reflect on whether the timing of outputs from other directives could be amended to better feed into the NECP analyses.

([2]) The Regulation on the governance of the energy union and climate action (EU)2018/1999

1. Introduction

The national energy and climate plans (NECPs) are part of the 'Clean energy for all Europeans' package, and describe strategies and measures for the period 2021–2030 designed to achieve the EU's 2030 energy and climate targets. One of the objectives is to break the silos across policies and sectors to define a pathway to 2030.

European Union Member States were required to submit the final NECPs for the period 2021–2030 to the Commission by the end of 2019 in accordance with the governance regulation ([3]). Progress reports should be submitted every 2 years.

The national plans outline how the EU Member States intend to address energy efficiency, renewables, greenhouse gas emission reductions, interconnections, and research and innovation. This report analyses the heating and cooling (H & C) aspects for the energy efficiency and renewable dimensions.

H & C in buildings and industry accounted for 46 % of the EU's final energy consumption (FEC) in 2018. From this, 21 % was generated by renewable energy ([4]), whereas almost 80 % of the heating energy was still being generated by fossil fuels. Hence, the European H & C sector plays an important role in fulfilling the EU's climate and energy goals.

This report assesses Member States' targets, projections, strategies and measures for the H & C sector, as provided in the final NECPs. It evaluates the extent to which Member States' incorporated the H & C sector to decarbonise their energy systems, highlights missed opportunities and provides recommendations on how to improve the next round of NECPs in 2029.

The report includes an assessment of the following parts of the NECPs:

- estimated trajectories of total final energy consumption (TFEC) in the H & C sector, and quantity and shares of renewable energy in FEC for H & C from 2021 to 2030;
- renewable energy technologies to achieve the trajectories for H & C, bioenergy demand and renewable energy in district heating;
- compliance with the targets of Article 23 of the RED II (increase of RES share in the H & C sector, the role of waste heat and cold, constrains for not meeting the requirements);
- compliance with the targets of Article 24 of the RED II (plans to increase the share of RES in DHC, if applicable);
- energy efficiency measures used to reach the savings targets;
- policies and measures to achieve the trajectories for the H & C sector, including sector- and technology-specific measures, measures on financial support, and measures under Article 7 of the EED;
- current potential for the application of high-efficiency cogeneration, waste heat, and efficient DHC (in accordance with Article 14(1) of the EED); and
- impact assessment of planned policies and measures.

The structure of the report is as follows. Chapter 2 concerns the current H & C FEC, the forecast until 2030, the share of renewable energy, and energy savings. Chapter 3 addresses the policies and measures presented by Member States with which they intend to meet the targets. Chapter 4 contains the recommendations on how the next round of NECPs can be improved.

([3]) Under the Governance Regulation (Regulation on the governance of the energy union and climate action (EU)2018/1999), the EU Member States develop integrated national energy and climate plans based on a common template.

([4]) Own calculation based on Eurostat data (SHARES tool data) (https://ec.europa.eu/eurostat/web/energy/data/shares).

2. Current situation and projections

2.1. Background

The governance regulation requires Member States to report an indicative national trajectory for the overall share of renewable energy in gross FEC from 2021 to 2030, including the sectorial share of renewable FEC in the H & C sector. This also includes estimated renewable energy trajectories per technology and sector in million tonnes of oil equivalent (Mtoe) and installed capacity.

In this chapter, we analyse the data provided in the NECPs for the current situation and projections. The analysis concerns primarily the completeness of information, whether targets were met, and the priorities selected by Member States.

As the NECPs should reflect the annual increase in the share of renewable energy in the H & C sector provided for in Directive (EU) 2018/2001 (Article 23), we estimate compliance with this article, including the role of waste heat and cold, and the constraints that caused Member States not to meet the requirements. Next, we show the role of renewable technologies (biomass, heat pumps, solar thermal, geothermal and municipal waste) in achieving the sectorial trajectories for renewable energy. Furthermore, we analyse the FEC for DHC and the share of renewable energy sources (RESs) in this sector.

2.2. Final energy consumption and renewable sources

Following the governance regulation, Member States have to provide the estimated trajectories for the share of renewable energy in the H & C sector and the FEC by renewables in the H & C sector from 2021 to 2030. Using these two data sets, we estimated the TFEC for H & C until 2030. These data were compared with Eurostat data from 2018.

The current TFEC for H & C made up 46 % of the TFEC for the 27 EU Member States (EU-27) in 2018 (TFEC for H & C amounted to 467.2 Mtoe). H & C makes up more than 50 % of the TFEC in nine Member States (see Table 1). The highest TFEC was in Germany (109.2 Mtoe), followed by France (61.2 Mtoe) and Italy (55.5 Mtoe).

The TFEC for H & C is estimated to decrease by more than 10 % from 2020 to 2030 in the EU-27 (excluding Spain and Latvia ([5])). The highest decreases are expected in Luxembourg, Slovenia and Italy, where reductions of 29 %, 18 % and 16.5 % between 2020 and 2030 are predicted, respectively. Germany, Ireland, France, Poland and Slovakia have reductions of at least 10 % in FEC in the H & C sector. However, five countries show an increasing trend over the same period: Croatia, Cyprus, Lithuania, Malta and Sweden.

The share of renewable energy in the H & C sector amounted to 21 % in 2018 in the EU-27. It was expected to reach 23 % in 2020 and is expected to reach 33 % in 2030 (Spain and Latvia are not included). The share of renewable energy was above 50 % by 2020 in Denmark, Estonia, Latvia, Lithuania and Finland ([6]). In Sweden, this share was above 60 % ([7]). Several countries report a low share of RESs in the H & C sector.

All countries increase their share of renewable energy in the H & C sector from 2020 to 2030. However, the levels of ambition vary considerably between Member States. The highest increase in the RES share in the H & C sector is estimated in Luxembourg (16.8 %), followed by Lithuania (16.3 %) and Greece (12.4 %). The lowest increase is expected in Sweden (3 %), followed by Belgium (3.3 %) and Malta (3.7 %).

([5]) No data are available in their NECPs.

([6]) Above 50 %, a Member State has to achieve half of the renewable increase requirement, i.e. 5.5 or 6.5 percentage points per year (Article 23(2)(c) of the renewable energy directive).

([7]) Above 60 %, a Member State is not subject to the renewable increase requirement (Article 23(2)(b) of the renewable energy directive).

Table 1. Current and future FEC for H & C, and RES share in the H & C sector. Data sources: European Commission (2019) and Eurostat (2018).

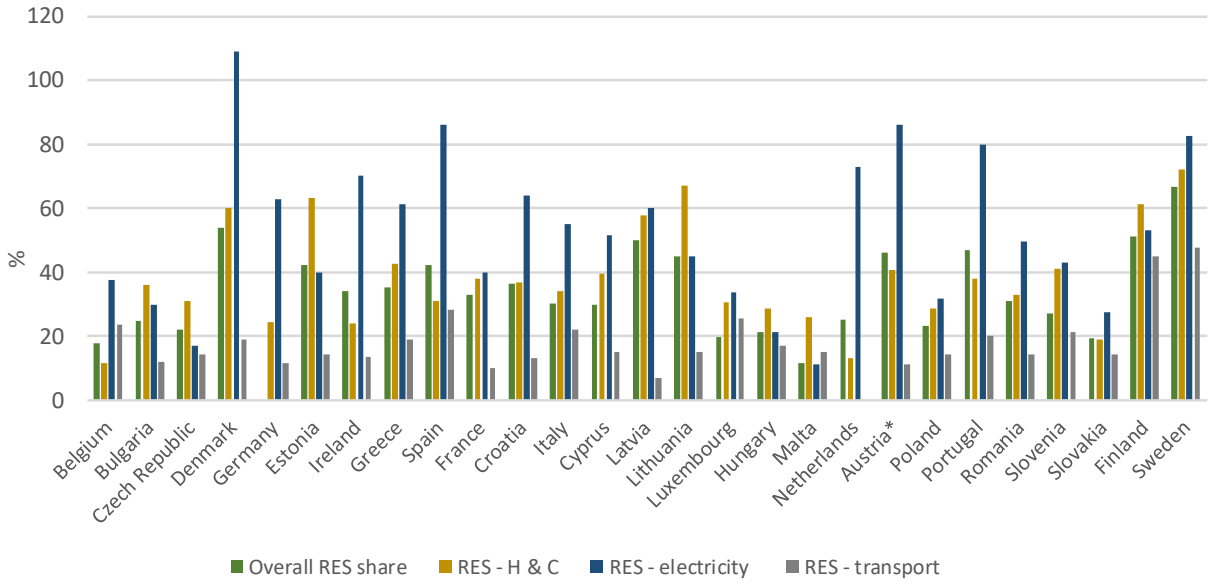
Member State	Share of H & C in TFEC, 2018 (%)	TFEC for H & C (ktoe)			RES H & C contribution (%)		
		2020	2025	2030	2020	2025	2030
Belgium	51.0	18 849	18 957	18 336	8.0	9.4	11.3
Bulgaria	37.1	4 069	4 080	3 978	31.3	38.1	42.6
Czechia	52.8	13 871	13 294	12 805	20.7	25.9	30.7
Denmark	48.1	7 584	7 639	7 505	54.0	58.0	60
Germany	49.1	104 005	93 776	87 827	16.0	19.1	24.2
Estonia	49.6	1 549	NA	1 502	55.3	59.0	63
Ireland	38.4	5 017	4 803	4 407	7.8	15.1	24
Greece	30.0	5 755	5 721	5 721	30.6	37.0	43
Spain	33.6	NA	NA	NA	18.0	25.0	31
France	40.0	60 452 ([8])	57 438 ([8])	52 708 ([8])	26.0	35	38
Croatia	48.0	3 548	NA	3 835	33.3	NA	38
Italy	48.0	53 200	49 500	44 400	20.6	24.6	33.9
Cyprus	27.0	556 ([9])	NA	604	32.0	35.5	39.4
Latvia	56.3	NA	NA	NA	53.4	56.1	57.6
Lithuania	45.1	3 109	3 169	3 364	50.9	63.5	67.2
Luxembourg	25.1	1 020	879	720	13.7	19.9	30.5
Hungary	53.9	10 692	9 879	9 484	18.2	20.7	28.7
Malta	11.6	91.4	98.9	102.7	22.1	24.6	25.8
Netherlands	54.0	25 745	NA	24 476	7.8	NA	13.0
Austria	47.0	13 260	13 075	12 910	36.5	38.1	40.6
Poland	50.3	37 654	35 420	33 498	17.4	22.7	28.4
Portugal	36.0	5 310	5 067	4 916	34.0	36.0	38.0
Romania	54.5	14 117	14 051	13 363	25.2	29.3	33.0
Slovenia	36.0	1 808	1 619	1 481	36.4	37.3	41.4
Slovakia	53.0	5 718 ([10])	5 322 ([10])	4 926	10.9 ([11])	14.9 ([12])	19.0
Finland	54.6	14 824	NA	14 348	54.0	58.0	61.0
Sweden	42.0	16 000	NA	17 000	69.2	NA	72.2

NB: Underlined elements are calculated numbers (based on the NECPs), not underlined elements are taken directly from the NECPs, data for the share of H&C in total FEC 2018 is based on the Eurostat SHARES tool.
NA - not available.

([8]) Interpolated data (original data are given for 2018, 2023 and 2028).
([9]) Interpolated data (originally given for 2021).
([10]) Interpolated data (originally given for 2021, 2030).
([11]) Interpolation between 2021 and 2018.
([12]) Interpolation between 2020 and 2030.

As mentioned above, nearly 50 % of FEC is used for H & C purposes in Europe. The remaining energy is consumed by the transport and electricity sectors. The trajectories of the share of RESs in these three sectors can be seen in **Figure 1**. In 18 countries, the electricity sector has the largest share of renewable energy, compared with the other two sectors, in 2020. This situation remains in 2030. Denmark, Estonia, Austria and Sweden expect to reach more than 80 % of the RES share in electricity consumption by 2030. There are four countries with a larger share than 60 % in the H & C sector by 2030: Sweden (72 %), Lithuania (67 %), Estonia (63 %) and Denmark (60 %). Biomass energy is an important contributor to RESs in the H & C sector in these countries. The transport sector lags far behind other sectors. In 19 countries, the share of RESs in this sector stays below 20 % in 2030. Sweden, Finland and Spain show the most ambitious development of renewable energy in the transport sector and plan to reach 48 %, 45 % and 28 %, respectively.

Figure 1. Trajectories for the RES share in the H & C (in yellow), electricity (in blue) and transport (in grey) sectors in 2030 in EU Member States (in scenarios with additional measures). Data source: European Commission (2019).



Austria *: the overall RES share ranges from 46-50%

2.3. Renewable target under Article 23 of the renewable energy directive

Regarding Article 23(1) of the renewable energy directive (RED II), Member States must endeavour to increase their RES shares in FEC for H & C by an indicative 1.3 percentage points as annual average counting for the periods 2021–2025 and 2026–2030, starting from the share of renewable energy in the H & C sector in 2020. Article 23(1) also indicates that this increase must be limited to 1.1 percentage points for Member States in which waste heat and cold is not used. If the share of RESs in the H & C sector in 2020 is above 60 %, Member States may count any such share as fulfilling the average annual increase (see Article 23(2b)); if the share is above 50 % and up to 60 %, Member States may count any such share as fulfilling half of the average annual increase (see Article 23(2c)). Member States must provide any information as to the constraints that may have caused them not to meet the requirements, such as structural barriers arising from the high share of natural gas or cooling, or from a dispersed settlement structure with a low population density.

Table 2 shows the RES share in the H & C sector in 2020, and the average annual increase in the RES share in the H & C sector by 2025 and 2030. It also indicates whether Member States take waste heat and cold into account and whether the constraints that caused Member States not to meet the requirements are provided ([13]). Considering all criteria from Article 23(1 and 2), we identified whether Member States meet the requirements. Member States that do not meet the requirements are highlighted in red, whereas those that meet the requirements are highlighted in green.

Nine countries (Estonia, Ireland, Greece, Spain, France, Lithuania, Luxembourg, Finland and Sweden) meet their targets, whereas 13 countries do not meet them, and five countries are expected to comply in one of the periods (2020–2025 or 2026–2030) but not in the other period.

([13]) For example, structural barriers arising from the high share of natural gas or cooling, or from a dispersed settlement structure with low population density.

Table 2. RES share in the H & C sector regarding Article 23 of RED II. Own calculation based on criteria from Article 23 (1 and 2) and data from NECPs. Data source: European Commission (2019).

Member State	RES share in the H & C sector in 2020 (%) ([14])	Average annual increase in RES share in the H & C sector by 2025 (%)	Average annual increase in RES share in the H & C sector by 2030 (%)	Whether waste heat is counted	Constraints that caused Member States to not meet the requirements provided
Belgium	8.0	0.28	0.38	No	No
Bulgaria	31.3	1.40	0.9	No	No
Czechia	20.7	1.04	0.96	No	Yes
Denmark	54.0	0.80	0.4	No	No
Germany	16.0	0.72	0.92	NA	No
Estonia	55.3	0.74	0.8	No	No
Ireland	7.8	1.46	1.78	No	No
Greece	30.6	1.28	1.2	NA	No
Spain	18.0	1.40	1.2	NA	No
France	26.0	1.21	1.2	NA	No
Croatia	33.3	0.34	0.32	NA	No
Italy	20.9	0.80	1.9	NA	No
Cyprus	31.9 ([15])	0.73	0.78	NA	No
Latvia	53.4	0.54	0.30	No	Yes
Lithuania	50.9	2.5	0.75	No	No
Luxembourg	13.7	1.23	2.12	NA	No
Hungary	18.2	0.5	1.6	NA	No
Malta	22.0	0.5	0.24	NA	Yes
Netherlands	8.0	0.5 ([16])	0.5	NA	No
Austria	36.5	0.32	0.5	NA	No
Poland	17.4	1.06	1.14	NA	No
Portugal	34.0	0.4	0.4	No	Yes
Romania	25.2	0.82	0.74	NA	Yes
Slovenia	36.4	0.18	0.82	NA	No
Slovakia	12.5	0.72	0.58	NA	No
Finland	54.0	0.8	0.56	No	No
Sweden	69.2	0.56	0.04	Yes	No

NB: Member States that do not meet the requirements of Article 23 are highlighted in red, whereas those that meet the requirements are highlighted in green. NA - not available.

([14]) RES share in final energy consumption for H & C.
([15]) Interpolated value (the original value was given for 2021, and it amounts to 32.6 %).
([16]) Calculated for the period 2021–2030 (data for 2025 are not provided).

Czechia, Latvia, Malta, Portugal and Romania provided information on the constraints that caused them not to meet the requirements (see the list below). Looking at the fuel mix for H & C, planned policy measures, ambiguity in scenario calculation and data used, we identified the barriers that might influence a slow increase in RESs in the H & C sector. These barriers are as follows.

- **Natural gas as an alternative to coal.** The projected low share of RESs in Bulgaria may be attributed to the country's shift from coal to natural gas. In Czechia, natural gas is further promoted and seen as an alternative to coal. Poland's policy objectives suggest that the use of natural gas is an important alternative to coal.
- **Natural gas as the most cost-effective investment.** In Romania, the calculation assumptions considered the most cost-effective investments to cover the national heat demand, which is natural gas. That is why the use of natural gas in heating processes is expected to increase.
- **Reduction in biomass due to energy efficiency improvements.** In Latvia, the reduction in energy consumption due to the renovation of buildings using old decentralised solid biomass boilers is identified as a constraint that caused the country not to meet the requirements.
- **Untapped potential.** Bulgaria has high geothermal energy potential. However, scenarios show a slow increase in geothermal use by 2030. The country promotes studies mapping the potential and analysing the utilisation of geothermal.
- Ambiguity in scenario calculation.
  - Portugal does not include consumption by heat pumps in its calculation of the share of RESs in the TFEC for H & C. This can result in the country not meeting the targets specified in Article 23 of RED II. It is said that Portugal will revise these numbers by considering ambient heat for heat pumps.
  - Denmark has defined the political measures for the period until 2024, but it is not clear what will happen afterwards. Clarification is needed as to how the period after 2024 was calculated and whether the same political measures apply.
  - Similarly, the analysis of France ends in 2028.
- **RESs in the H & C sector are already high.** Romania's NECP states that the share of RESs in the H & C sector is already relatively high. It was estimated at 25.6 % in 2020.
- **Lack of statistics for biomass consumption.** In Romania, the national statistics on biomass are incomplete. Houses in rural areas use firewood, which is difficult to count.
- **Lack of indigenous resources and infrastructure.** In Malta, the lack of a natural gas distribution system on the Maltese territory excludes the option of blending biogas. The country has no sources of indigenous biomass.
- **The dispersion of housing**/inhabitants in Romania's rural areas is a constraint.
- **Misunderstanding of definitions.** The definition of waste heat is not clear in the directives. Croatia assumed that co-generated heat is waste heat, which in most cases is not correct. The Commission should clarify the definition of waste heat and cold.

2.4. Renewable energy technologies

To estimate the contribution of renewable technologies in achieving the sectorial trajectories for renewable energy from 2021 to 2030, we assess the estimated trajectories by renewable energy technology provided by Member States in their NECPs. First of all, we estimate data for 2018, which were obtained from the SHARES tool. For 2030, we take the TFEC in the H & C sector by RESs in 2030, as given in the countries' sectorial trajectories, and the FEC by renewable technologies.

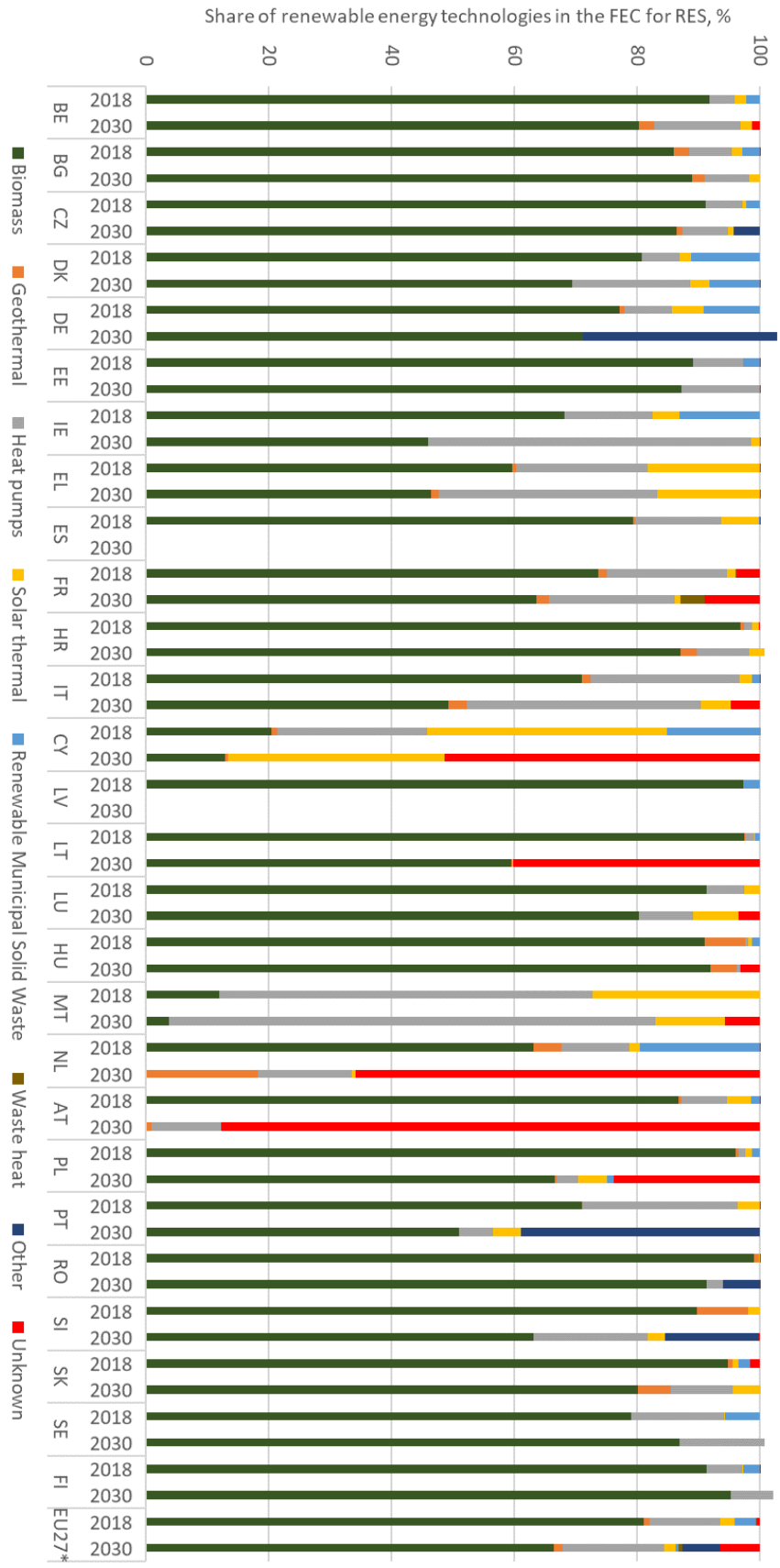
Biomass was the dominant renewable fuel in all Member States in 2018. According to the SHARES tool data (Eurostat), the use of biomass in the H & C sector amounted to 79 975 ktoe in 2018, which is 81 % of the total usage of RESs in this sector. The use of biomass is expected to decrease by 2030; however, with a share of 66 %, it remains the dominant technology in the EU-27 ([17]) in 2030. Heat pumps are the second most-used renewable technology, and account for the largest relative growth among RESs in the H & C sector in EU-27 over the period 2020–2030. In 2018, heat pumps provided 11 316 ktoe, which equated to 11 % of the total RESs in this sector. This amount is expected to increase to 21 130 ktoe by 2030, thereby contributing 17 % of RESs in the H & C sector. The use of solar thermal amounted to 2 414 ktoe in 2018 and the use of geothermal energy ([18]) amounted to 848.97 ktoe ([19]), which equated to 2 % and 1 % of the total usage of RESs in this sector, respectively.

To show the share of renewable technologies contributing to the total H & C sector trajectories for renewable energy, we introduce an 'unknown' category (see Figure 2), which serves as residual (the difference between the TFEC for renewable H & C and the sum of FEC by specific renewable H & C technologies). This discrepancy could be interpreted as resulting from a lack of data, since some Member States focused on the main technologies to be relied on to reach the sectorial target.

In some Member States, the sum of the individual RES technologies is slightly higher than TFEC in the H & C sector by RESs.

([17]) Data for Spain and Latvia are not included (no data found in the NECPs).
([18]) Excluding low-temperature geothermal heat in heat pump applications.
([19]) Excluding Czechia, Denmark, Estonia, Ireland, Latvia, Luxembourg, Malta and Finland (data for these countries were not provided).

Figure 2. Share of renewable energy technologies for H & C in 2018 and 2030 in the EU-27. Data sources: European Commission (2019), Eurostat (2018).



*Data for 2030 are not available for Spain and Latvia.

Biomass

Biomass was the dominant renewable fuel in all Member States in 2018, except in Cyprus and Malta. In the following Member States, biomass made up more than 90 % of the TFEC by renewables in the H & C sector: Romania (99 %), Lithuania (98 %), Latvia (97 %), Croatia (97 %), Poland (96 %), Belgium (92 %), Hungary (91 %), Finland (91 %), Czechia (91 %), Luxembourg (91 %) and Slovenia (90 %).

In 2030, biomass remains the dominant renewable H & C technology. The following countries expect to reach a share higher than 80 %: Finland (95 %), Hungary (92 %), Romania (91 %), Bulgaria (89 %), Czechia (87 %), Estonia (87 %), Croatia (87 %), Sweden (87 %), Belgium (80 %), Luxembourg (80 %) and Slovakia (80 %).

In most of the Member States, biomass consumption is estimated to increase by 2030, except in Italy, Lithuania, Portugal, Slovenia and Slovakia. In Lithuania and Slovakia, the use of biomass increases until 2020, but it is expected to decrease thereafter. The projections for Denmark show an increase from 2020 to 2025 and a decrease after 2025.

The highest predicted increase in biomass consumption is in Hungary, Luxembourg, Bulgaria and France. From 2020 to 2030, the use of biomass is expected to increase by 40 %, 39 %, 36 % and 33 % in these countries, respectively.

Heat pumps

In 2018, ambient energy from heat pumps made up more than 20 % of the total RESs in the H & C sector in the following countries: Malta (61 %), Portugal (25 %), Cyprus (24 %), Italy (24 %), Greece (21 %) and France (20 %).

In 2030, the share of heat pumps is the highest in Cyprus (90 %), Malta (79 %), Italy (38 %) and Greece (36 %). Meanwhile, all countries expect to see an increase in FEC by heat pumps over the period 2020–2030. The highest increase can be seen in Spain (1 046 %), followed by Hungary (467 %), Belgium (234 %) and Poland (195 %). However, the highest FEC in 2030 is in Italy (5 700 ktoe), followed by France (4 500 ktoe) ([20]).

It should be noted that there is no common European accounting methodology for renewable cooling yet. Therefore, it is likely that some Member States will update the amount of ambient energy from heat pumps for cooling later.

Solar thermal

The highest share of solar thermal in total RESs in the H & C sector in 2018 was in Cyprus (38.9 %), followed by Malta (27.3 %) and Greece (18.3 %). Germany had the highest consumption of solar thermal in 2018 (763 ktoe), followed by Spain (324.3 ktoe) and Greece (277 ktoe).

The highest relative increases over the period 2020–2030 are seen in Denmark, Italy, Luxembourg, Poland and Slovakia.

In 2030, the highest share of solar thermal in the H & C sector is estimated to be in Cyprus (35.5 %), followed by Greece (16.7 %).

Geothermal

The highest share of geothermal in total RESs in the H & C sector in 2018 was in Slovenia (8.3 %), followed by Hungary (6.7 %) and the Netherlands (4.5 %), according to the SHARES tool. Projections for geothermal usage in 2020 and 2030 were missing for most Member States. Countries that provided data showed substantial increases from 2020 to 2030: Slovakia (689 %), Czechia (443 %), Belgium (432 %), Croatia (300 %), the Netherlands (233 %), Italy (126 %), Austria (125 %), France (95 %), Lithuania (62 %), Hungary (38 %) and Poland (10 %).

([20]) Data for Germany, Latvia and Lithuania are not included.

Municipal waste

According to data from the SHARES tool, the use of municipal waste in the H & C sector amounted to 3 889 ktoe ([21]) in 2018, which was 4 % of total RESs in the H & C sector. Two Member States, Denmark and Poland, counted municipal waste in their RESs in the H & C projection. In Denmark, municipal waste is estimated to decrease from 386 ktoe in 2020 to 369 ktoe in 2030. In Poland, there is an increase from 81.4 ktoe in 2020 to 110.5 ktoe in 2030.

2.5. District heating and cooling under Article 24 of the renewable energy directive

Member States were asked to provide, if applicable, other national trajectories and objectives, including long-term or sectorial ones (e.g. share of renewable energy in district heating, renewable energy use in buildings). Moreover, Member States were requested to describe the implementation of both Article 24(4a) and Article 24(10) of RED II if applicable. In accordance with Article 24(4a), Member States should increase the annual share of energy from renewable sources and from waste heat and cold in DHC by at least 1 percentage point for the periods 2021–2025 and 2026–2030, starting from the share in 2020. If that share in 2020 is above 60 %, the Member State may count any such share as fulfilling the average annual increase. Member States may decide not to apply Article 24(4a) if they fulfil the criteria defined in Article 24(10) (points a, b or c) of RED II. Considering all criteria from Article 24(4 and 10), we identify whether Member States meet the requirements.

To estimate the TFEC for DHC and the share of RESs, we use the national trajectories and objectives for energy in this sector. Table 3 shows data on FEC by DHC, FEC of renewables in the DHC sector, and the RES share in the DHC sector in 2018, 2020 and 2030.

Trajectories for DHC were often missing in the NECPs. Although two countries (LT, NL) estimate an increasing energy consumption over the period 2020–2030, six countries (CZ, DK, EE, PL, FI, SE) show decreasing energy consumption. This decrease is mainly due to efficiency improvements in the building stock and district heating networks.

Member States were asked to provide information on gross final consumption of waste heat and cold from DHC. These data were not provided for most of the countries. However, some countries mentioned that they intend to exploit waste heat for district heating.

Three Member States provided targets for RES use in the DHC sector: Estonia, Lithuania and Poland.

([21]) Excluding Ireland, Greece, Croatia, Malta, Portugal and Slovenia (data for these countries were not provided or are equal to zero).

Table 3. Current and future FEC for DHC, and share of RESs in the DHC sector. Data source: European Commission (2019).

Member State	Share of DHC in TFEC for H & C (%)	FEC by DHC (ktoe)			FEC of RESs for DHC (ktoe)			RES share in the DHC sector (%)		
	2018 ([22])	2018	2020	2030	2018	2020	2030	2018	2020	2030
Belgium										
Bulgaria										
Czechia	15.4 ([23])		2 133	1 933						
Denmark	42	3 191 ([24])	3 145	2 997	1 924	2 223	2 376	60.3	70.7	79.3
Germany										
Estonia	40	625 ([25])		516	323	430	413	51.6		80
Ireland	0.8	38 ([26])								
Greece					46 ([27])	43	39			
Spain	0.15	42.5 ([28])								
France										65
Croatia					950					
Italy	7.8	830								
Cyprus				6						
Latvia		709						46.7	44.9	58.4
Lithuania	29 ([29])		915	959		656	863	67.5	71.7	90
Luxembourg						51	58			
Hungary										
Malta		0	0	0				0	0	0
Netherlands	5.1	1 380		1 810						
Austria										
Poland	6	2 342 ([30])	2 123	1 391				2 ([31])	47 ([32])/ 4 ([33])	72/29
Portugal										
Romania					54 ([34])	76	264			
Slovenia	16.2	213 ([35])			34			16.2		
Slovakia	30.9	1 767			281			15.9		
Finland	20 ([36])	2 855 ([37])		2 838 ([38])				40 ([39])	50 ([39])	75 ([39])
Sweden		4 700		4 400						

NB: Underlined elements indicate calculated number (based on number provided in the NECPs); numbers that are not underlined are values that come directly from the NECPs.

([22]) The year might vary from country to another (see the relevant footnotes).
([23]) 2020.
([24]) Interpolated value (original given for 2017).
([25]) 2017.
([26]) Calculated taking the FEC for H & C and the share of district heating in total FEC.
([27]) Interpolated value (original given for 2015).
([28]) 2017.
([29]) 2020.
([30]) Interpolated value (original for 2015).
([31]) 2015.

Only eight countries assessed or discussed Article 24(4a) in their NECPs. Based on the projections for the FEC of RESs from DHC and the criteria from Article 24(4a), we identified whether the following Member States meet the requirements:

Denmark. The RES share in DHC amounted to more than 70 % in 2020. This country automatically meets the target specified in Article 24(4a) of RED II, since its share of renewable energy in district heating was higher than 60 % in 2020.

Estonia. This Member State provides the FEC of RESs from DHC for 2018, 2020 and 2030. Its sectorial target is 80 % RESs in the DHC sector in 2030. Considering the fact that the share of RESs in the DHC sector amounted to 51.6 % in 2017, Estonia significantly exceeds the requirements of Article 24(4).

Ireland. The current share of DHC in TFEC for H & C was approximately 0.8 %, which is below the 2 % set in Article 24(10)(a) of RED II. Therefore, Ireland is not required to apply Article 24(4).

Latvia. The share of RESs in the DHC sector accounted for 46.7 % in 2018. According to the projections, the share of renewable energy in district heating will increase from 44.9 % in 2020 to 58.4 % in 2030. Hence, Latvia meets the requirements of Article 24(4a).

Lithuania. District heating plays a key role in the overall decarbonisation of the H & C sector. The country has set a target to reach 90 % renewable energy share in the total district heating sector by 2030. The share of RESs was expected to reach 71.7 % in 2020. In addition, the share of renewable energy in district heating was already higher than 60 % in 2020, meaning that Lithuania fulfils Article 24(4a).

Poland. The NECP contains different messages concerning RESs in the DHC sector. However, it says that the share of RESs in the DHC sector was 2 % in 2015 (coal made up 90 %) and is projected to increase to 29 % by 2030. It also says that the country's goal is to increase the share of renewable energy in the DHC sector to 47 % by 2020 and to 72 % by 2030. In either case, Poland meets the requirements of Article 24(4a) to increase the share by 1 percentage point annually.

Romania. This Member State did not give details of the renewable share of RESs in the DHC sector. However, according to the scenario with planned measures, the renewable energy used in district heating, with geothermal energy as source, is projected to increase from 31 ktoe in 2016 to 45 ktoe in 2030. This would not meet the requirements of Article 24(4).

Finland. Article 24(10) states that a Member State must not be required to apply paragraphs 2–9 of Article 24 if its share of high-efficiency combined heat and power (HECHP) and efficient DHC systems constitutes over 90 % of total sales of its DHC. According to Finland's current calculations, their share exceeds 90 %, which means that the country will be obliged to implement only paragraph 1 of Article 24. However, Finland still aims to increase the share of renewables and waste heat in district heating. The share of renewable energy in district heating increases from about 50 % in 2020 to around 75 % in 2030 (including waste heat).

([32]) Target.
([33]) Projected value (scenario with additional measures).
([34]) Interpolated value (original for 2016).
([35]) 2017.
([36]) Total sales of district heating are taken into calculation.
([37]) 2017; total sales of district heating.
([38]) Total sales of district heating.
([39]) Including waste heat in DHC.

2.6. Co-generation of heat and power

Countries must provide trajectories for heat generation from combined heat and power (CHP) plants, and the current potential for the application of HECHP and efficient DHC in accordance with Article 14(1) of Directive 2012/27/EU (European Union, 2012). The information provided by Member States is summarised in Table 4.

According to the NECPs, heat generation from CHP plants is expected to increase in Czechia, Estonia, Luxembourg, Portugal, Slovakia and Slovenia. Less generation is expected in Denmark, Germany, Spain, the Netherlands, Austria and Finland. Malta expects a stable development of heat generation from CHP plants until 2030. Other Member States did not provide estimations of the potential for new CHP, but supporting measures for new installations were mentioned in Bulgaria, Czechia, Greece, Latvia, Lithuania, Poland and Romania (see Section 3.5). Some countries said that they would perform the analysis in 2020 for the update on the comprehensive assessment related to energy efficiency in the H & C sector (Article 14 of the energy efficiency directive (EED)).

The reasons mentioned for a decline in heat generation from CHP vary. In Germany, electricity generation from CHP plants is expected to decline long term because of the expansion of wind and photovoltaics (PVs). Similarly, in Denmark, the percentage of district heating demand that heat generation from CHP supplies is expected to decrease from 73 % in 2012 to 63 % in 2025 because of the integration of RES electricity into the power grid. In Spain, approximately 2 400 MW of CHP will exceed its regulatory useful life by 2030. A supporting measure is envisaged during the period 2021–2030, which boosts high-efficiency co-generation of 1 200 MW. In Finland, almost 70 % of heat supply in district heating was based on CHP in 2017. Owing to the ban on coal in energy production, coal CHP plants will mainly be replaced by heat-only boilers using biomass. In the Netherlands, the deployment of centralised CHP is expected to decrease because of unfavourable competitive position, but decentralised CHP in industry and horticulture are expected to continue to be profitable until 2030. In 2017, CHP plants provided about 4.3 Mtoe of heat in the Netherlands. This is expected to decline to 3 Mtoe by 2030. According to the Austrian NECP, HECHP is already widely used in Austria. Heat generation from CHP plants accounted for 17 083 GWh ([40]) in 2020 and is expected to account for 16 368 GWh ([41]) in 2030.

Table 4. Current potential for the application of HECHP plants and projections of heat generation from CHP plants in the EU-27. Data source: European Commission (2019).

Member State	**Current potential for HECHP**	**Heat generation from CHP**		
		Current	**2020**	**2030**
Belgium	187 MW_e (Flanders) 428 MW_e (Wallonia)		1 929 ktoe	2 021 ktoe
Bulgaria	1.1 ktoe/year (technical potential)			214 ktoe
Czechia		11 777.6 MWe and 24 551 MWth (installed capacity), 10 230.8 GWh (gross electricity production), 103 620.3 TJ (equal to 28 783 GWh) (useful heat supply)		CHP substitution 230 MW_e, CHP under new sold heat, biogas and waste heat recovery 153 MW_e, CHP to complement/replace heat plants 275 MW_e, micro CHP 30 MW_e

([40]) Waste heat from industry is also included.
([41]) Waste heat from industry is also included.

Member State	Current potential for HECHP	Heat generation from CHP		
		Current	2020	2030
Denmark	22 TWh (1 892 ktoe) in 2015 and 25 TWh (2 150 ktoe) in 2020 (CHP economic potential, as per Article 4(1) for the years 2015 and 2020)		2 210 ktoe	1 870 ktoe
Germany	244 TWh (CHP electricity generation, economic potential, estimated in 2014)		10 300 ktoe	10 500 ktoe
Estonia	62.1 MW_{th} (CHP thermal capacity, economic potential in accordance with Article 14(1) of the EED)			600 MW_e (target)
Ireland				
Greece		234.7 MW_e (capacity in 2015, according to the comprehensive assessment under Article 14)	3.7 ktoe	3.4 ktoe
Spain				
France	0.99 Mtoe (economic potential; analysis for 2015 from Article 14 of the EED is still relevant; it will be updated in 2020)			Between 260 and 460 ktoe predicted by 2028 (analysis for 2015 from Article 14 of the EED)
Croatia	Conservative scenario 132 ktoe, optimistic scenario 397 ktoe	211 ktoe	213 ktoe	199 ktoe
Italy	1.2 Mtoe of heat and 0.9 Mtoe of electricity (potential for HECHP; Italy is going to update this analysis in 2020)			
Cyprus	50 MW_e (economic potential)			
Latvia		326 GWh electricity and 527 GWh (45 ktoe) heat; the share of co-generation in the district heating sector was 72.6 % in 2017		
Lithuania		1 600 MW (total installed capacity (thermal) of efficient CHP plants in 2018) 9 582 MW (total installed capacity of heat generation in district heating systems)		
Luxembourg		326 GWh of electricity and 527 GWh (45.3 ktoe) of heat were produced using CHP technology in 2015	51 ktoe (only renewable contribution)	58 ktoe (only renewable contribution)
Hungary	Assessment regarding Article 14(1) of Directive 2012/27/EU will be updated to identify the potential		361 ktoe	520 ktoe
Malta		8 GW_e in 2015	7 GW_e	7 GW_e

Member State	Current potential for HECHP	Heat generation from CHP		
		Current	2020	2030
Netherlands		In 2017, CHP plants provided about 4.3 Mtoe of heat. Power generation from CHP is 160 PJ (3 820 ktoe) in 2017	The heat generation from CHP to DHC was expected to cover 95 % of heat demand in 2020	The heat generation from CHP to DHC is expected to cover 78 % in 2030
Austria			1 469 ktoe	1 407 ktoe
Poland	4.56 Mtoe (economic potential)	186 626 TJ (in 2015)		48 000 ktoe
Portugal	2 500 ktoe (supply heating sector)	7 484 GWh (electricity) 19 249 GWh (thermal energy) in 2014; for the thermal production, co-generated heat represents 36 % of the FEC (based on data from 2020)	650 ktoe	677 ktoe
Romania				
Slovakia	Economic potential for CHP was 1.16 Mtoe according to the comprehensive assessment under Article 14 of the EED	CHP suppled 984 ktoe of heat in 2014. In 2017, the installed capacity for HECHP was 1 242 MW producing 2 545 MWh of electricity	In 2025, it is expected to be 1 160 ktoe	
Slovenia		984 ktoe (heat supplied)		1 160 ktoe (in 2025)
Finland		70 % of the district heat production was based on CHP		
Sweden	The potential for CHP by 2030 is 648 ktoe, of which 62.5 % is for district heating and the rest for industry	Power production from industrial CHP is 6 TWh (516 ktoe) today		The reference scenario envisages the expansion of CHP capacity by 430 ktoe from 2021 to 2030, and industrial CHP by 516 ktoe. DHC is expected to decrease by 310 ktoe from 2011 to 2030.

3. Policies and measures

3.1. Background

The governance regulation emphasises how to meet the EU's 2030 energy and climate targets. The main objectives of the regulation are to implement integrated strategies and measures to achieve the goals (European Parliament, 2018).

This chapter describes Member States' existing and planned measures for energy efficiency and renewable H & C to achieve the 2030 goals.

3.2. National objectives and measures

We collected the existing and planned measures for the H & C sector provided in both the energy efficiency and renewable energy dimensions of the NECPs. The policies and measures of Member States and the instruments used are summarised in

Table 5 and **Table 6**. Existing measures ([55]) are measures that have already been implemented, whereas planned measures ([56]) are likely to be implemented.

Countries promote renewable H & C systems and energy efficiency improvements using the following instruments:

- economic (direct subsidies, grants, preferential loans, tax incentives),
- regulatory (building codes, RES heating obligations),
- other instruments (information, advice, capacity building, qualification, quality assurance).

A summary of the main renewable H & C measures from

Table 5 is shown in the list below. Table 5 also displays the countries in which a particular measure is implemented or discussed.

- New decentralised heating system installations, such as heat pumps, solar thermal and biomass boilers (economic instruments) (found in 17 NECPs).
- RES central heating installations, such as central boilers and high-efficiency co-generation with biomass (economic instruments) (found in 15 NECPs).
- A shift from fossil energy to RESs: replacement of a heating system using fossil energy (oil, gas, coal) with a RES heating system (centralised or decentralised) (economic instruments) (found in nine NECPs).
- Ban on fossil boilers: prohibition to install a heating system using fossil energy (oil, gas, coal) (found in seven Member States' NECPs).
- Obligation to use RESs to cover part of the energy needs of new buildings or buildings undergoing renovation (the total amount of energy or a part of the energy has to be covered by RESs in new buildings in 10 countries, and in buildings undergoing renovation in seven countries).
- Other measures: industry – measures supporting or obligating the industry companies to use RESs (found in three NECPs); communities – measures supporting or obligating communities to use RESs (found in eight NECPs); cooling – measures addressing cooling, for example relating to equipment efficiency, and RESs in cooling generation (found in seven NECPs).

Table 5. Measures and instruments addressing different sectors in the renewable energy dimension. Data source: European Commission (2019).

Member State	Measures for renewable energy									
	Economic			Regulatory			Other			
	Decentralised RESs	Centralised RESs	Shift from fossil energy to RESs	RESs in new buildings	RESs in renovation	Ban on fossil boilers	Industry	Communities	Cooling	Other
Belgium										
Bulgaria			([42])		([43])		([44])			
Czechia			([45])							
Denmark						([46])				
Germany										
Estonia										
Ireland				([47])						
Greece					([48])					
Spain										
France										
Croatia										
Italy										
Cyprus					([49])					
Latvia										
Lithuania										
Luxembourg				([50])	([51])					
Hungary										
Malta										
Netherlands						([52])				
Austria										

([42]) Bulgaria promotes the shift from coal to natural gas in the centralised energy systems.
([43]) Requirements to use RESs in buildings where this is technically possible and economically viable.
([44]) Increase the use of natural gas in industry through new gas infrastructure, and the use of alternative fuels.
([45]) Gas condensing boilers are also included.
([46]) For centralised energy systems.
([47]) Limiting the use of fossil fuel energy.
([48]) Address public buildings.
([49]) Public buildings.
([50]) Address public buildings.
([51]) Address public buildings.
([52]) New buildings cannot be connected to gas network.

Member State	Measures for renewable energy									
	Economic			Regulatory			Other			
	Decentralised RESs	Centralised RESs	Shift from fossil energy to RESs	RESs in new buildings	RESs in renovation	Ban on fossil boilers	Industry	Communities	Cooling	Other
Poland				([53])						
Portugal									([54])	
Romania										
Slovenia										
Slovakia										
Finland										
Sweden										

NB: green indicates existing measures ([55]) that are described in detail; red indicates existing measures that lack detailed information; the diagonal line across a cell indicates planned measures ([56]); white means that no measure found was found).

Table 6 presents the following measures addressing energy efficiency improvements, as well as the countries in which a particular measure is implemented or discussed:

- building renovation: economic instruments supporting building thermal renovation in relation to both residential and non-residential buildings (found in 21 NECPs);
- boiler modernisation or replacement: decentralised heating boiler or boiler system (e.g. pipes) modernisation and/or high-efficient boiler installation (found in 11 NECPs);
- centralised energy system renovation or construction: economic instruments supporting centralised heating system (boilers, district heating network) modernisation and/or high-efficiency boiler installation (found in 14 NECPs);
- building codes addressing new buildings and building renovation: nearly zero-energy building (NZEB) standards obligation for new buildings; obligation to implement ambitious or NZEB standards for buildings undergoing thermal renovation (NZEB requirements for new buildings found in 11 countries' NECPs, and NZEB requirements for buildings undergoing renovation found in five countries' NECPs);
- renovation of centralised heat supply: obligation to modernise old centralised system to achieve a certain level of efficiency (e.g. Lithuania is updating the regulation framework pledging heat supply companies to undertake retrofitting and/or replacing old biofuel boilers) (found in four NECPs);
- industry: instruments supporting or obligating industry companies to increase the energy efficiency of industrial processes and reuse energy waste from industry (found in 12 NECPs);
- waste heat: instruments supporting the usage of waste heat (found in seven NECPs);
- other measures: instruments addressing other sectors in the energy efficiency dimension (found in 13 NECPs).

([53]) Newly constructed buildings are required to install an alternative heating system if they meet economic, technical and environmental criteria.
([54]) Address industrial cooling.
([55]) Existing policies and measures mean implemented policies and measures and adopted policies and measures (European Parliament, 2018b).
([56]) Planned measures mean options that are under discussion and that have a realistic chance of being adopted and implemented after the date of submission of the NECP (European Parliament, 2018b).

Table 6. Measures and instruments addressing different sectors in the energy efficiency dimension. Data source: European Commission (2019).

Member State	Measures on energy efficiency								
	Economic			Regulatory			Other		
	Building renovation	Boiler modernisation/ replacement	Centralised system modernisation/ installation	New building (NZEB)	Building renovation	Centralised system renovation	Industry	Waste heat	Other
Belgium									
Bulgaria									
Czechia									
Denmark	([57])								
Germany									
Estonia									
Ireland									
Greece									
Spain									
France									
Croatia									
Italy									
Cyprus				([58])					([59])
Latvia									
Lithuania									
Luxembourg									
Hungary									
Malta									
Netherlands									
Austria									
Poland									
Portugal									
Romania									

([57]) Financial aid is given to the homeowners if they achieve a certain energy label.
([58]) Requirements for boiler efficiency.
([59]) CHP.

Member State	Measures on energy efficiency								
	Economic			Regulatory			Other		
	Building renovation	Boiler modernisation/ replacement	Centralised system modernisation/ installation	New building (NZEB)	Building renovation	Centralised system renovation	Industry	Waste heat	Other
Slovenia	([60])								
Slovakia									
Finland									
Sweden									

NB: green indicates existing measures ([55]) that are described in detail; red indicates existing measures that lack detailed information; diagonal line across a cell indicates planned measures ([56]); white means that no measure was found.

Improving thermal insulation for buildings is the most common measure in the NECPs. The instrument used is usually economic support, for example subsidies. The second most common is financial support for decentralised RES installation, for example heat pumps. Half of the countries support modernising centralised heating systems, and heating networks, as well as the installation of renewables in this sector. Eight countries intend to make use of financial incentives and five intend to make use of regulatory provisions to phase out the use of fossil fuels by replacing them with RESs. There are only a few countries that presented existing measures for energy efficiency in industry in their NECP. However, there are several countries with planned policies for this sector. Policies for waste heat were found in seven countries. However, the descriptions of these policies are vague in most cases.

It should be emphasised that the information about policies and measures provided by the Member States is often incomplete. Details about measures are often missing, such as (i) expected benefit, such as energy savings, (ii) an indicative timeline, and (iii) the source and amount of budget required.

However, several countries identified concrete objectives for the H & C sector. Some of these objectives are summarised in **Table 7**.

Table 7. Objectives for the H & C sector. Data source: European Commission (2019).

Member State	Objectives
Belgium	Phase out back-up coal in residential sector by 2030; start exit from heating oil from 2025; start exit from natural gas in 2030 (in Brussels).
Bulgaria	NA
Czechia	A minimum of 60 % of the heat supply from district heating is produced by HECHP. Significantly increase the use of waste in waste-to-energy plants to achieve a high utilisation rate until 2024.
Denmark	NA
Germany	The majority of district heating generation from coal-fired co-generation plants will be eliminated by 2030.

([60]) Subsidy in relation to energy poverty.

Member State	Objectives
Estonia	Target for RESs: 11 TWh (946 ktoe) of the total heat demand must be covered by biomass by 2030. The share of RESs in district heating must reach 80 % by 2030. Target for Estonia until 2030: ≥ 40 %: share of small residential buildings from the total building stock with the energy performance indicator class being at least C or D. ≥ 50 %: share of small apartment buildings from the total building stock with the energy performance indicator class being at least C. ≥ 20 %: share of non-residential buildings from the total building stock with the energy performance indicator class being at least C.
Ireland	A shift to alternative heating sources, with 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. Retrofit social dwellings that are more than 40 years old (30 % of the social housing stock). Improvement in the energy efficiency of the building stock with a target of 500 000 existing buildings by 2030.
Greece	NA
Spain	Targets for energy renovation of buildings up to 2030: energy efficiency improvement (thermal envelope) over the decade in a total of 1 200 000 dwellings. Energy efficiency improvement (renovation of thermal heating systems and air conditioning systems) in 300 000 houses per year on average.
France	NA
Croatia	NA
Italy	NA
Cyprus	NA
Latvia	At least 2 000 residential multi-apartment buildings and at least 5 000 private homes will be renovated between 2020 and 2030. This also includes an installation of RES technologies (non-emission technologies) and a connection to the district heat network.
Lithuania	A replacement of 50 000 inefficient boilers with heat pumps or efficient district heating each year. Usage of waste heat with the yearly contribution of 0.45 TWh (15 % of the theoretical potential). Installation of new RES boilers, installed capacity 200 MW until 2030. By 2030, the target is to renovate 5 000 multi-family houses and 500 yearly (equal to an area of 750 000 m^2).
Luxembourg	Renovation objective for the existing housing stock: 3 % renovation rate at 72 % renovation depth, on average.
Hungary	By 2030, at least 200 000 households must have roof-mounted solar panels with an average power of 4 kW. Hungary's objective is to reduce the gas import ratio to close to 70 % by 2030 by reducing energy consumption and increasing domestic production.
Malta	NA
Netherlands	Cannot connect new houses to gas network from 2020, and 1.5 million homes should have switched from gas by 2030.
Austria	The target is to replace half of the existing 700 000 boilers by 2030; doubling of the 'thermal renovation rate' is envisaged for the period 2020–2030. The use of liquid fossil fuels in public buildings of the federal government and the *Länder* (owned and used) is to be phased out by 2030.
Poland	NA

Member State	Objectives
Portugal	NA
Romania	NA
Slovenia	Phasing out coal: at least 30 % by 2030 and the decision not to use coal in Slovenia according to the principles of a just transition to 2021. A ban on the sale and installation of new heating oil boilers until 2023.
Slovakia	At the latest in 2021, ban heating oil in new constructions and the sale and installation of new boilers fired with heating oil in 2023.
Finland	Phasing out the use of coal in energy production by 2029. Finland will phase out the use of fossil fuel oil in heating by the start of the 2030s.
Sweden	NA

NA – not available

3.3. Sustainability of biomass

Biomass is the largest RES contributing to the H & C trajectories for renewable energy from 2021 to 2030. This biomass, however, must be produced in a sustainable manner. Since biomass production involves activities ranging from the growing of feedstock to final energy conversion, Member States addressed the sustainability of biomass in different ways. Although RED II sets out sustainability criteria for bioenergy through different provisions, including indirect land use change, more clarification and harmonisation of information on this topic are needed in the next NECPs.

We collected pieces of information about the sustainability of biomass provided by Member States and grouped them as follows.

- **Linking to their national bioeconomy strategy and the forestry development plans.** In the Austrian NECP, it is stated that bioenergy is addressed in the national bioeconomy strategy. France refers to the national bioeconomy mobilisation strategy, which identifies three major challenges: the preservation of soil quality, and the preservation and enhancement of biodiversity. In Estonia, wood for energy is in line with the forestry development plan. In Hungary, the forest act obliges forest owners to replace their felled forests in accordance with the required minimum level of quality and time limit, thereby guaranteeing the sustainability of forests at national level and the continued provision of their various services.
- **Ensuring that the sustainability of biomass meets the criteria from RED II.** In Hungary, domestic forest management meets the criteria laid down in RED II. In Ireland, the Support Scheme for Renewable Heat includes detailed sustainability criteria in line with the RED II.
- **Promoting the use of waste and forest residues.** In Germany, bioenergy should be based more on waste and residual materials in the future. In Finland, a major share of wood fuels is derived from waste and residues, including black liquor originating from the pulp-making process and bark, sawdust and other industrial wood residues. Croatia describes three main aspects regarding the sustainability of biomass, including the collection and treatment of agricultural plantations and residues for energy use. In Greece, the use of biomass for energy or fuel production is limited in relation to the availability of residual biomass. Its use should take into account the characteristics of domestic farming activities, competitiveness and the potential for the development of supply chains.
- **Establishing certification schemes and documentation.** According to the voluntary Danish industry agreement on sustainable biomass, 90 % of the biomass used must be sustainable, and its sustainability must be documented. The remaining 10 % must also be sustainable, but there is no need for documentation. In Lithuania, bioenergy sustainability is ensured by forestry certificates showing product quality and sustainability in the whole chain from production to supply.

— **Introducing instruments promoting sustainable biomass.** Luxembourg plans to extend the European sustainability criteria to large CHP installations (> 20 MW) (the new Directive (EU) 2018/2001) and to set up criteria for biomass used in smaller CHP plants. For example, plants with a rated electrical output above 10 MW using biomass or waste wood should comply with these sustainability criteria to obtain the feed-in tariff/market premium. In the Netherlands, sustainability criteria will be developed for different types of bioenergy. Subsidies will be used to stimulate the use of sustainable biomass.

— **Increasing use of domestic biomass**. Cyprus anticipates future use of biofuels from waste. Whether it is sustainable is not discussed. In Italy, 27.5 % of the sustainable biofuels were produced domestically in 2017.

— **Sustainable management.** There is a plan for the sustainable management of biomass in Flanders and Wallonia (Belgium). In Wallonia, Belgium, most biomass is produced domestically.

— **Biogas production.** Several countries addressed domestic biogas production. In Belgium, increased biomethane use is anticipated for CHP, heat alone and the transport sector. A study shows a potential amount of 656 ktoe. It will preferably be based on the treatment of waste, and agricultural, household and industrial uses. Biogas is planned to be injected into the natural gas grid. In Croatia, an advanced biofuel market development plan is one of the measures regarding the sustainability of biomass. In Slovakia, biomethane is seen as one of the key fuels to decarbonise the H & C sector. The intention is primarily to decarbonise the district heating systems by using biomethane CHP as a fuel.

— The NECPs of Bulgaria, Spain, Latvia, Portugal and Romania did not consider the sustainability of biomass. Although the Italian NECP does not address the sustainability of bioenergy, it states that only sustainable bioenergy is included in trajectories for biomass and biofuels.

Other information on the sustainability of biomass provided by Member States:

In France, beyond the existing limit for conventional biofuels, the incorporation of biofuels from feedstock with a high risk of causing indirect land-use change (e.g. palm oil and soya beans) is limited.

The Czech NECP addresses the country's Ministry of Agriculture's strategy, which allows an increase of 20 % in the energy use of agricultural biomass by 2030. This can be achieved only under the conditions of maintaining a strategic level of agricultural production for food use. Thus, the strategy confirms that the main role of agricultural land is food security.

Imported biomass in Malta primarily includes wood pellets, fuel wood in logs or briquettes, sawdust and wood charcoal, all of which is assumed to be consumed by the residential sector for heating purposes. In 2018, 49 % of biomass imports originated from EU countries, whereas 51 % was imported from non-EU countries.

In the Netherlands, the following biomass fuels are to be applied for certain sectors: wood pellets are to be used for steam production in industry, and biomethane is to be used for CHP. The Netherlands will import a large share of the biomass fuels. They will ensure that it is sustainable.

To make the use of biomass more sustainable, Poland suggests:

— moving away from co-incineration as an inefficient way of producing electricity;

— further increasing the use of local biomass and reducing biomass imports;

— taking a new approach to using land for biomass that can be taken into account of the balancing of emissions.

Although Sweden ensures that its national biomass fuels are sustainable, it cannot ensure the sustainability of imported biomass.

Slovenia does not anticipate significant imports of wood biomass for energy needs. The use of wood biomass is aligned with the land use, land use change and forestry targets and does not reduce sinks. Slovenia sees that there is a need to ensure prudent forest management and improve the sustainable use of wood in a sustainable manner, including the following aspects.

— The largest possible share of Slovenian wood is to be processed domestically and used for maximum added-value products strengthening value chains (for energy purposes at the end of the chain).

— Green public procurement is to be based on indicators of sustainable construction by integrating timber.

The economic aspect is also important, as the use of less quality wood for industrial and energy purposes greatly improves the economics of wood-processing chains. Wood biomass is of great importance to the production of heat and electricity in district systems using the latest technologies.

3.4. Energy efficiency measures under Article 7 of the energy efficiency directive

Under Article 7 of the EED (Directive 2012/27/EU), each Member State must set up the energy obligation scheme. This scheme should ensure that energy companies deliver the cumulative annual energy end-use savings. In the period 2021–2030, Member States should achieve savings of 0.8 % of FEC, except for Cyprus and Malta, which have 0.24 % as a target. The end-use savings can be reached by establishing one or a combination of the following approaches: (i) energy efficiency obligation schemes or (ii) alternative policy measures. Alternative policy measures can include energy and CO_2 taxes, regulation or voluntary agreements, financial schemes and fiscal instruments, standards and norms, energy labels, and training and education (European Union, 2012).

In their NECPs, Member States were asked to provide the cumulative amount of energy savings to be achieved over the period 2021–2030 under Article 7(1)(b) of the EED on energy saving obligations. Moreover, Member States were requested to describe policy measures to achieve the energy saving targets under this article.

Table 8 shows the cumulative energy savings over the period 2021–2030 in all Member States, measures (for some countries four to five of the largest policy measures in terms of energy savings are shown), instruments and energy saved by the particular measure. Most of the countries provided the cumulative energy savings. Regarding measures and policies, it seems that only few countries have chosen the energy obligation scheme only. The majority of countries identified alternative measures as well.

Most of the major policies and measures in Article 7 address energy consumption reduction in the H & C sector (see Table 8). Almost all Member States include measures related to building renovation in their policy portfolios. In fact, their most important measures usually focus on energy efficiency improvements. However, several countries address energy supply as well: energy/fuel taxation (CZ, NL, SE), CO_2 pricing (DE, SE), replacement of boilers (LT) and HECHP promotion (PT).

Table 8. Cumulative energy savings for the period 2021–2030 under Article 7 of the EED, and policy measures reported in the NECPs related to Article 7, the types of instruments and related energy savings. Data source: European Commission (2019).

Member State	**Cumulative energy savings for the period 2021–2030 (Mtoe)**	**Measure**	**The types of instruments**	**Energy savings stemming from the particular measure (Mtoe)**
Belgium	7.2 in Flanders and 0.79 in Wallonia	Improve building envelopes (Flanders) Energy performance contracts (Flanders) (The role of H & C policies and measures in Article 7: the majority of measures are related to H & C sector (Flanders))	Economic	1.1 4.7
Bulgaria	4.4	Energy savings obligation scheme	Regulatory	

Member State	Cumulative energy savings for the period 2021–2030 (Mtoe)	Measure	The types of instruments	Energy savings stemming from the particular measure (Mtoe)
		Alternative measures: supporting renovation of apartment buildings setting individual targets for industry and public houses supporting energy efficiency in large companies	 Economic Economic	
Czechia	11.0	Fuel taxation New green savings Modernisation fund	Energy tax Economic	0.48 0.45 0.29
Denmark	6.4	Competitive subsidy scheme for private enterprises Competitive subsidy scheme for buildings Efficiency of existing buildings by other measures	Economic Economic	0.98 0.24 0.66
Germany	95.5	CO_2 pricing for the transport and heating sectors Renovation of existing buildings Tax incentives for energy-efficient building refurbishment Federal funding for energy-efficient buildings	CO_2 tax Regulatory Financial Economic	17.0 13.7 3.0 7.3
Estonia	0.3	Reconstruction of public sector and business buildings Reconstruction of private residences and apartment buildings		
Ireland	5.2	Obligation scheme on energy suppliers and distributors A range of alternative measures	Regulation	
Greece	7.3	Energy efficiency obligation scheme Energy upgrading of residential buildings Energy upgrading of public buildings Energy upgrading of third sector Energy efficiency improvement Energy managers in public buildings	Regulation	7.3 2.9 0.21 0.43 0.2 1.04
Spain	36.8	Energy efficiency obligation scheme Energy Efficiency National Fund (economic support, technical assistance, training and information) Total savings	Financial, economic	 0.67/year
France	62.8	Energy savings certificates		62.8

Member State	Cumulative energy savings for the period 2021–2030 (Mtoe)	Measure	The types of instruments	Energy savings stemming from the particular measure (Mtoe)
Croatia	2.95	Energy efficiency obligation scheme Other measures	Regulatory	50 % of total cumulative savings
Italy	51.0	White certificates Tax reduction on energy efficiency measures Thermal account National energy efficiency fund		12.3 18.5 3.9 4.1
Cyprus	0.24	Energy efficiency obligation scheme Individual energy efficiency interventions and energy efficiency retrofits in selected governmental buildings Promoting energy efficiency renovation in dwellings Energy efficiency investments in the residential and public sectors and energy audits in small and medium-sized enterprises	Regulatory Economic Economic Economic	0.10 0.02 0.03 0.04
Latvia	1.76	—		
Lithuania	2.3	Renovation of multifamily houses Renovation of public buildings Replacement of old boilers Modernisation of heating and hot water systems Renovation of individual houses		0.47 0.05 0.95 0.05 0.06
Luxembourg	NA	Energy savings obligation scheme Alternative schemes will be possibly used in the future	Regulation	
Hungary	7.9	Tax reduction for energy efficiency investments Obligation scheme requiring companies to put in place schemes and measures to deliver energy savings Energy efficiency investments in buildings carried out by energy service companies	Financial Regulation	
Malta	0.62	Electricity tariffs supporting energy efficiency Energy performance contracts for public buildings		
Netherlands	13.28–16.50	Energy savings obligation Forbid connection of new houses to gas network Switch 1.5 million homes from gas by 2030		22.1

Member State	Cumulative energy savings for the period 2021–2030 (Mtoe)	Measure	The types of instruments	Energy savings stemming from the particular measure (Mtoe)
		Value added tax reduction for energy efficiency investments Increased energy tax on natural gas and tax reduction on electricity		
Austria	11.9	Energy efficiency obligation scheme Housing, energy and environmental support for the regions Environmental support scheme Renovation scheme 'renovation offensive'	Regulatory Economic Economic Economic	1.5 0.7 0.5 0.1
Poland	24.50	Energy efficiency obligation scheme		
Portugal	6.74	Promote efficient equipment High-efficiency co-generation		
Romania	10.12	Alternative policies and measures		
Slovenia	0.77	Implementation of Eco fund programmes Tax mechanisms		
Slovakia	4.12	Support energy audits Regional energy centres Voluntary energy savings agreements Thermal insulation of multiapartment buildings and installation of RESs Thermal insulation of single family houses and non-residential houses Energy savings in industry Total		0.08
Finland	13.16	Heat pumps for detached and terraced houses Total (not only H & C)		1.75 13.2
Sweden	NA	Alternative policies and measures including CO_2 and energy taxes		14.8

NA – not available

3.5. Measures addressing CHP

Various actions and measures addressing CHP were found in the NECPs. Six Member States (CZ, EE, LU, PT, SI, SK,) envisage increased heat supply from co-generation from 2020 to 2030, whereas six (DK, DE, ES, NL AT, FI) expect to see decreased heat supply (see Section 2.6). The mixed trends are due to different market conditions and national priorities.

Seven Member States (CZ, EE, EL, ES, LT, PT, RO) promote the new construction of HECHP plants and two Member States (EE, PL) aim to increase installed capacity. Germany and Finland define the timing for phasing out coal-fired CHP plants. Six Member States (BG, IE, FR, LT, LU, SK) support RESs in CHP plants. Five Member States (HR, IT, LV, LT, PL) promote increased energy efficiency through the use of CHP in district heating systems.

Promotion of new HECHP plants and increase in capacity

- Czechia has investment support for the implementation of CHP, covered by both operational and national programmes. There is a target to increase the heat supply from district heating produced by high-efficiency co-generation by 60 %.
- Estonia supports HECHP; its target is to increase total electricity generation from CHP by at least 600 MWe by 2030.
- Greece has a financial programme to promote HECHP and district cooling in the new programming period (2021–2027).
- Spain plans to add 1 200 MW of HECHP during the period 2021–2030. This will be achieved by establishing a multiannual auction.
- Lithuania supports the construction of a large new CHP plant.
- In Poland, the development of heat production from co-generation is one of the main objectives in the energy efficiency dimension, and the potential to significantly increase the production of heat is high. In the long term, heat should be produced primarily in CHP plants.
- Portugal plans to promotes HECHP based on RESs during the period 2020–2030.
- Romania is promoting HECHP through a support scheme, which was established through Government Decision No 219/2007 on the promotion of co-generation based on useful heat.

Phasing out coal-fired CHP plans

- Germany plans to phase out coal-fired CHP plants by 2030.
- Finland has adopted phasing out coal in CHP as one of its new government objectives. Finland has already adopted legislation to phase out the use of coal in energy production by 2029. A special incentive package to support replacements is under preparation. This incentive will support district heating companies in towns and cities that phase out the use of coal as early as 2025.

Supporting renewables

- Bulgaria supports increased use of biomass in existing and new CHP plants using financial and legal measures.
- Ireland has a support scheme for projects to provide additional energy from biomass technologies, including anaerobic digestions and CHP.
- France plans to achieve 0.8 GW of biomass CHP by 2028, compared with 0.59 GW in 2016, by promoting heat recovery from biomass for HECHP.
- Lithuania promotes the use of RESs for CHP heat generation by assessing the potential of solar technologies, heat pumps and heat storage in CHP systems.
- Luxembourg supports biomass use, mainly in the CHP sector in recent years.
- Slovakia wants to phase out fossil fuels from the H & C sector by supporting the use of biomass and biogas for CHP plants.

Supporting energy efficiency measures

- Croatia supports energy efficiency of district heating systems (replacing steel pipes with insulated pipes and boilers with high-efficiency CHP plants or heat pumps) using financial and organisational instruments.
- Italy supports CHP and efficient DHC, as well as the extension of networks.

— Latvia plans to promote efficiency and RESs in the centralised energy supply, as well as the construction of new CHP plants.

— Lithuania promotes the renovation of existing CHP plants and the modernisation of the network grid.

— Poland supports HECHP plants and systemic change in the district heating sector to develop efficient and low-carbon district heating. Moreover, Poland aims to replace low-energy coal power plants with the new high-efficiency plants that comply with restrictive environmental standards.

Other measures

— In Italy high-efficiency co-generation is promoted through white certificates, which are a negotiable instrument that certifies energy savings in final energy use achieved through energy efficiency interventions.

— Cyprus uses a net billing scheme for HECHP.

— In Finland, efficient co-generation competes with other generation plants in an open energy market. Energy efficiency measures for HECHP are promoted through energy efficiency agreement activities.

— In Sweden, CHP plants, which are not in the EU Emissions Trading System, pay full energy tax and full CO_2 tax on fuel for heat production.

3.6. Planned investments

Table 9 provides information about major planned investments in different areas of the H & C sector and **Table 10** the financial sources used. The information is incomplete, since many Member States did not provide detailed information about their measures.

Investments in building renovation are most prominent in many countries, followed by investments in the centralised energy supply (district heating network, CHP) and modernisation or installation of renewable decentralised heating systems (e.g. heat pumps).

Funding sources were mentioned in 22 countries' NECPs. In most of the countries, EU funds were mentioned as a possible source of finance but without details of how the funding would be split among the sectors or policies.

Member States intend to benefit from the European Structural and Investment Funds, such as the European Regional Development Fund and the Cohesion Fund. Other financial sources mentioned were:

— InvestEU,

— LIFE programme,

— Modernisation Fund,

— European Investment Bank (EIB) loans,

— private investments and green finance.

Table 9. Overview of investment needs for the period 2021-2030 (in EUR billion). Data source: European Commission (2019).

Member State	H&C ([61])	Energy efficiency	Building renovation	New buildings, NZEB	RES heat	CHP and district heating networks	Individual boiler and heating system modernisation	Phasing out fossil fuels	Other
Belgium			~40.0		3.4				
Bulgaria			4.0			0.15 and 1.6 ([62])			18.1
Czechia					0.89				0.49
Denmark			✓		✓			0.02	
Germany									
Estonia	0.35 ([63])		1						
Ireland									
Greece		11.0							
Spain		83 ([64])			92.0 ([65])				
France	3.5		35.0		8.0	0.75			
Croatia	0.08		1.73	5.1	0.4				
Italy					4.0	7.0			3.0
Cyprus	0.91								
Latvia			1.7						1.7
Lithuania						0.57			
Luxembourg					0.21 ([66])				
Hungary									0.11
Malta					0.3				
Netherlands			6.8–13.5			0.05–0.35		0.5–1.5	
Austria	29.7	0.7	16.3			1.7	8.7		
Poland		0.13				8.3			
Portugal			117.0						

([61]) Several countries identified investment needs for the H & C sector without actually specifying an area.
([62]) Total network investments (heat and electricity).
([63]) Only a part is dedicated to heating energy.
([64]) This is dedicated to the whole energy sector, not only the H & C sector.
([65]) Not only heating.
([66]) Not only H & C.

Member State	H&C ([61])	Energy efficiency	Building renovation	New buildings, NZEB	RES heat	CHP and district heating networks	Individual boiler and heating system modernisation	Phasing out fossil fuels	Other
Romania	150.0 ([67])								
Slovenia									
Slovakia			1.6			0.1	0.1		0.3
Finland						0.004			0.34
Sweden						20.0			

NB: ✓ indicates that investments for these sectors are planned

Table 10. Source of financing. Data source: European Commission (2019).

Member State	Source of financing
Belgium	Structural and investment funds, European Social Fund, common agricultural policy, LIFE programme and the EIB
Bulgaria	Structural funds, InvestEU, Modernisation Fund, EIB loans and private investments
Czechia	— Operational programme competitiveness 2021–2027 — Operational programme environment (2021–2027) — Integrated regional operational programme 2021–2027 — New green savings programme — EFEKT programme — PANEL programme — Modernisation Fund — Taxation of fuels in households — Prohibition of the operation of boilers on solid fuel 1 and 2 of the emission class
Denmark	Public and private investments
Germany	— Energy and Climate Fund — European Regional Development Fund — EU Just Transition Fund, which will be reinforced by allocations from the European Regional Development Fund and the European Social Fund
Estonia	— The state's tax revenue — EU 2014–2020 budgetary framework funds (primarily the funds of the European Regional Development Fund, the Cohesion Fund, the Connecting Europe Facility, European Agricultural Fund for Rural Development, the LIFE programme and Horizon 2020)

([67]) Total investments needed, not only for H & C.

Member State	Source of financing
	— Auctioning revenue from the EU ETS (in compliance with targets provided for in Article 10(3) of Directive 2003/87/EC117, subsection 161(4) of the Atmospheric Air Protection Act and the state budget strategy)
Ireland	The national development plan 2018–2027 sets out investment priorities of EUR 21.8 billion for climate action for the 10-year period, of which EUR 7.6 billon would come from the Exchequer. The remaining investment would be made by Ireland's semi-state companies and by the private sector.
Greece	— Domestic and international financial resources — Special account for RESs, with specific sources of economic revenue for operating support for the production of electricity from RESs — National operational programmes under the new programming period — New investment law
Spain	A very substantial part of the total investment comes from the private sector (80 % of the total); the remaining part will come from the public sector (20 % of the total). In the event of public sector investments, a part will come from the European funds.
France	National: the Heat Fund; lower value added tax; the Ecological and Solidary Transition; expenditure on energy EU: European Fund for Strategic Investments; the Connecting Europe Facility; European Agricultural Fund for Rural Development Other: crowdfunding
Croatia	European Structural and Investment Funds, European Fund for Strategic Investments, the Modernisation Fund, the Innovation Fund and funds from the ETS. National: Environmental Protection and Energy Efficiency Fund. Funding from the EIB.
Italy	NA
Cyprus	EU funds, national financing and private financing
Latvia	— State budget — Municipal budget — The EU's multiannual financial framework for 2021–2027, including the InvestEU fund, Horizon Europe, the Connecting Europe Facility and other funds
Lithuania	EU funds (European Regional Development Fund and Cohesion Fund), electricity and heat tariffs, public budgets (climate change programme, waste management programme, etc.) and municipal budgets, the Modernisation Fund, the Innovation Fund, the Connecting Europe Facility, the LIFE programme and other funds.
Luxembourg	NA
Hungary	— Cohesion Fund for the next 7-year EU budget period (2021–2027) — Use of a certain share of the proceeds from the sale of allowances during the third trading period of the EU ETS — Modernisation Fund — Horizon Europe — Connecting Europe Facility (energy infrastructure)

Member State	Source of financing
	— LIFE programme (environment) — Structural reform support programme (institutional and growth-enhancing reforms, climate and energy objectives) — Digital Europe programme (digitalisation) — InvestEU (efficient transport infrastructure, green energy and innovation) — Private financing
Malta	NA
Netherlands	National and European funds, such as the Connecting Europe Facility, the European Fund for Strategic Investments and Horizon 2020
Austria	— Public (national (federal government/*Länder*/municipalities) — EU — Private investments and green finance
Poland	— European funds for operational programmes — Norwegian Financial Mechanism — Loans from international financial institutions (e.g. World Bank, EIB, Council of Europe Development Bank) — Thermo-modernisation and Repairs Fund
Portugal	— National initiatives: green taxation; promotion of sustainable finance; development of a green bank through the development finance institution S.A. — National funding: the Environmental Fund; the Innovation Fund; funding for technology and economics; the Energy Efficiency Fund. — European sources: the LIFE programme, the cohesion policy, InvestEU, the Connecting Europe Facility, Horizon Europe, the Innovation Fund (NER 450), the InnovFin Energy Demonstration Projects, the EU Just Transition Fund and the EIB, the Macroeconomic Sustainability Fund for Energy (European Fund for Southeast Europe), the Innovation Support Fund, the blue economy initiative, and the national fund for the rehabilitation of the economy.
Romania	— Structural funds: the European Regional Development Fund and the Cohesion Fund — InvestEU — EU Just Transition Fund — Modernisation Fund — EIB loans — State budget
Slovenia	The main sources of funding are earmarked contributions and the Climate Fund. Funding is also expected from cohesion funds.
Slovakia	National: the Modernisation Fund; the Environmental Fund; the State Housing Development Fund

Member State	Source of financing
	EU: the Connecting Europe Facility; the European Regional Development Fund; the Cohesion Fund
Finland	NA
Sweden	NA

NA – not available

3.7. Impact assessment of planned measures

The impacts of planned policies and measures on renewable heat and energy efficiency improvements can be observed by comparing two scenarios: scenarios with existing measures (WEM) and scenarios with additional measures (WAM). The WEM scenario takes existing measures into account, whereas the WAM scenario also incorporates the planned measures (see Section "List of definitions").

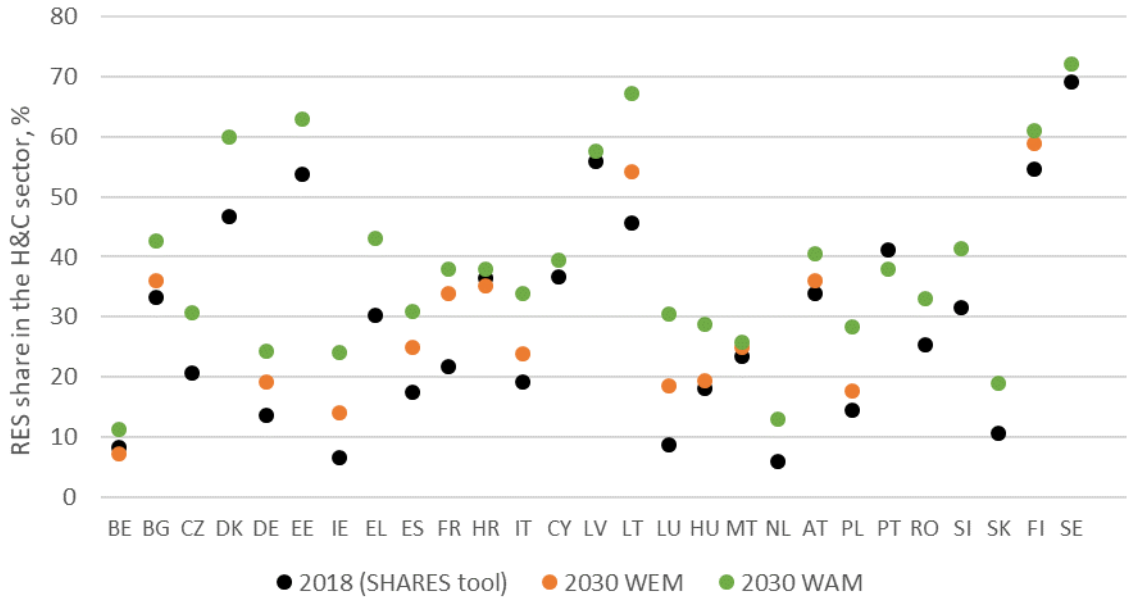
Figure 3 shows the share of renewable energy in FEC in 2018 and 2030 in the H & C sector. Two different projections are shown for 2030: the WEM projections and the WAM projections.

Planned policies and measures are expected to contribute to an increased RES share in the H & C sector by 2030 in the WAM scenario compared with the WEM scenario in investigated Member States ([68]). The level of new planned measures varies considerably between the countries. Planned policies allow RESs in the H & C sector to increase by the highest number of additional percentage points by 2030, compared with existing measures in the following countries: Lithuania (13 %), Luxembourg (11.9 %), Poland (10.7 %), Italy (10.1 %) and Ireland (10 %). Ireland and Lithuania provided good assessments of the impact of planned measures and policies, and these are presented below.

- **Ireland.** Planned policies are expected to help increase RESs in the H & C sector by an additional 10 percentage points by 2030 in the WAM scenario compared with the WEM scenario. The increase is driven by the full delivery of the Support Scheme for Renewable Heat in the non-ETS industry and services sectors, growth in the use of biogas, and the impact of the heat pump grants for homes switching from oil boilers, with the assumption that 377 000 heat pumps will be deployed in existing homes by 2030 and 178 000 will be deployed in new homes. The uptake of low-carbon heating technologies in new buildings is driven by building regulations and an effective ban on oil boilers (2022) and gas boilers (2025) in new dwellings in the WAM scenario.
- **Lithuania.** Planned policies are expected to help increase RESs in the H & C sector by an additional 13 percentage points by 2030 in the WAM scenario compared with the WEM scenario. The share of RESs in the centralised heat energy supply will increase by 30 % and reach 91 % in 2027. The highest impact will be delivered by two big new CHP constructions in Vilnius and Kaunas, accompanied by other smaller constructions / modernisation of the CHP plants. That high share of RESs would be impossible without implementation of energy efficiency measures – retrofitting of the building stock and modernisation of the decentralised heating boilers. Moreover, with planned policies, Lithuania will promote the renovation of buildings and the increase in the use of heat pumps. Its concrete objective is to replace 50 000 inefficient boilers with heat pumps or efficient district heating each year.

([68]) 12 countries were excepted because of a lack of data.

Figure 3. RES share in the H & C sector in 2018 and 2030 (WEM and WAM scenarios). Data source: European Commission (2019), Eurostat (2018).



4. Recommendations

Based on the information collected in the final NECPs – namely quantitative data, projections and qualitative data on policies and measures – and our assessment using this information and criteria from several EU directives, we provide some recommendations below. Our recommendations are meant to assist the individual EU Member States and the European Commission in increasing the quality of the next NECPs by streamlining the analyses of Member States, highlighting ambiguities in directives. The recommendations will eventually support the implementation of new measures and adapting provisions that will decarbonise the H & C sector. Neither the Commission nor Member States are obliged to implement any of these recommendations, which are the opinions of the authors of this report.

Renewable energy targets

Background. Most Member States are less ambitious in decarbonising their H & C sector in comparison with their power sector. Moreover, in the context of fulfilling Article 23(1 and 2) of RED II, to increase the share of RESs in the H & C sector by 1.3 percentage points ([69]) annually over the period 2021–2030, only nine countries met those targets.

— **Recommendation.** For the following NECP, it is essential for countries lagging behind with the implementation of renewables in the H & C sector to increase their level of ambition, given the important role of this sector in fulfilling the EU's climate and energy goals.

Constraints that caused Member States not to achieve renewable energy targets

Background. With regard to Article 23(2) of RED II, Member States must provide information as to the constraints that may have caused them not to meet the objectives, for example structural barriers arising from the high share of natural gas or cooling, or from a dispersed settlement structure with low population density. Only few countries provided such details in their NECPs.

— **Recommendation.** For the next NECPs, Member States could provide more information on the constraints that caused them not to meet the requirement of reaching the RES targets in the H & C sector. In addition, it is advised that Member States provide a detailed plan with measures to close the gap.

RES technologies contributing to the sectorial target achievement

Background. In their NECPs, Member States should provide estimated trajectories for the renewable H & C technologies from 2021 to 2030. The majority of Member States identified the renewable technology projections used in the H & C sector, but some did not. In addition, in some countries, there is a significant gap between total RES projection in the H & C sector and the projections of renewable technologies contributing to that goal. In other words, it is not clear which H & C technologies they intend to use to meet the target.

Although most of the Member States take into account biomass, geothermal, solar thermal and renewable energy from heat pumps, some countries also consider renewable municipal solid waste and heat from CHP plants.

— **Recommendation I.** It is advised that Member States identify and provide trajectories for the main RES technologies contributing to reaching the sectorial target.

— **Recommendation II.** The Commission could prepare a template to clarify the technologies and data to be included as a minimum in the next NECP.

([69]) This increase can be limited to 1.1 percentage points, 0.65 percentage points or 0.55 percentage points per year (Article 23(1 and 2)of RED II).

Co-generation of heat and power and efficient DHC

Background. Following Article 14 of the EED, Member States promote energy efficiency in the H & C sector by assessing the potential for the application of HECHP and efficient DHC, along with a cost–benefit analysis. If these assessments identify the potential for such an application, the countries must develop measures to promote HECHP, efficient DHC infrastructure and the use of waste heat.

Overall, 14 Member States identified current potential for the application of HECHP and efficient DHC. Rather than providing data, some Member States referenced the forthcoming comprehensive assessment, which was to be submitted to the European Commission by the end of 2020.

The NECPs do not show a significant expansion of DHC during the period 2021–2030. Only Belgium, Lithuania and the Netherlands expect an increasing share of heat supply from DHC. Six countries anticipate a decline in heat supply from DHC, primarily because of savings from better insulation of houses and thermal networks. The remaining countries did not provide projections.

— **Recommendation I.** As HECHP and efficient DHC are considered to be key technologies in the future energy system, it is suggested that they should be discussed as an option in the NECPs by all Member States. The Commission could facilitate the exchange of experiences and knowledge support.

— **Recommendation II.** For the next NECPs, Member States are encouraged to provide current potential and expected trajectories for the application of high-efficiency co-generation and efficient DHC in accordance with Article 14 of the EED. It should be mentioned, in case other technologies are prioritised.

— **Recommendation III.** Why CHP appears to grow in some markets whereas it declines in others should be evaluated.

— **Recommendation IV.** The contribution of CHP to targets should be clarified in future NECPs, since countries have different interpretations. For example, co-generated heat from natural gas CHP plants should not be considered waste heat and, therefore, cannot be counted towards the target specified in Article 23 of RED II. However, co-generated heat from CHP using bioenergy as fuel could be considered renewable heat and therefore be counted towards the renewable target.

Waste heat and cold, and process heat

Background. According to Article 23(2) and Article 24(4a) of RED II, Member States may count waste heat and cold when calculating their share of renewable energy in the H & C sector. Article 14 of the EED encourages countries to develop measures to promote the use of waste heat.

Most Member States did not provide information on whether waste heat and cold was counted as contributing to the H & C target. Some Member States mentioned waste heat and cold as a heat source that should be exploited but without providing figures.

Moreover, Member States were asked to provide information on gross final consumption of waste heat and cold for H & C, and gross final consumption of waste heat and cold from DHC. These data were not available for most of the countries.

— **Recommendation I.** Member States would benefit from performing more systematic studies on waste heat potential, for example as part of the comprehensive assessment in line with Article 14 of the EED. The updated NECP should describe what type of waste heat and how much waste heat will be utilised based on the identified potential.

— **Recommendation II.** The amount of waste heat and cold that will be counted as fulfilling the target for renewable energy in the H & C sector in the context of Articles 23 and 24 of RED II should be specified.

Process heat

Background. Process heat accounts for a large share of heat consumption in industry, and in the longer term it also needs to be decarbonised. This topic was not addressed in the NECPs.

— **Recommendation.** Member States are advised that the next version of the NECPs also present plans on how process heat and cold can achieve energy efficiency improvements and decarbonisation.

Heat pumps

Background. Heat pumps are one of the key technologies designed to decarbonise and increase energy efficiency in the H & C sector.

Heat pumps were addressed by all Member States, but not all Member States provided trajectories. In addition, several countries have a very limited increase in absolute numbers.

— **Recommendation I.** It is advised that all Member States provide trajectories on how heat pumps will develop in the future.

— **Recommendation II.** A deeper analysis of how to increase the use of heat pumps should be performed by Member States. Information exchange could be simplified by the Commission.

Sustainable bioenergy

Background. RED II sets out sustainability criteria for bioenergy through different provisions, including indirect land use change. However, the NECPs used many different interpretations of the sustainability of bioenergy.

— **Recommendation:** It is advised for the Commission to investigate whether further clarification of sustainable bioenergy criteria is needed.

Measures and policies

Background. Member States were asked to describe the existing and planned policies and measures that are contributing to reaching the 2030 targets.

In most cases, the description of policies and measures did not detail how much each measure would aim for in terms of energy savings or renewable heat or cold. The cost of specific measures was also not provided in many cases.

Replacing fossil fuels. To decarbonise the European H & C sector, one of the essential tasks is to replace fossil fuels, including coal, oil and natural gas, both in individual heating and in the DHC sector. Six Member States have regulatory instruments to ban fossil fuels and nine Member States have financial support to switch from a fossil fuel boiler to renewable boiler.

DHC. DHC measures mostly concerned the construction of new HECHP plants (sometimes biogas fuelled) and the improvement of thermal insulation of networks. The option to build new DHC networks was not explored much. Countries without a significant share of DHC in particular appear not to consider it as an option.

CHP. There are important differences among the countries. Although seven Member States promote the construction of new HECHP plants (mostly with economic incentives), some Member States expect a reduction in the level of importance of HECHP because of a more difficult competitive situation in some markets.

Heat pumps. These are a key technology today, and it is expected that they will be more important in the future. The NECPs' planned absolute growth in million tonnes of oil equivalent is expected to be nearly as large as biomass in the period 2020–2030. Nevertheless, in some countries such growth is expected to be significantly smaller. The measures in those countries are often focused on centralised systems and CHP.

Waste heat. Reusing waste heat from industry is another pillar in the effort to improve energy efficiency and thereby support the decarbonisation of the European H & C sector. Seven countries presented policies on waste heat from industry. Denmark, France, Lithuania and Finland identified concrete objectives for increasing the use of waste heat. Most other countries did not explore this option.

— **Recommendation I.** A plan for phasing out fossil fuels in the H & C sector could be a significant step towards decarbonising the H & C in the next NECP.

— **Recommendation II.** Member States should make greater effort to systematically look for sources of waste heat. The comprehensive assessments in line with Article 14(1) of the EED could provide the framework for this. The usefulness of the next NECPs would increase by incorporating measures to exploit waste heat and cold.

— **Recommendation III.** Analyse why increased use of HECHP was successful in some countries and not in others. Is it due to different incentives, market conditions, traditions, etc.?

— **Recommendation IV.** Some countries envisage a slow increase in the deployment of heat pumps. The Commission could facilitate an information exchange on best practices.

— **Recommendation V.** Member States should describe measures in greater detail, such as (i) expected results, (ii) an indicative timeline, and (iii) the source and amount of budget required.

Cooling

Background: Member States focused mostly on heating and much less on cooling. Since heating accounts for a significantly larger share than cooling, this could be a valid explanation for the first evaluation. However, as our climates become warmer and our demand for comfort increases, cooling will become increasingly important.

Seven countries have planned measures for increasing cooling demand. Four countries intend to support district cooling development by either amending administrative and legal frameworks or providing economic incentives. Other countries promote the development of cooling maps and shifting to renewable cooling equipment.

— **Recommendation I.** Member States should address the cooling sector more in the updated NECP and consider the anticipated increase in cooling demand.

— **Recommendation II.** A definition for renewable cooling is still missing. The Commission should prepare guidelines.

General recommendations

— **Recommendation I.** Member States often claim that some data will be updated after the final NECP report, for example their long-term renovation strategy. It would benefit future NECPs if related directives and the analyses of such directives were ready before the next NECPs. This would ensure a more complete analysis in future NECPs. The Commission could analyse whether the timing of directives serving as input to the NECPs could be better aligned with the timing of the NECPs.

— **Recommendation II:** Data collection procedures and national and Eurostat statistics should be improved to include key H & C energy streams, such as waste heat, process heat and heat pumps for cooling.

— **Recommendation III:** All Member States should have the same end year in their analyses.

— **Recommendation IV:** Require that Annex I be filled in by Member States, and expand its use to include more data. This would ensure that they cover all essential aspects of their NECP.

5. Summary and conclusions

NECPs describe strategies and measures for the period 2021–2030 designed to achieve the EU's 2030 energy and climate targets. In their NECPs, Member States addressed different areas related to the H & C sector, which allowed us to assess the status of the European H & C market and its development, as well as national actions to achieve the renewable energy and energy efficiency targets.

Our analysis shows that the current TFEC for H & C amounts to 467 Mtoe and makes up 46 % of the TFEC in the EU-27 ([70]). The renewable energy share in the H & C sector amounted to 21 % in 2018 in the EU-27.

WAM projections ([71]) show a decrease of more than 10 % in the TFEC for H & C from 2020 to 2030 in the EU-27 ([72]). The share of RESs is expected to increase in all estimated Member States ([73]) reaching 23% by 2020 and is expected to increase to 33 % by 2030.

The current shares of RESs in the H & C sector, as well as the levels of ambition to increase them over the period 2020–2030, vary considerably between the Member States. Although the contribution of renewables is above 50 % in six countries, with the highest shares projected in Sweden (69 %), Finland (54 %) and Denmark (54 %), there are nine countries whose share of RESs, in 2030, will still be smaller than 20 %. The lowest shares are projected in Belgium (8 %), Ireland (8 %) and the Netherlands (8 %).

All countries anticipate an increase in the share of renewable energy from 2021 to 2030. However, the increase is not ambitious enough in most of the countries. This is also evident when verifying compliances with Article 23 of RED II, which requires Member States, starting in 2020, to increase the annual RES share by 1.3 percentage points, if they use waste heat, or by 1.1 percentage points in the period 2021–2030. Only 9 out of 27 Member States meet the requirements. Countries were asked to identify the constraints that caused them not to meet the requirements, such as a high share of natural gas or dispersed settlement structures. However, only few countries provided these details in their NECPs.

The dominant renewable technology was biomass-heating systems, followed by heat pumps, with shares of 81 % and 11 % in 2018, respectively. Solar thermal, geothermal and renewable municipal waste contributed to 2 %, 1 % and 4 %, respectively. Although the use of biomass will increase slightly, the use of heat pumps will double over the period 2021–2030 in most of the countries. Evaluating the development of the RES share for the EU-27 was not possible because of lacking or inconsistent data. Several Member States did not explain which technologies they would employ to reach the RES target in the H & C sector.

NECPs are important documents providing an opportunity to compare Member States and link the current situation and national targets to policies and measures. For the next NECP, we recommend that Member States improve the following areas.

- Increase their level of ambition regarding the RES share in the H & C sector.
- Explain the barriers that caused them not to reach the targets set out in Article 23 of RED II.
- Specify whether waste heat and cold is counted when calculating the share of renewable energy in the H & C sector.
- Harmonise and provide details regarding measures such as (i) expected results, (ii) an indicative timeline, and (iii) the source and amount of budget required.

([70]) Calculation based on the SHAREs tool (Eurostat statistics).
([71]) WAM projections mean projections of policies and measures that have been adopted and implemented to mitigate climate change or meet energy objectives, as well as policies and measures that are planned for that purpose (European Parliament, 2018b).
([72]) Data for Spain and Latvia were not available, so these two countries are not included in the calculation.
([73]) Latvia and Spain are not included

References

European Union (2012), Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, OJ L 315, Brussels, 14.11.2012, p. 1–56.

European Union (2018a), Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable sources, OJ L 328, 21.12.2018, p. 82–209.

European Union (2018b), Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council, OJ L 328, 21.12.2018, p. 1–77.

Data sources:

European Commission (2019), 'National energy and climate plans (NECPs)' (https://ec.europa.eu/energy/topics/energy-strategy/national-energy-climate-plans_en).

Eurostat (2018), 'SHARES tool' (https://ec.europa.eu/eurostat/web/energy/data/shares).

List of abbreviations and definitions

CHP	combined heat and power
DHC	district heating and cooling
EED	energy efficiency directive
EIB	European Investment Bank
ETS	Emissions Trading System
EU	European Union
EU-27	27 Member States of the EU
FEC	final energy consumption
GEG	Gebäudeenergiegesetz (Buildings Energy Act)
H & C	heating and cooling
HECHP	high-efficiency combined heat and power
HPWH	heat pump water heater
JRC	Joint Research Centre
NECP	national energy and climate plan
NZEB	nearly zero-energy building
PV	photovoltaic
RED II	renewable energy directive
RES	renewable energy source
SWH	solar water heater
TFEC	total final energy consumption
VAT	value added tax
WAM	with additional measures
WEM	with existing measures

Member States

BE	Belgium
BG	Bulgaria
CZ	Czechia
DK	Denmark
DE	Germany
EE	Estonia
IE	Ireland
EL	Greece
ES	Spain
FR	France
HR	Croatia
IT	Italy
CY	Cyprus

LV	Latvia
LT	Lithuania
LUX	Luxembourg
HU	Hungary
MT	Malta
NL	Netherlands
AT	Austria
PL	Poland
PT	Portugal
RO	Romania
SI	Slovenia
SK	Slovakia
FI	Finland
SE	Sweden

Units

GW	gigawatt
GW_e	gigawatt electrical
GWh	gigawatt hour
kWh	kilowatt hour
Mtoe	million tonnes of oil equivalent
MW_e	megawatt electrical
MW_{th}	megawatt thermal
PJ	petajoule
TJ	terajoule
toe	tonne of oil equivalent
TWh	terawatt hour

The list of definitions is based on the governance regulation (European Union, 2018b) and RED II (European Union (2018a)).

“policies and measures” means all instruments which contribute to meeting the objectives of the integrated national energy and climate plans and/or to implement commitments under points (a) and (b) of Article 4(2) of the UNFCCC [United Nations Framework Convention on Climate Change], which may include those that do not have the limitation and reduction of greenhouse gas emissions or change in the energy system as a primary objective;

“existing policies and measures” means implemented policies and measures and adopted policies and measures;

[…]

“planned policies and measures” means options that are under discussion and that have a realistic chance of being adopted and implemented after the date of submission of the integrated national energy and climate plan or of the integrated national energy and climate progress report.

[…]

“projections with measures” means projections of anthropogenic greenhouse gas emissions by sources and removals by sinks that encompass the effects, in terms of greenhouse gas emission reductions or developments of the energy system, of policies and measures that have been adopted and implemented;

“projections with additional measures” means projections of anthropogenic greenhouse gas emissions by sources and removals by sinks or developments of the energy system that encompass the effects, in terms of greenhouse gas emission reductions, of policies and measures which have been adopted and implemented to mitigate climate change or meet energy objectives, as well as policies and measures which are planned for that purpose;

“the Union’s 2030 targets for energy and climate” means the Union-wide binding target of at least 40 % domestic reduction in economy-wide greenhouse gas emissions as compared to 1990 to be achieved by 2030, the Union-level binding target of at least 32 % for the share of renewable energy consumed in the Union in 2030, the Union-level headline target of at least 32.5 % for improving energy efficiency in 2030, and the 15 % electricity interconnection target for 2030 or any subsequent targets in this regard agreed by the European Council or by the European Parliament and by the Council for 2030;

[…]

“indicator” means a quantitative or qualitative factor or variable that contributes to better understanding progress in implementing;

[…]

“energy from renewable sources” or “renewable energy” means energy from renewable sources or renewable energy as defined in point (1) of Article 2 of Directive (EU) 2018/2001;

“gross final consumption of energy” means gross final consumption of energy as defined in point (4) of Article 2 of Directive (EU) 2018/2001;

[…]

“district heating’ or “district cooling” means district heating or district cooling as defined in point (19) of Article 2 of Directive (EU) 2018/2001;

“waste” means waste as defined in point (23) of Article 2 of Directive (EU) 2018/2001;

“biomass” means biomass as defined in point (24) of Article 2 of Directive (EU) 2018/2001;

“biogas” means biogas as defined in point (28) of Article 2 of Directive (EU) 2018/2001;

“bioliquids” means bioliquids as defined in point (32) of Article 2 of Directive (EU) 2018/2001;

[…]

“final energy consumption” means final energy consumption as defined in point (3) of Article 2 of Directive 2012/27/EU;

“energy efficiency” means energy efficiency as defined in point (4) of Article 2 of Directive 2012/27/EU;

“energy savings” means energy savings as defined in point (5) of Article 2 of Directive 2012/27/EU;

“energy efficiency improvement” means energy efficiency improvement as defined in point (6) of Article 2 of Directive 2012/27/EU;

[…]

“implementing public authority” means implementing public authority as defined in point (17) of Article 2 of Directive 2012/27/EU;

[…]

“cogeneration” means co-generation as defined in point (30) of Article 2 of Directive 2012/27/EU;

[…]

“nearly zero-energy building” means a nearly zero-energy building as defined in point (2) of Article 2 of Directive 2010/31/EU;

“heat pump” means heat pump as defined in point (18) of Article 2 of Directive 2010/31/EU;

“fossil fuel” means non-renewable carbon-based energy sources such as solid fuels, natural gas and oil.’

“waste heat and cold” means unavoidable heat or cold generated as by-product in industrial or power generation installations, or in the tertiary sector, which would be dissipated unused in air or water without access to a district heating or cooling system, where a cogeneration process has been used or will be used or where cogeneration is not feasible.

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Annexes

Annex 1. Country summaries

A1.1. Austria

The TFEC for H & C amounted to almost 13.4 Mtoe in 2018. This was 47 % of Austria's FEC ([74]).

Estimated trajectories for FEC in the H & C sector show a decrease of almost 3 % from 2020 to 2030. The share of renewable energy in FEC in the H & C sector was 34 % in 2018. A further increase from 36.5 % in 2020 to 40.6 % in 2030 is expected.

There are no projections for DHC or the RES share in DHC. According to the NECP, high-efficiency co-generation and efficient district heating are already widely used in Austria. Heat generation from CHP plants amounted to 17 389 GWh ([75]) in 2020 and is expected to amount to 16 047 GWhe ([76]) in 2030.

Table 11. FEC and RES share in the H & C sector and the district heating sector in Austria

	2018 ([77])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	13 382.9	13 260.4	13 074.8	12 909.8
RES energy consumption for H & C (ktoe)	4 547.4	4 840.1	4 981.5	5 241.4
RES share in the total energy consumption for H & C (%)	34.0	36.5	38.1	40.6
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.32	0.5
Energy consumption by district heating (ktoe)	NA	NA	NA	NA
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the Austria's NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 12 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. With a share of 87 %, biomass was the dominant technology in this sector in 2018.

Table 12. Technology contribution in the H & C sector in Austria, in ktoe (share, %)

	2018 ([78])	**2020**	**2025**	**2030**
Total biomass	3 943.2 (87)	NA	NA	NA
Geothermal	25.58 (1)	21.3 ([79])	NA	48
Heat pumps	333.6 (7)	411.4 ([80])	NA	597 ([81])
Solar thermal	180.7 (4)	NA	NA	NA
Renewable municipal solid waste	64.3	NA	NA	NA
Total	4 547.36	NA	NA	NA

([74]) Gross final consumption of energy amounted to 28.55 Mtoe in 2018 (SHARES tool 2018).
([75]) Waste heat from industry is also included.
([76]) Waste heat from industry is also included.
([77]) Eurostat SHARES tool 2018 data.
([78]) Eurostat SHARES tool 2018 data.
([79]) Interpolated value (original: 24 ktoe in 2021; and 48 ktoe in 2030).
([80]) Ambient heat. Interpolated value (given for 2021 – 430 ktoe).
([81]) Ambient heat.

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the Austria's NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The bioenergy trajectory shows an increasing demand for the period 2021–2030. Bioenergy is addressed in the national bioeconomy strategy and is considered one of the pillars of decarbonisation of the energy system.

Table 13. Bioenergy trajectories in Austria, in ktoe

	2018	**2021**	**2025**	**2030**
Bioenergy, total (including solid biomass used in district heating, biomass liquid, electricity from biomass and biomethane / synthetic methane / biogas)	4 302 ([82])	5 733	5 923	6 473
Solid biomass (including biogenic waste and alkalis in district heating)	NA	4 514	4 514	4 825

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the Austria's NECP report. Data sources: Eurostat (2018), European Commission (2019).

With regard to Article 23 of RED II, Austria must endeavour to increase the annual share of RESs in the H & C sector by 1.1 percentage points or 1.3 percentage points during the periods 2021–2025 and 2026–2030. The share of RESs in the H & C sector in 2020 was lower than 50 %. Therefore, a reduced increase rate does not apply. There is no information in the Austrian NECP on whether waste heat is counted. Looking at the scenario results, Austria does not meet the requirements. However, the country does not provide any information as to the constraints that may have caused it not to meet the requirements.

The main political measures in the building and heat sector concern thermal building renovation and renewable heat, including the following.

— A ban on oil-fired boiler installations in new buildings built after 2020. This regulation was already implemented in several regions.

— 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.

The scenarios provided show that Austria expects a reduction of 3 % in H & C demand, which indicates a rather significant effort in terms of energy efficiency. A key measure of lowering demand seems to be the doubling of the renovation rate between 2020 and 2030.

— The federal government and the *Länder* jointly developed a definition of the term 'thermal renovation rate'. Based on this definition, a doubling of the renovation rate is envisaged for the period 2020–2030.

([82]) Including electricity and H & C (Eurostat SHARES tool 2018 data).

A1.2. Belgium

The TFEC for H & C was 18 679 ktoe in 2018, which was 51 % of the country's FEC.

In the period 2020–2030, the FEC in the H & C sector is expected to decrease by 2 %.

The share of RESs in the H & C sector was 8.2 % in 2018, and it is expected to be 11.3 % in 2030. This does not meet the target specified in Article 23(1) of RED II.

Table 14. Target FEC and RES share in the H & C sector and the district heating sector in Belgium

	2018 ([83])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	18 679	NA	NA	18 336
RES energy consumption for H & C (ktoe)	1 530	NA	NA	2 072
RES share in the total energy consumption for H & C (%)	8.2	8.0	NA	11.3
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.33	0.33
Energy consumption by district heating (ktoe)	49	NA	NA	116
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from Belgium's NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

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. Wallonia identified that waste heat could provide 8 ktoe of primary energy savings.

The potential for CHP is 187 MWe in Flanders and 428 MWe in Wallonia.

The biomass trajectory shows an increase by 18.6 % until 2030. Of the total increase in RESs in the H & C sector, biomass accounts for 48 %. Heat pumps account for the largest growth among RESs in the H & C sector with 360 %. Of the total increase in RESs in the H & C sector, heat pumps account for 42 %.

Table 15. Technology contribution in the H & C sector in Belgium, in ktoe (share, % relative to absolute value of overall increase)

	2018 ([84])	**2020**	**2025**	**2030**
Total biomass	1 404	NA	NA	1 665 (48)
Geothermal	1.3	NA	NA	51 (9.2)
Heat pumps	62	NA	NA	290 (42)
Solar thermal	28	NA	NA	41 (2.4)
Waste heat	NA	NA	NA	NA
Total	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from Belgium's NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

([83]) Eurostat SHARES tool 2018 data.
([84]) Eurostat SHARES tool 2018 data.

Table 16. Bioenergy trajectories in Belgium, in ktoe

	2018	**2021**	**2025**	**2030**
Bioenergy, total	1 404	NA	NA	1 665
Solid biomass (including biogenic waste and alkalis in district heating)	1 293	NA	NA	NA
Biogas	107	NA	NA	NA
Bioliquids	5	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from Belgium's NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

There was no particular constraint that caused this Member State not to meet the requirements of the H & C trajectory set out in Article 23 of RED II. The priority was instead on decarbonising the electricity and transport sectors.

The focus of the measures is to remove fossil fuels from the H & C sector as well as improving the energy performance of buildings.

- In the non-ETS, the main 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.

A1.3. Bulgaria

The TFEC for H & C amounted to 4 Mtoe in 2018. This was 37.14 % of Bulgaria's FEC ([85]).

Estimated trajectories for FEC in the H & C sector 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. It is expected to increase from 31.27 % in 2020 to 42.6 % in 2030.

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

With respect to Article 14 of the EED, the technical potential of high-efficiency co-generation amounts to 46 627 GWh/year.

Table 17. Energy consumption and RES share in the H & C sector and the district heating sector in Bulgaria

	2018 ([86])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	4 051.7	4 069	NA	3 978
RES energy consumption for H & C (ktoe)	1 349.2	1 264	NA	1 695
RES share in the total energy consumption for H & C (%)	33.3	31.27	38.11	42.6
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			1.4	0.9
Energy consumption by district heating (ktoe)	NA	NA	NA	NA
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the Shares Tool (Eurostat); data for 2020, 2025 and 2030 is taken from Bulgaria's NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 18 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. With a share of 88 %, biomass is the dominant technology in this sector.

Table 18. Technology contribution in the H & C sector in Bulgaria, in ktoe (share, %)

	2018 ([87])	**2020**	**2025**	**2030**
Total biomass	1 160 (88.4)	1 109 (88)	NA	1 508 (89)
Geothermal	34.6 (2.6)	35 (3)	NA	35 (2)
Heat pumps	92.40 (7)	98 (8)	NA	122 (7)
Solar thermal	24.9 (1.9)	23 (2)	NA	30 (2)
Total	1 311.9	1 265	NA	1 695

NB: data for 2018 is based on the Shares Tool (Eurostat); data for 2020, 2025 and 2030 is taken from Bulgaria's NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The total bioenergy consumption is expected to increase by 20 % over the period 2020–2030. The use of biomass is expected to increase across all sectors: electricity, H & C and transport. Overall, 66 % of the total bioenergy consumption was in households in 2020. Bioenergy is expected to increase by 11 % until 2030 in this sector.

Table 19. Bioenergy trajectories in Bulgaria, in ktoe

([85]) Gross final consumption of energy amounted to 10.77 Mtoe in 2018 (SHARES tool 2018).
([86]) Eurostat SHARES tool 2018 data.
([87]) Eurostat SHARES tool 2018 data.

	2018	2020	2025	2030
Bioenergy, total	NA	1 152.2	NA	1 384.4

NB: data for 2018 is based on the Shares Tool (Eurostat); data for 2020, 2025 and 2030 is taken from Bulgaria's NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Following the conditions of Article 23(1) of RED II, the average annual increase over the periods 2021–2025 and 2026–2030 should be 1.1 percentage points, compared with 2020 (waste heat and cold are not counted). The share of RESs in the H & C sector in 2020 was lower than 50 %. Therefore, a reduced increase rate does not apply. The scenario results suggest that Bulgaria meets the requirements for the first period but will fail to meet the requirements for the second period. The main contribution to fulfilling the requirements comes from biomass. The significant increase in biomass is expected because of the development of new co-generation plants (from 4 GWh in 2020 to 2 497 GWh in 2030). The projected low share of RESs may be attributed to the country's shift from coal to gas. Moreover, although Bulgaria has high geothermal potential, its use is expected to increase only slowly until 2030. Studies analysing the potential and utilisation are promoted.

The main policies promoting an RES increase in the H & C sector are the increase in 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).

Regarding synergies with energy efficiency, there are policies addressing both energy efficiency and RESs.

- Meeting the energy efficiency targets is strategically linked to the renovation of building stock. Priority will be given to energy efficiency combined with the use of RESs.
- Increasing the energy efficiency in DHC infrastructure involves both the renovation of heat transmission networks and the replacement of old heating stations.

A1.4. Cyprus

The TFEC for H & C was 501 ktoe in 2018, which was 27 % of the country's FEC.

In the period 2021–2030, the FEC in the H & C sector is expected to increase from 583 to 604 ktoe.

The share of RESs in the H & C sector was 36.7 % in 2018, and it is expected to be 32.6 % in 2021 and 39 % in 2030. This is below the recommended increase in RESs in the H & C sector of 13 % from 2020 to 2030, as suggested by Article 23(1) of RED II. No explanation was provided.

Table 20. Target FEC and RES share in the H & C sector and the district heating sector in Cyprus

	2018 ([88])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	501	NA	NA	604
RES energy consumption for H & C (ktoe)	184	NA	NA	236
RES share in the total energy consumption for H & C (%)	36.7	31.88 ([89])	35.5	39
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.6 ([90])	0.725
Energy consumption by district heating (ktoe)	0	NA	0	6
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Overall, 6 ktoe is expected to be met using DHC by 2030. Its heat source was not discussed. The economic potential of efficient co-generation is 50 MWe.

Measures related to sustainable biomass are under investigation. Domestic production today is primarily biogas. The use of biogas from waste is envisaged. The SHARES tool data indicate a significantly higher share of biomass in the H & C sector than the trajectories provided in the NECP.

Bioenergy for H & C was expected to provide 23 ktoe by 2020 and is expected to provide 31 ktoe by 2030. The largest additional RES H & C technology contribution is from heat pumps, followed by solar thermal and then bioenergy.

Table 21. Technology contribution in the H & C sector in Cyprus, in ktoe (share, % relative to absolute value of overall increase)

	2018 ([91])	**2021**	**2025**	**2030**
Total biomass	37.7 (SHARES)	24.6	NA	30.3 (12)
Geothermal	1.6	1.4	NA	1.2
Heat pumps	45	186	NA	213 (59)
Solar thermal	72	71.2	NA	83.8 (27)
Solid waste	28	NA	NA	NA
Total	184	190	NA	236

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).

([88]) Eurostat SHARES tool 2018 data.
([89]) Interpolated value; the original value was given for 2021, and it amounts to 32.6 %.
([90]) Based on the increase from 2021, when the share was 32.6 %.
([91]) Eurostat SHARES tool 2018 data.

NA – not available

Table 22. Bioenergy trajectories in Cyprus, in ktoe

	2018	**2021**	**2025**	**2030**
Bioenergy, total	42.6	53	NA	63
Solid biomass (including biogenic waste and alkalis in district heating)	NA	NA	NA	NA
Biogas	NA	NA	NA	NA
Bioliquids	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The focus of the measures is to replace fossil-based H & C technologies and upgrade to more efficient equipment.

- Install heat pumps.
- Replace old existing equipment, such as boilers and solar thermal equipment.
- Upgrade building envelopes.
- Install CHP in public buildings.

A1.5. Czechia

The TFEC for H & C amounted to 14.1 Mtoe in 2018. This was 52.8 % of Czechia's FEC.

Estimated trajectories for FEC in the H & C sector 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 increase from 20.7 % in 2020 to 30.7 % in 2030, which shows that Czechia meets the requirements.

The energy consumption for DHC amounted to 2 133 ktoe in 2020. It is expected to decrease to 1 933.4 ktoe by 2030.

The total current installed capacity by CHP plants amounted to 11 777.6 MWe and 24 550.9 MWth in 2017.

Table 23. Energy consumption and RES share in the H & C sector and the district heating sector in Czechia

	2018 ([92])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	14 103.5	13 871.4	13 293.6	12 805.5
RES energy consumption for H & C (ktoe)	2 912.3	2 871.4	3 443.0	3 931.3
RES share in the total energy consumption for H & C (%)	20.65	20.7	25.9	30.7
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			1.04	0.96
Energy consumption by district heating (ktoe)	NA	2 133	2 041.2	1 933.4
RES share in district heating (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 24 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. With a share of more than 93 %, biomass was the dominant technology in this sector in 2020.

Table 24. Technology contribution in the H & C sector in Czechia, in ktoe (share, %)

	2018 ([93])	**2020**	**2025**	**2030**
Biomass ([94])	2 655.8	2 616 (93.2)	NA	3 401 (90.3)
Geothermal	0	7 (0.2)	NA	38 (1.0)
Heat pumps	172.8	158 (5.6)	NA	288 (7.6)
Solar thermal	20.8	25 (0.9)	NA	38 (1.0)
Renewable municipal solid waste	63	NA	NA	NA
Total	2 912.3	2 806	NA	3 765

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The total bioenergy consumption is expected to increase by almost 31 % over the period 2020–2030. Overall, 75 % of the total bioenergy was consumed in households in 2020. Bioenergy consumption plays a significant role in increasing the share of RESs.

([92]) Eurostat SHARES tool 2018 data.
([93]) Eurostat SHARES tool 2018 data.
([94]) Solid biomass and biogas.

Table 25. Bioenergy trajectories in Czechia, in ktoe

	2018	**2020**	**2025**	**2030**
Bioenergy, total	NA	3549	NA	4 665.6
Bioenergy for heating	11 1992.0	2674.9	NA	3 566.6

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Following the conditions of Article 23(1) of RED II, the average annual increase over the periods 2021–2025 and 2026–2030 should be 1.1 percentage points, compared with 2020 (waste heat and cold are not counted). The share of RESs in the H & C sector in 2020 was lower than 50 %. Therefore, a reduced increase rate does not apply. Looking at the scenario results, Czechia does not meet the requirements. Czechia claims that it is problematic to meet this indicative target because of the already relatively high share of RESs in the H & C sector (20.65 % in 2018). Natural gas is further promoted and seen as an alternative to coal.

— In the household sector, there is a scheme supporting the installation of gas condensing boilers.

— The country seeks to support the transition from smaller heat systems to multifuel systems using locally available biomass, natural gas and, if appropriate, other fuels. Gas will fulfil the role of a complementary fuel.

Regarding measures supporting an RES increase in the H & C sector, Czechia has two existing economic support schemes addressing the installation of biomass boilers and heat pumps. These schemes offer the possibility of combining the improvement in the energy performance of buildings with a greening of heating sources.

It seems that there is a limited number of policies promoting RESs in the H & C sector. Instead, Czechia is more focused on the long-term phase-out of coal in the H & C sector, and thus prioritises efficiency gains and savings. There is a target to increase the heat supply from district heating produced by high-efficiency co-generation by 60 %. There is also an investment support scheme for CHP.

A1.6. Croatia

The TFEC for H & C was 3 253 ktoe in 2018, which was 48 % of the country's FEC.

In the period 2020–2030, the FEC in the H & C sector is expected to increase by 8 %.

The share of RESs in the H & C sector was 36.5 % in 2018, and it is expected to be 36.6 % in 2030. This does not meet the target specified in Article 23(1) of RED II. The NECP does not describe wheather waste heat is counted.

Table 26. Target FEC and RES share in the H & C sector and the district heating sector in Croatia

	2018 ([95])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	3 253	3 548	3 692	3 835
RES energy consumption for H & C (ktoe)	1 188	1 182	1 266	1 350
RES share in the total energy consumption for H & C (%)	36.5	33.3	35	36.6
Average annual increase in the RES share in the H & C sector by 2025 and 2030, (percentage points)			0.34	0.32
Energy consumption by district heating (ktoe)	950	NA	NA	NA
RES share in district heating (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Heat demand in the district heating sector would increase to 130 ktoe in a conservative scenario and 400 ktoe in an optimistic scenario. The heat sources are not specified. There is no projection provided for CHP.

The biomass trajectory shows a slight increase until 2030. Heat pumps account for the largest relative growth among RESs in the H & C sector (41 %).

Table 27. Technology contribution in the H & C sector in Croatia, in ktoe (share, % relative to absolute value of overall increase)

	2018 ([96])	**2020**	**2025**	**2030**
Total biomass	1 150	1 107	NA	1 175 (40)
Geothermal	7.6	9.4	NA	37.6 (17)
Heat pumps	15.1	45.6	NA	114.1 (41)
Solar thermal	13.9	19.5	NA	33.8 (9)
Waste heat	NA	NA	NA	NA
Total	1 187	1 182	1 199	1 361

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 28. Bioenergy trajectories in Croatia, in ktoe

([95]) Eurostat SHARES tool 2018 data.
([96]) Eurostat SHARES tool 2018 data.

	2018	2021	2025	2030
Bioenergy, total	NA	NA	NA	NA
Solid biomass (including biogenic waste and alkalis in district heating)	1 139	1 107	1 114	1 175
Biogas	11.5	NA	NA	NA
Bioliquids	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

There was no particular constraint that caused this Member State not to meet the requirements of the H & C trajectory set out in Article 23 of RED II. However, Croatia claims that it meets the requirements owing to the fact that it has more than 60 % of CHP (79 %) in the district heating supply. The fuel source for the CHP is not specified. Croatia can possibly claim that waste heat from CHP should be counted. Croatia's claim that it already exceeds the 60 % share of RESs in the H & C sector appears not to be correct. In either case, they need to explain their assumption.

Most measures related to RESs in the H & C sector are a continuation of existing measures. Several measures concern advice or making plans. The most important and tangible measures are as follows.

— CO_2 emission tax for non-ETS stationary sources emitting more than 30 tonnes of CO_2 annually (economic; continuation).

— Many cities participate in the Covenant of Mayors, with the aim of reducing emissions by 40 % (voluntary; continuation).

— Measures related to the energy renovation programme for apartment buildings, single-family houses and public buildings. These include both improving thermal insulation and replacing heating systems (financial; planned).

— Increasing efficiency of district heating systems by replacing steel pipes with insulated pipes and replacing boilers with CHP (financial, organisational; planned).

There is a mix of measures covering both energy efficiency and RESs in the H & C sector. Nevertheless, the expected increase in RESs in the H & C sector from 2021 to 2030 remains very limited.

A1.7. Germany

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

The share of renewable energy in FEC in the H & C sector was 13.63 % in 2018. According to scenarios with planned measures, it is expected to increase from 16 % in 2020 to 24.2 % 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 significantly in the coming years, mainly because of the phasing-out of coal-fired CHP plants by 2030.

According to the latest estimates for 2014, the CHP electricity generation potential was expected to amount to 244 TWh (economic potential). Electricity generation from CHP plants is expected to decrease in the long term.

Table 29. FEC and RES share in the H & C sector and the district heating sector in Germany

	2018 ([97])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	109 161.7	104 004.80	93 776	87 827
RES energy consumption for H & C (ktoe)	14 877.3	15 704.7	18 473.9	20 770.2
RES share in the total energy consumption for H & C (%)	13.63	16	19.6	24.2
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.72	0.92
Energy consumption by district heating (ktoe)	NA	NA	NA	NA
RES share in the district heating sector (%)	NA	20 ([98])	25 ([98])	30 ([98])

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 30 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. In Germany, biomass plays a key role in the production of renewable energy, followed by renewable municipal solid waste and heat pumps.

It is expected that the share of biomass in the TFEC for H & C will 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.

Table 30. Technology contribution in the H & C sector in Germany, in ktoe (share, %)

	2018 ([99])	**2021**	**2025**	**2030**
Total biomass	11 489.0 (77)	NA (13.3 ([100]))	14 160.18 ([101]) (15.1 ([100]))	14 771 ([101]) (16.7 ([100]))
Geothermal	106.6 (1)	NA	NA	NA
Heat pumps	1 152.5 (8)	NA	NA	NA
Solar thermal	763.3 (5)	NA	NA	NA

([97]) Eurostat SHARES tool 2018 data.
([98]) Target value to be in line with Article 24 of RED II.
([99]) Eurostat SHARES tool 2018 data.
([100]) Biomass and renewable solid waste. This number shows the share in the total energy consumption for H & C.
([101]) Calculated using total FEC for H & C.

Renewable municipal solid waste	1 366.0 (9 %)	NA	NA	NA
Total	14 877.3	NA	NA	NA
Other renewable sources (including solar thermal, geothermal and ambient heat)	NA	(2.7 ([102]))	4 219.9 ([102]) (4.5)	6 587 ([102]) (7.5)

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The use of biomass is expected to decline in the electricity sector, whereas it will increase in the heating, cooling and transport sectors by 2030. In the future, bioenergy is to be based more on waste and residual materials.

Table 31. Bioenergy trajectories in Germany, in ktoe

	2018	**2021**	**2025**	**2030**
Bioenergy, total	NA	26 989.6	27 228.4	26 368.6
Bioenergy for heating (including biodiesel in agriculture)	NA	14 689.02	15 477.21	15 453.33

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

With regard to Article 23 of RED II, Germany must endeavour to increase the annual share of RESs in the H & C sector by 1.1 percentage points or 1.3 percentage points over the periods 2021–2025 and 2026–2030. Since the share of RESs in the H & C sector in 2020 was lower than 50 %, a reduced increase rate does not apply. The country's NECP does not contain any information on whether waste heat is counted. According to the scenario results, Germany will fail to meet the requirements in both periods. Germany does not provide any information as to the constraints that may cause it not to meet the requirements.

With respect to Article 24(4a) of RED II, Germany may increase the share of RESs in the district heating network from 20 % in 2020 to 25 % in 2025 and to 30 % in 2030. The country's NECP does not provide any projections for the RES share in district heating.

The main political measures to increase the RES share in the H & C sector can be broken down into incentives to promote renewable-based heating technologies in buildings and the decarbonisation of district heating.

In the building sector, the building subsidy programme and the Buildings Energy Act (Gebäudeenergiegesetz (GEG)) for existing buildings seem to be the major measures (based on the cumulative energy saved calculated following Article 7 of the EED).

- Federal Funding for Energy-Efficient Buildings (Bundesförderung für effiziente Gebäude (BEG)) provides financial support (investment grants and low-interest loans) for building construction and renovation, as well as heating boiler installation. This programme is designed to be open to all kinds of new technologies. Although biomass boilers have been dominant until now, this funding scheme is expected to contribute to increasing the demand for heat pumps as a result of the improvement in energy standards.
- The GEG creates a new, coordinated set of energy efficiency requirements for new buildings and existing buildings, and for the use of renewable energies for the H & C of buildings. However, the current level of requirements for new buildings and renovation remains unchanged. The review of the energy requirements for new and existing buildings in 2023 will be laid down, and a regulation on the installation of oil heating systems from 2026 will be presented.

([102]) Share in the total energy consumption for H & C.

The main drivers of the expansion of renewable energies for district heating generation are the subsidies provided by the renewable energy bonus in the “Kraft-Wärme-Kopplungsgesetzt” (CHP low), the investment grants in the market incentive programme, and the Heating Network Systems 4.0 programme, as well as its extension to promote existing networks (federal promotion of efficient heating networks), which is to be implemented from 2021.

All these measures contribute to the achievement of targets in the ‘energy efficiency’ dimension.

A1.8. Denmark

The TFEC for the H & C sector amounted to 7.6 Mtoe in 2018. This was 48.13 % of Denmark's FEC ([103]).

Estimated trajectories for FEC in the H & C sector show a decrease of 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.

The energy consumption for DHC accounted for 3 220.9 ktoe in 2018. It is expected to decrease to 2996.6 ktoe by 2030. The share of RESs in DHC was 55.1 % in 2017; it was projected to increase to 70.7 % by 2020 and is expected to increase to 79.3 % by 2030.

Heat generation from CHP plants, including industrial waste heat, will decrease from 25 705 GWhe in 2020 to 21 772 GWhe in 2030.

The economic potential for the application of high-efficiency co-generation was estimated to be 2 150 toe in 2020.

Table 32. Energy consumption and RES share in the H & C sector and the district heating sector in Denmark

	2018 ([104])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	7 644.2	7 583.5	7 639.1	7 505.0
RES energy consumption for H & C (ktoe)	3 566.7	4 095.1	4 430.7	4 503.0
RES share in the total energy consumption for H & C (%)	46.66	54.0	58.0	60.0
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.8	0.4
Energy consumption by district heating (ktoe)	3 190.7	3 144.6	NA	2 996.6
RES share in the district heating sector (%)	60.3 ([105])	70.7	NA	79.3

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 33 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. According to the projections, the use of bioenergy will increase from 2020 to 2025 and decrease after 2025. Heat pumps are the second most-used technology, followed by biomass. The use of heat pumps is expected to increase by 151 % over the period 2020–2030. As a result, heat pumps will make up almost 20 % of the total renewable energy in the H & C sector in 2030.

Table 33. Technology contribution in the H & C sector in Denmark, in ktoe (share, %)

	2018 ([106])	**2020**	**2025**	**2030**
Total biomass (bioenergy)	2 882.0 (80.8)	3 297 (80.5)	3 301 (74.5)	3 129 (69.5)
Geothermal	1.3	NA	NA	NA
Heat pumps (ambient heat)	217.9 (6.11)	345 (8.4)	633 (14.3)	866 (19.2)
Solar thermal	66 (1.85)	67 (1.6)	120 (2.7)	138 (3.07)

([103]) Gross final consumption of energy amounted to 15.79 Mtoe in 2018 (SHARES tool 2018).
([104]) Eurostat SHARES tool 2018 data.
([105]) Interpolated value (original for 2017).
([106]) Eurostat SHARES tool 2018 data.

Waste (biodegradable)	399.5 (11.2)	386 (9.4)	378 (8.5)	369 (8.25)
Total	3 566.7	4 095	4431	4 503

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Denmark has not yet set any individual objectives or targets for total bioenergy demand. Following Denmark's Energy and Climate Outlook 2019, the use of bioenergy will continue to grow from 2020 to 2025, after which consumption is expected to decrease slightly. More than half of the present bioenergy consumption is used to produce district heat and electricity, followed by bioenergy in households.

With regard to Article 23 of RED II, Denmark must endeavour to increase the annual share of RESs in the H & C sector by 0.55 percentage points for the periods 2021–2025 and 2026– 2030. Denmark may count half of the average annual increase in the RES share in the H & C sector (Article 23(1c)), and the NECP states that any contribution from surplus heat is not included. Looking at the scenario results, Denmark meets the requirements for the period 2021–2025 but does not meet them for the second period, in which the average annual increase amounts to 0.4 %. Denmark does not provide any information as to the constraints that may have caused the country not to meet the requirements. The technology mix suggests that it can be related to the decrease in the use of biomass after 2025. Another aspect is that Denmark has defined the political measures for the period until 2024, but it is not clear what will happen afterwards. Clarification is needed as to how the period after 2024 is calculated and whether the same political measures apply.

With respect to Article 24(4a) of RED II, the share of renewable energy in district heating was higher than 60 % in 2020. Therefore, Denmark fulfils this article and does not need to implement the 1 percentage point option.

The potential for CHP in Denmark has decreased since 2012 and is expected to decrease further until 2025. CHP covered 73 % of the total district heating demand in 2012 and is expected to cover 63 % in 2025. The main reason is the integration of RES-electricity sources into the electricity grid. Regarding the district cooling consumption, Denmark does not expect a dramatical growth. It is expected to reach 2 866 MW in 2030.

With regard to the main political measures to increase the RES share in the H & C sector, Denmark promotes the installation of heat pumps through the use of two instruments. The first one is an economic incentive for electric heat pumps supporting individual households, companies and district heating producers. The second instrument is an initiative to reduce the electrical heating tax to approximately DKK 0.15/kWh (2018 prices), effective from 2021.

Moreover, Denmark supports the phase-out of both natural gas (primarily in the district heating sector) and oil boilers in the individual heating sector. Natural gas is expected to be replaced by renewables in smaller district heating areas by implementing the regulatory binding on the choice of fuels (applicable from January 2019). To phase out oil boilers, there is 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.

Regarding measures supporting energy efficiency, Denmark provides 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.

A1.9. Estonia

The TFEC for H & C amounted to almost 1.6 Mtoe in 2018. This was 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.

The energy consumption for DHC amounted to 624.9 ktoe in 2018 and is expected to decrease to 515.9 ktoe by 2030.

The share of RESs in the district heating supply was 51.64 % in 2017 and is expected to reach 80 % by 2030.

With regard to the heat generation from CHP plants, the target is to increase the co-generation's total electricity power and reach at least 600 MWe by 2030.

Table 34. FEC and RES share in the H & C sector and the district heating sector in Estonia

	2018 ([107])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	1 560.8	1 548.5	NA	1 501.6
RES energy consumption for H & C (ktoe)	838	856	NA	946
RES share in the total energy consumption for H & C (%)	53.7	55.3	59	63
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.74	0.8
Energy consumption by district heating (ktoe)	624.9	NA	NA	515.9
RES share in the district heating sector (%)	51.6 ([108])	NA	NA	80

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 35 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. Biomass was the dominant technology in 2020 with a share of 90.4 %, followed by heat pumps, which made up 9.6 %. The contribution from heat pumps is expected to increase by almost 46 % from 2020 to 2030.

Table 35. Technology contribution in the H & C sector in Estonia, in ktoe (share, %)

	2018 ([109])	**2020**	**2025**	**2030**
Biomass	746.6	773.86 (90.4)	NA	825.5 (87.3)
Geothermal	NA	NA	NA	NA
Heat pumps	69.3	82 (9.6)	NA	120 (12.7)
Solar thermal	NA	NA	NA	NA
Renewable municipal solid waste	22	NA	NA	NA
Total	838.0	855.86	NA	945.5

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

([107]) Eurostat SHARES tool 2018 data.
([108]) In 2017.
([109]) Eurostat SHARES tool 2018 data.

The total bioenergy consumption amounted to almost 860 ktoe in 2018. Overall, 86 % of the total bioenergy is consumed in the heating sector. In the heating sector, biomass has been used for boilers producing thermal energy (206.36 ktoe in 2017) and CHP plants (361.14 ktoe of thermal energy and 94.58 ktoe of electrical energy in 2018).

Table 36. Bioenergy trajectories in Estonia, in ktoe

	2018	**2020**	**2025**	**2030**
Bioenergy, total	859.8	946.3	NA	957.9
Bioenergy for heating	739.5	773.86	NA	825.5

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

According to Article 23(1c) of RED II, Estonia may count half of the average annual increase. Waste heat and cold are not counted, which means that Estonia is obliged to increase its annual share of RESs in the H & C sector by 0.55 % for the periods 2021–2025 and 2026–2030. The provided trajectories suggest that Estonia is on track to meet these requirements. The main contribution comes from biomass, especially biomass in the centralised heat supply, and new heat pump installations. There are two existing policy measures contributing to the fulfilment of the requirements for increasing the RES share in the H & C sector. The first one is an economic support measure for energy production from renewables and co-generation. The second policy measure supports the transition from oil to renewable energy, as well as energy efficiency improvements in the district heating network and boilers.

Overall, Estonia identifies two main pillars in achieving the national RES targets, both of which are supposed to help lower demand: the renovation of the country's building stock and increasing the share of renewables in district heating supply. There are direct subsidies for the thermal renovation of public, commercial and private buildings. Subsidised renovation must achieve an efficiency class of at least C. The NECP does not specify whether renewable energy is part of the requirements in class C.

Estonia has identified a concrete objective for the reduction of heat loss in district heating by 2030, compared with 2012. The indicative target is 0.1 TWh. However, the concrete measure is not provided in the NECP.

A1.10. Greece

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

The share of renewable energy in FEC in the Greek H & C sector was 30.18 % in 2018. According to the NECP scenario, it is expected to increase from 30.6 % in 2020 to 43 % in 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 RESs in the DHC sector exists in specific areas in Greece where the conditions for geothermal energy and residual solid biomass are favourable.

The potential for the use of high-efficiency co-generation is not reported in the NECP. However, according to the comprehensive assessment under Article 14, the capacity amounted to 234.7 MWe in 2015. There is a financial programme to promote high-efficiency CHP and district cooling in the new programming period (2021–2027).

Table 37. FEC and RES share in the H & C sector and the district heating sector in Greece

	2018 ([110])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	5 019.2	5 754.9	NA	5 720.9
RES energy consumption for H & C (ktoe)	1 514.8	1 761	2 115	2 460
RES share in the total energy consumption for H & C (%)	30.18	30.6	37	43
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			1.28	1.2
Energy consumption by district heating (ktoe)	NA	NA	NA	NA
RES in the district heating sector (ktoe) ([111])	50.0	43.0	41.0	39.0

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 38 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. With a share of 60 %, biomass was the dominant technology in this sector in 2018, followed by heat pumps (21 %) and solar thermal (18 %). According to the NECP, the use of biomass will only slightly increase over the period 2020–2030. Renewable energy from heat pumps amounted to 410 ktoe in 2020. It is estimated that it will increase by almost 114 % until 2030. The role of heat pumps is especially significant in the tertiary sector. Renewable energy from solar thermal amounted to 296 ktoe in 2020. It is projected to increase by 39 % until 2030.

Table 38. Technology contribution in the H & C sector in Greece, in ktoe (share, %)

	2018 ([112])	**2020**	**2025**	**2030**
Bioenergy	905.0 (60)	1 035 (59)	1 087	1 142 (46)
Geothermal	8.9 (1)	21 (1)	NA	30 (1)
Heat pumps (ambient energy)	323.8 (21)	410 (23)	NA	876 (36)
Solar thermal	277 (18)	296 (17)	NA	411 (17)
Total	1 514.8	1 762	2 115	2 460

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).

([110]) Eurostat SHARES tool 2018 data.
([111]) In residential sector.
([112]) Eurostat SHARES tool 2018 data.

NA – not available

Following the conditions of Article 23(1), the average annual increase over the periods 2021–2025 and 2026–2030 should be 1.1 percentage points or 1.3 percentage points compared with 2020 (it is unclear whether waste heat and cold are counted). The share of RESs in the H & C sector in 2020 was lower than 50 %. Therefore, a reduced increase rate does not apply. Looking at the scenario results, Greece meets the requirements (as long as waste heat and cold are not counted).

The use of RES systems for H & C (mainly heat pumps and solar thermal systems) will be enhanced by combining different policy measures. The available financial tools in the new programming period (2021–2027) and the corresponding operational programmes will be designed to contribute to the promotion of economically viable RES systems addressing the final consumer. To complement this financial measure, special tax incentives for the installation of RES systems for H & C in the residential and tertiary sectors have been developed.

Moreover, Greece plans to implement financial instrument aid to develop the next period of RES district heating networks using solid biomass and geothermal energy.

There are two policy measures for H & C in the energy efficiency dimension:

- a mandatory installation of solar thermal systems in both new buildings and buildings undergoing deep renovation;
- financial programmes to promote high-efficiency CHP and district cooling in the new programming period.

A1.11. Finland

The TFEC for H & C amounted to almost 14.5 Mtoe in 2018. This was 54.6 % of Finland's FEC.

Estimated trajectories for FEC in the H & C sector show a decrease of 3.2 % from 2020 to 2030. The share of renewable energy in FEC in the H & C sector was 54 % in 2018. It is expected to increase from 54 % in 2020 to 61 % in 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. The share of RESs in DHC was 40 % in 2018; it was projected to increase to 50 % by 2020 and is expected to increase to 75 % by 2030.

Almost 70 % of the district heat production was based on CHP in 2017. There are no projections for heat generation from CHP plants, nor is the estimated potential for the application of high-efficiency co-generation specified.

Table 39. Energy consumption and RES share in the H & C sector and the district heating sector in Finland

	2018 ([113])	**2020**	**2025**	**2030**
Total energy consumption for H & C (ktoe)	14 466	14 824.1	NA	14 347.5
RES energy consumption for H & C (ktoe)	7 904.2	8 005	NA	8 752
RES share in the total energy consumption for H & C (%)	54	54	58	61
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.8	0.56
Energy consumption by district heating (ktoe)	2 854.69	NA	NA	2 837.5
RES share in the district heating sector (%)	40	50	NA	75

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 40 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. In Finland, bioenergy plays 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. The share of heat pumps was 6.5 % in 2020. The contribution of heat pumps is expected to grow until 2025 and remain at the same level over the period 2025–2030.

Table 40. Technology contribution in the H & C sector in Finland, in ktoe (share, %)

	2018 ([114])	**2020**	**2025**	**2030**
Biomass	7 222.7	7 480.7 (93.55)	8 082.5 (93.07)	8 340.5 (93.27)
Geothermal	NA	NA	NA	NA
Heat pumps	463.3	515.9 (6.45)	601.9 (6.93)	601.9 (6.73)
Solar thermal	2	NA	NA	NA
Renewable municipal solid waste	216.1	NA	NA	NA
Total	7 904.1	7 996.6	8 684.2	8 942.39

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).

([113]) Eurostat SHARES tool 2018 data.
([114]) Eurostat SHARES tool 2018 data.

NA – not available

The total bioenergy consumption was 9 286 ktoe in 2020. Between 2020 and 2030, bioenergy will increase by almost 13.88 % in all sectors. Overall, 80.55 % of the total bioenergy is used in the H & C sector.

Table 41. Bioenergy trajectories in Finland, in ktoe

	2018	**2020**	**2025**	**2030**
Bioenergy, total	NA	9 286.3	10 146.1	10 576.0

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

With regard to Article 23 of RED II, Finland must endeavour to increase the annual share of RESs in the H & C sector by 0.55 % for the periods 2021–2025 and 2026–2030. Finland may count half of the average annual increase in the RES share in the H & C sector (Article 23(1c)), and it states that any contribution from waste heat is not included. Looking at the scenario results, Finland meets the requirements for the periods 2021–2025 and 2026–2030.

The share of renewable energy in district heating is expected to increase from approximately 50 % in 2020 to approximately 75 % in 2030 (including waste heat), which shows that Finland meets the requirement of Article 24(4a) to increase this share by 1 percentage point annually.

Finland's new government identified ambitious objectives that might be the main triggers for increasing RESs in the H & C sector: phasing out coal in CHP, phasing out oil in buildings and supporting heat pumps in district heating. The concrete instruments are as follows.

- Finland has already adopted legislation to phase out the use of coal in energy production by 2029. A special incentive package to support replacements is under preparation. This incentive will support district heating companies in towns and cities that phase out the use of coal as early as 2025. Phasing out coal will have a notable impact on the district heating sector, because in Finland coal is used mainly in CHP plants. Coal CHP plants will mainly be replaced by heat-only boilers using biomass.
- The government programme envisages a stepwise phase-out of the use of oil for heating by the beginning of the 2030s. Oil heating will no longer be used in properties owned by central and local governments after 2024.
- The government programme indicates that heat pumps generating heat for district heating networks will be transferred to the lower category of electricity tax, which is mainly applied to energy-intensive industries. This change should have a positive effect on the utilisation of waste heat.

There are several measures supporting energy efficiency in buildings, such as improvements in standards and subsidies for building renovation. All of these are existing measures, and there is no information on whether these measures are effective after 2020.

In the field of DHC, improvements in the efficiency of primary energy use, more efficient utilisation of waste heat and the overall efficiency of energy production are promoted within the scope of voluntary energy efficiency agreement activities.

A1.11. France

The TFEC for H & C was 61 200 ktoe in 2018, which was 40 % of the country's FEC.

In the period 2020–2030, the FEC in the H & C sector is expected to decrease from 61.2 to 54.6 Mtoe.

The share of RESs in the H & C sector was 21.8 % in 2018, and it is expected to be 38.0 % in 2030. The increase from 2020 to 2030 is 12 %, which is 1 % below the recommended increase suggested by Article 23(1).

Table 42. Target FEC and RES share in the H & C sector and the district heating sector in France

	2018 ([115])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	61 200	NA	NA	54 600
RES energy consumption for H & C (ktoe)	13 300	NA	NA	18 700–21 200
RES share in the total energy consumption for H & C (%)	21.8	26	NA	38
Average annual increase in the RES share in the H & C sector by 2025 and 2030, (percentage points)			1.2	1.2
Energy consumption by district heating (ktoe)	NA	NA	NA	NA
RES share in the district heating sector (%)	NA	NA	NA	65

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The share of RESs 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.

It is said that the assessment performed in 2015 for new CHP is still valid, although a new assessment is due by the end of the year. In 2015, the economic potential of 0.99 Mtoe was identified.

Biomass consumption is expected to increase from 9 800 ktoe in 2018 to 13 000–14 000 ktoe in 2030. It is not known how much of this is consumed in the H & C sector. Bioenergy accounts for the largest growth among RESs in the H & C sector, followed by heat pumps.

Table 43. Technology contribution in the H & C sector in France, in ktoe (share, % relative to absolute value of overall increase)

	2018 ([116])	**2020**	**2025**	**2030**
Total biomass	9 800	NA	NA	14 000 (58)
Geothermal	187	NA	NA	450 (4)
Heat pumps	2 600	NA	NA	4 500 (26)
Solar thermal	181	NA	NA	210
Waste heat	38	NA	NA	860 (11)
Total	12 806	NA	NA	20 020

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

([115]) Eurostat SHARES tool 2018 data.
([116]) Eurostat Stool 2018 data.

Table 44. Bioenergy trajectories in France, in ktoe

	2018	**2021**	**2025**	**2030**
Bioenergy, total	13 272	NA	NA	~ 17 500
Solid biomass (including biogenic waste and alkalis in district heating)	9 261	NA	NA	14 500
Biogas	613	NA	NA	2 700
Bioliquids	3 398	NA	NA	~ 6 000

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The most important measures related to renewables and energy efficiency in the H & C sector are as follows.

- 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.

A1.12. Hungary

The TFEC for H & C amounted to almost 10.3 Mtoe in 2018. This was 53.9 % of Hungary's FEC.

Estimated trajectories for FEC in the H & C sector show a decrease of 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.

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

Projections for efficient CHP and efficient DHC are not provided.

Table 45. Energy consumption and RES share in the H & C sector and the district heating sector in Hungary

	2018 ([117])	**2020**	**2025**	**2030**
Total energy consumption for H & C (ktoe)	10 295.3	10 692.3	9 879.2	9 484.3
RES energy consumption for H & C (ktoe)	1 865.5	1 946	2 045	2 722
RES share in the total energy consumption for H & C (%)	18.12	18.2	20.7	28.7
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.5	1.6
Energy consumption by district heating (ktoe)	NA	NA	NA	NA
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 46 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. With a share of 92 %, biomass was the dominant technology in this sector in 2018. According to Hungary's NECP, the use of biomass will increase over the period 2020–2030. Energy use by heat pumps amounted to 2.4 ktoe in 2020. Although such use is expected to increase by more than 400 % by 2030, the share of heat pumps will remain rather insignificant. Energy use by geothermal energy is projected to increase by 38 % over the same period.

Table 46. Technology contribution in the H & C sector in Hungary, in ktoe (share, %)

	2018 ([118])	**2020**	**2025**	**2030**
Biomass	1 698.3 (92)	1 785.0	NA	2 504.0
Geothermal	124.2 (6.7)	84.6	NA	116.6
Heat pumps	7.9 (0.4)	2.4 ([119])	NA	13.6
Solar thermal	12.6 (0.7)	NA	NA	NA
Total	1 843.0	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The total bioenergy consumption is expected to increase by almost 30 % over the period 2020–2030. The use of biomass is expected to increase across all sectors: electricity, H & C and transport. Almost 83 % of the total bioenergy consumption was in the H & C sector in 2020.

([117]) Eurostat SHARES tool 2018 data.
([118]) Eurostat SHARES tool 2018 data.
([119]) Data source for 2020 is Hungary's NECP. Data for 2018 come from the Eurostat SHARES tool. A large difference can be seen between these two data sources.

Table 47. Bioenergy trajectories in Hungary, in ktoe

	2018	2020	2025	2030
Bioenergy, total (electricity, H & C and transport)	NA	2 305	2 429	2 981
Bioenergy for H & C	NA	1 911	1 959	2 584

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

With regard to Article 23 of RED II, Hungary must endeavour to increase the annual share of RESs in the H & C sector by 1.1 percentage points and 1.3 percentage points over the periods 2021–2025 and 2026–2030, respectively. Since the share of RESs in the H & C sector in 2020 was lower than 50 %, a reduced increase rate does not apply. The country's NECP does not contain any information on whether waste heat is counted. According to the scenario results, Hungary complies with the requirements in the period 2021–2025 but will fail to meet them in the second period. Hungary does not provide any information as to the constraints that may have cause it not to meet the requirements.

Hungary's NECP states that natural gas and biomass are the most important fuels for household energy consumption. The consumption of both fuels will increase slightly by 2030. By contrast, coal and oil consumption will almost completely disappear by 2030. Thus, the increase in gas may result in the country not meeting the requirements of Article 23 of RED II.

Unlike in the residential sector, the share of gas in district heating will drop to 50 % by 2030. Reducing the use of gas in DHC appears to be one of the primary objectives in the H & C sector. The main policy tool to achieve this goal is the green heat programme, which promotes the use of renewables (geothermal, biomass and waste) for DHC. Under this scheme, large district heating areas considering local conditions are analysed.

For individual houses, the Hungarian government has established a loan programme supporting investments in energy efficiency and renewable energy. The NECP does not provide any further information on the duration and impact of this instrument.

In the longer term, Hungary aims to increase the use of geothermal energy. Owing to its geological conditions, the country has great potential in this respect.

In the energy efficiency dimension, the modernisation of district heating and the construction of mini-heat plants, as well as the increase in the energy efficiency of buildings, will lead to significant energy savings in the H & C sector. To increase the efficiency of the district heating supply, Hungary will address district heating networks at municipality level, at which the district heating supplies to the grid reach 100 000 GJ. The NECP does not provide information about what instruments have been implemented in this field.

As far as energy efficiency is concerned, the modernisation of buildings will be carried out on a market-oriented basis under the energy efficiency obligation scheme so that the costs are not essentially borne by households and the public budget. Hungary requires energy distributors and/or retail energy sales companies to put in place schemes and implement measures that deliver certified energy savings for the end user. Energy efficiency investments in public buildings by the central budget and municipalities will be carried out using energy service company-based services.

A1.13. Ireland

The TFEC for H & C amounted to almost 4.79 Mtoe in 2018. This was 38.4 % of Ireland's FEC ([120]).

Estimated trajectories for FEC in the H & C sector show a decrease of 12 % from 2020 to 2030. The share of renewable energy in FEC in the H & C sector was 6.47 % in 2018. It is expected to increase from 7.8 % in 2020 to 24 % in 2030.

DHC in Ireland is at a very low level and 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.

There are no projections for heat generation from CHP plants, nor is the current potential for the application of high-efficiency co-generation and efficient DHC in accordance with Article 14(1) of the EED specified.

Table 48. FEC and RES share in the H & C sector and the district heating sector in Ireland

	2018 ([121])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	4 784.9	5 016.7	4 802.6	4 406.7
RES energy consumption for H & C (ktoe)	309.7	391.3	725.2	1 057.6
RES share in the total energy consumption for H & C (%)	6.47	7.8	15.1	24
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			1.46	1.78
Energy consumption by district heating (ktoe)	38.3 ([122])	NA	NA	NA
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 49 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. With a share of more than 74.2 %, biomass was the dominant technology in 2020, followed by heat pumps (22.3 %). The use of heat pumps is expected to increase by almost 541 % from 2020 to 2030.

Table 49. Technology contribution in the H & C sector in Ireland, in ktoe

	2018 ([123])	**2020**	**2025**	**2030**
Biomass and biogas	211.2	290.3	436.5	485.4
Geothermal	0	NA	NA	NA
Heat pumps	44.3	87.1	274.4	558
Solar thermal	13.5	13.9	14.1	14.1
Renewable municipal solid waste	40.7	NA	NA	NA
Total	309.7	391.3	725	1 057.5

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019). NA – not available

([120]) Gross final consumption of energy amounted to 12.46 Mtoe in 2018 (SHARES tool 2018).
([121]) Eurostat SHARES tool 2018 data.
([122]) Calculated taking FEC for heat and the estimated share of DHC of 0.8 % of heat consumption.
([123]) Eurostat SHARES tool 2018 data.

The total bioenergy consumption is expected to increase by almost 35.8 % over the period 2021–2030. Overall, 49 % of the total bioenergy was consumed for heating purposes in 2021.

Table 50. Bioenergy trajectories in Ireland, in ktoe

	2018	**2021**	**2025**	**2030**
Bioenergy for heat	251.9	309.4	436.5	485.4
Bioenergy, total (including electricity, heat and transport)	479.2	632.1	801.8	858.6

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2021, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Following the conditions of Article 23(1), the average annual increase over the periods 2021–2025 and 2026–2030 should be 1.1 percentage points, compared with 2020 (waste heat and cold are not counted). The share of RESs in the H & C sector in 2020 was lower than 50 %. Therefore, a reduced increase rate does not apply. The scenario results suggest that Ireland meets the requirements for both periods. With respect to Article 24 of RED II, the current share of DHC in TFEC for H & C is approximately 0.8 %, which is below the 2 % set out in Article 24(10)(a) of RED II. Therefore, Ireland is not required to apply Article 24(2–9).

However, Ireland is planning to increase the use of DHC in the future – a new policy framework is currently being developed to support the uptake of district heating in Ireland.

Ireland has the following objectives and targets for the heating sector.

- A shift to alternative heating sources, with a target of 600 000 heat pumps to be 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 through the introduction of new regulatory standards for home heating systems. Progressively phase out oil and gas boilers in existing dwellings through a combination of incentives, information and regulatory measures.
- Retrofitting social dwellings that are more than 40 years old (30 % of the social housing stock) to a B2-equivalent Building Energy Rating.
- Improvement in 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.

There are two main economic instruments to increase the use of renewable energy in the heating sector: 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.

There are no specific targets for DHC and HECHP plants. To support the uptake of district heating in Ireland, a new policy framework is currently being developed. There is a support scheme for projects to provide additional energy from biomass technologies, including anaerobic digestion and CHP.

A1.14. Italy

The TFEC for H & C was 55.5 Mtoe in 2018, which was 48 % of the country's FEC.

In the period 2020–2030, the FEC in the H & C sector 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 it is expected to be 33.9 % in 2030. The increase from 2020 to 2030 is 13.3 %, which is in accordance with the increase suggested by Article 23(1).

Table 51. Target FEC and RES share in the H & C sector and the district heating sector in Italy

	2018 ([124])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	55 500	53 200	49 500	44 400
RES energy consumption for H & C (ktoe)	10 700	11 000	12 200	15 000
RES share in the total energy consumption for H & C (%)	19.2	20.6	24.6	33.9
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.8	1.9
Energy consumption by district heating (ktoe)	830	NA	NA	NA
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The increase in the share of RESs in the H & C sector exceeds the target of 1.3 percentage points set out in Article 23 of RED II. No targets are available for waste heat utilisation.

The potential for new CHP was estimated at 1 500 ktoe in 2015. The assessment for CHP and DHC will be updated later this year.

Biomass consumption is expected to increase from 10 050 ktoe in 2018 to 11 000 ktoe in 2030, but it is expected to 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 %).

Table 52. Technology contribution in the H & C sector in Italy, in ktoe (share, % relative to absolute value of overall increase)

	2018 ([125])	**2020**	**2025**	**2030**
Total biomass	7 600	NA	7 100 ([126])	7 400 ([127])
Geothermal	150	NA	NA	450 (8)
Heat pumps	2 600	NA	NA	5 700 (83)
Solar thermal	220	NA	NA	750 (14)
Waste heat	NA	NA	NA	NA
Total	10 570	NA	NA	14 300

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

([124]) Eurostat SHARES tool 2018 data.
([125]) Eurostat SHARES tool 2018 data.
([126]) Target.
([127]) Target.

Table 53. Bioenergy trajectories in Italy, in ktoe

	2018	**2021**	**2025**	**2030**
Bioenergy, total	10 050	NA	NA	11 000
Solid biomass (including biogenic waste and alkalis in district heating)	7 600	NA	NA	NA
Biogas	1 750	NA	NA	NA
Bioliquids	700	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The most important measures related to renewables and energy efficiency in the H & C sector are:

- tax relief on renewable technologies in buildings;
- mandatory integration of RESs in buildings;
- white certificates;
- renovation of buildings.

A1.15. Latvia

The TFEC for H & C amounted to almost 2.46 Mtoe in 2018. This was 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 from 53.4 % in 2020 to 57.6 % in 2030.

The share of RESs in DHC was 46.7 % in 2018. According to the projections, the share of renewable energy in district heating will increase from 44.9 % in 2020 to 58.4 % in 2030, which shows that Latvia meets the requirement of Article 24(4a) to increase the share by 1 percentage point annually.

In 2018, district and local heating produced 709 ktoe of thermal energy. In total, 46.7 % of this amount was produced using RESs, with solid biomass (fuel wood) being the dominant source (93.5 %). The share of co-generation in Latvia's district heating sector was 72.6 % in 2017.

Latvia's NECP does not provide projections for CHP or the potential for this technology and efficient DHC.

Table 54. FEC and RES share in the H & C sector and the district heating sector in Latvia

	2018 ([129])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	2 459.3	NA	NA	NA
RES energy consumption for H & C (ktoe)	1 374.5	NA	NA	NA
RES share in the total energy consumption for H & C (%)	55.89 ([130])	53.4	56.08	57.59
Average increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.54	0.30
Energy consumption by district heating (ktoe)	709.11 ([131])	NA	NA	NA
RES share in the district heating sector (%)	46.7 ([132])	44.9	NA	58.4

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 55 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. Biomass was the dominant technology in this sector. Data for the future development of renewable technologies is not provided in the NECP.

Table 55. Technology contribution in the H & C sector in Latvia, in ktoe

	2018 ([133])	**2020**	**2025**	**2030**
Biomass	1 337.2	NA	NA	NA
Geothermal	NA	NA	NA	NA
Heat pumps	0.7	NA	NA	NA
Solar thermal	NA	NA	NA	NA
Total	1 337.9	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

([128]) Gross final consumption of energy amounted to 4.37 Mtoe in 2018 (SHARES tool 2018).
([129]) Eurostat SHARES tool 2018 data.
([130]) Latvia's NECP data.
([131]) Latvia's NECP data.
([132]) Latvia's NECP data.
([133]) Eurostat SHARES tool 2018 data.

The development of bioenergy is not addressed in the Latvia's NECP. Looking at the political objectives, biomass will remain the main renewable source in the future.

The shift from fossil fuels to biomass use in the energy transformation sector, mainly in the district heating system, will reduce emissions by around 80 kt CO_2 equivalent by 2030, compared with 2017.

With respect to Article 23 of RED II, Latvia states not using waste heat, which means that the increase in RESs in the H & C sector must be limited to 1.1 percentage points. The share of RESs in the H & C sector in 2020 was above 50 %. Therefore, Latvia may count any such share as fulfilling half of the average annual increase (Article 23(2c)). Following these two criteria, Latvia must increase the share of RESs in the H & C sector by at least 0.55 percentage points per year, on average, for the periods 2021–2025 and 2026–2030. The projections show an average increase in the RES share in the H & C sector of 0.54 % by 2025 and 0.30 % by 2030. Latvia does not meet the requirements. A constraint that caused the country not to meet the requirements has been identified as being a reduction in energy consumption due to the renovation of buildings using old decentralised solid biomass boilers.

There are two main action plans for the H & C sector. The first action plan addresses energy reduction in buildings by increasing energy efficiency. The second promotes the efficiency and RESs in the centralised energy supply, as well as the construction of new CHP plants. The latter action plan sets out the following concrete measures.

- Mobilise EU financial support for investments in the development of new regional district heating networks and the renovation of existing (old) networks in municipalities with an existing or planned heat grid intensity of more than 2 MWh/m.
- Develop economic incentives for final consumers to connect to the district heating network. Such incentives could work as a reduction in the common heating tariff of district heating.
- Update legislation that limits the installation of new fossil fuels in district heating.

Latvia sees energy efficiency as the main trigger in reducing costs and increasing the level of security of the energy supply by reducing energy consumption. The following main actions are planned.

- 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 an installation of RES technologies (non-emission technologies) and a connection to the district heating network.

A1.16. Lithuania

Lithuania's TFEC for H & C amounted to 2.6 Mtoe in 2018. This was 45.06 % of the country's FEC ([134]).

FEC in the H & C sector 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 from 50.9 % in 2020 to 67.2 % in 2030.

Energy consumption by district heating amounted to almost 915 ktoe in 2020, which was 29.4 % of the total energy consumption for H & C in 2020. District heating plays a key role in the overall decarbonisation of the H & C sector. The share of renewable energy in the total district heating sector must reach 90 % by 2030. With respect to Article 24(4a) of RED II, the share of renewable energy in the district heating sector was higher than 60 % in 2020; this means that Lithuania fulfils this article and does not need to implement the 1 percentage point option.

The total installed capacity (thermal) of efficient CHP plants was 1 600 MW in 2018. Projections for efficient CHP and efficient DHC are not provided. 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.

Table 56. FEC and RES share in the H & C sector and the district heating sector in Lithuania

	2018 ([135])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	2 597.3	3 109.4	3 169.3	3 364.3
RES energy consumption for H & C (ktoe)	1 185.1	1 582.7	2 011.2	2 260.8
RES share in the total energy consumption for H & C (%)	45.6	50.9	63.46	67.2
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			2.5	0.75
Energy consumption by district heating (ktoe)	NA	914.6	NA	959
RES share in the district heating sector (%)	67.5	71.7	89.3	90

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 56 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. With a share of 98.4 %, biomass was the dominant technology in this sector.

The NECP provides projections for biomass for heating (district heating and decentralised heaters), showing an increase of almost 9 % from 2018 to 2020. In contrast, the contribution from biomass is expected to decrease slightly over the periods 2020–2025 and 2025–2030.

Table 57. Technology contribution in the H & C sector in Lithuania, in ktoe (share, %)

	2018 ([136])	**2020**	**2025**	**2030**
Biomass	1 157 (98.4) (1 277 ([137]))	1 390	1 377	1 345
Geothermal	0.36 (0.03)	NA	NA	NA
Heat pumps	18.2 (1.55)	NA	NA	NA

([134]) Gross final consumption of energy amounted to 5.77 Mtoe in 2018 (Shares tool 2018).
([135]) Eurostat Shares tool 2018 data.
([136]) Eurostat Shares tool 2018 data.
([137]) Data from NECP. The data include solid biomass and forest residues used in district heating and decentralised heaters.

Solar thermal	0.5 (0.042)	NA	NA	NA
Total	1 176.1	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

With regard to Article 23 of RED II, Lithuania must endeavour to increase the annual share of RESs in the H & C sector by 0.55 percentage points for the periods 2021–2025 and 2026–2030. Lithuania may count half of the average annual increase in the RES share in the H & C sector (Article 23(1c)), and it states that any contribution from waste heat and cold is not included. Looking at the scenario results, Lithuania meets the requirements. The main contribution comes from local biofuels (although biomass is expected to decrease from 2020 to 2030 (see Table 56)).

Overall, there are two main action plans for the H & C sector. Lithuania prioritises the reduction in energy consumption in buildings. The second action plan aims to increase both the share of RESs and the efficiency in the heating energy supply.

Existing policies in the H & C sector, which are being implemented until 2021 and 2023, focus on centralised DHC, promoting the construction of new CHP plants and the retrofitting of both old heating boilers and the heat transmission network. Another goal is to increase the number of households with a centralised heat supply. An update of the country's existing regulatory framework seems to be the main instrument for the implementation of these policies.

Meanwhile, new policies set concrete targets and call on municipalities that still use coal and gas to promote the installation of new boilers. Existing boilers are supposed to be replaced by 2030. Moreover, new RES boilers with a total capacity of 200 MW must be installed by 2030.

In the energy efficiency dimension, policy measures focus on building renovation, especially the renovation of multifamily buildings. The main measures and their impact are as follows:

- thermal renovation of multifamily buildings – energy savings of 5–6 TWh by 2030;
- thermal renovation of public buildings – annual energy savings of 0.19 TWh and 1.1 TWh during the total period until 2030.
- replacement of 50 000 inefficient boilers each year with heat pumps or efficient district heating (which will result in annual energy savings of 200 GWh);
- modernisation of the district heating network (annual energy savings of 10 GWh).

There is a lack of information on concrete instruments.

A1.17. Luxembourg

The TFEC for H & C amounted to 1.1 Mtoe in 2018. This was 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.

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.

In 2015, almost 326 GWh of electricity and 527 GWh of heat were produced in Luxembourg using CHP technology.

Further potential for the use of high-efficiency co-generation can be found in the following areas:

- decentralised CHP installations in buildings,
- use of CHP in industry,
- heat grid supply and central CHP plants.

The estimated heat generation from CHP plants, including industrial waste heat, is expected to increase from 589 GWhe in 2020 to 676 GWhe in 2030.

Table 58. Energy consumption and RES share in the H & C sector and the district heating sector in Luxembourg

	2018 ([138])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	1 103.2	1 020	879	720
RES energy consumption for H & C (ktoe)	96.9	139.8	174.6	219.4
RES share in the total energy consumption for H & C (percentage points)	8.78	13.7	19.9	30.5
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			1.23	2.12
Energy consumption by district heating (ktoe)	NA	NA	NA	NA
RESs in the district heating sector (ktoe)	38.8 ([139])	50.6	53.7	58.2

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 59 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 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. Energy use from solar thermal amounted to 4.99 ktoe in 2020 and will increase by almost 224 % by 2030.

Table 59. Technology contribution in the H & C sector in Luxembourg, in ktoe (share, %)

([138]) Eurostat SHARES tool 2018 data.
([139]) Derived heat (RESs) SHARES tool 2018 data.

	2018 ([140])	**2020**	**2025**	**2030**
Biomass ([141])	88.5 ([142]) (91)	50.64 (36)	53.57 (30)	57.35 (27)
Biomass decentralised	NA	75.92 (54)	98.45 (55)	118.91 (56)
Geothermal	0	NA	NA	NA
Heat pumps	6 (6)	8.17 (4)	16.34 (5)	19.26 (8)
Solar thermal	2.4 (3)	4.99 (6)	9.72 (9)	16.16 (9)
Total	96.9	139.80	177.98	211.68

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Following the conditions of Article 23(1), the average annual increase over the periods 2021–2025 and 2026–2030 should be 1.1 percentage points or 1.3 percentage points, compared with 2020 (it is not clear whether waste heat and cold are counted). The share of RESs in the H & C sector in 2020 was lower than 50 %. Therefore, a reduced increase rate does not apply. Looking at the scenario results, Luxembourg meets the requirements.

Energy efficiency is considered a top priority and is of importance to Luxembourg in achieving its energy and climate objectives. Luxembourg has set an ambitious renovation objective for the existing housing stock (3 % renovation rate at 72 % renovation depth on average). This should be achieved by combining building efficiency (roof, walls, windows, cellars) with the elimination of fossil heating systems. Heat pumps are considered the main renewable technology in the housing sector and are therefore promoted through two policy instruments:

- 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 realisable potential of using near-surface geothermal energy associated with heat pumps is estimated at around 180 GWh per annum.

The NZEB construction standard for new residential buildings has been in force since 2017. This will be extended in the short term (A + energy class) to ensure 100 % renewable energy coverage.

Other planned policies to promote renewable technologies include 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. Luxembourg also plans to extend European sustainability criteria for biomass use in CHP plants to smaller plants. For example, plants with a rated electrical output of above 10 MW using biomass or waste wood as an energy source should comply with these sustainability criteria to obtain the feed-in tariff / market premium.

([140]) Eurostat SHARES tool 2018 data.
([141]) Solid biomass and biogas network connected.
([142]) Total biomass for H & C, including solid biomass, biogas and bioliquid (no distinction between centralised and decentralised).

A1.18. Malta

The TFEC for the H & C sector was 78.2 ktoe in 2018. This was 11.6 % of Malta's FEC.

Estimated trajectories for FEC in the H & C sector show an 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. The Maltese NECP assumes an increase from 22.1 % in 2020 to 25.8 % in 2030 (WPM scenario) (see table 60).

According to the NECP, 69 ktoe of fossil fuels were consumed in the H & C sector in 2017, with the largest contributions coming from liquified petroleum gas and gasoil.

There is no DHC in Malta. Heat generation from CHP plants, including industrial waste heat, amounted to 8 GWhe in 2015. The heat generation from CHP plants is expected to be 7 GWhe in 2020 and remain stable until 2030.

In view of the current installed stock of H & C technologies, which is already very efficient, and the low share of heating demand, Malta envisages the role of H & C networks and CHP technology to be only marginal over the next decade.

Table 60. Energy consumption and RES share in the H & C sector and the district heating sector in Malta

	2018 ([143])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	78.2	91.4	98.9	102.7
RES energy consumption for H & C (ktoe)	18.3	20.2	24.4	26.5
RES share in the total energy consumption for H & C (%)	23.4	22.1	24.6	25.8
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.5	0.24
Energy consumption by district heating (ktoe)	0	NA	NA	NA
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 61 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. Heat pumps, with a share of 61 %, were the most-used technology, followed by solar thermal (27 %). Data from 2020 to 2030 show electricity and heat generation from renewable energy in buildings ([144]).

According to the projections, renewable energy from heat pumps will increase by almost 62 % from 2020 to 2030. Meanwhile, the use of biomass will remain stable. Renewable energy from solar thermal will remain stable between 2020 and 2025 and is expected to then decrease until 2030. Solar PV (energy consumed) amounted to 22 ktoe in 2020 and is expected to grow by 50 % by 2030.

Table 61. Technology contribution in the H & C sector in Malta, in ktoe (share, %)

	2018 ([145])	**2020**	**2025**	**2030**
Total biomass	2.2 (12)	1	1	1
Geothermal	NA	NA	NA	NA
Heat pumps (ambient heat)	11.1 (61)	13	18	21

([143]) Eurostat SHARES tool 2018 data.
([144]) As defined in Article 2(1) of Directive 2010/31/EU.
([145]) Eurostat SHARES tool 2018 data.

Solar thermal	5 (27)	5	5	3
Waste (biodegradable)	NA	NA	NA	NA
Solar PV (energy consumed)	NA	22	30	33
Total	18.3	42 (20 ([146]))	54 (24)	59 (26)

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Following the conditions of Article 23(1), the average annual increase over the periods 2021–2025 and 2026–2030 should be 1.1 percentage points or 1.3 percentage points, compared with 2020 (it is unclear whether waste heat and cold are counted). Since the share of RESs in the H & C sector in 2020 was lower than 50 %, a reduced increase rate does not apply. Looking at the scenario results, Malta does not meet the requirements. In fact, several challenges make the target of 1.1 percentage points quite difficult to reach.

- The lack of a natural gas distribution system on the Maltese territory excludes the option of blending biogas.
- The country has no sources of indigenous biomass.
- A share of 28 % biodiesel blend would be required to meet the target of 1.1 percentage points by 2030, resulting in an additional cost to industry and services of approximately EUR 70 million. Given that all biofuels would need to be imported, incurring additional shipping costs (and associated carbon footprint), such a measure would not provide any tangible economic benefits to Malta.

Malta received recommendations from the Commission regarding additional measures in the buildings sector. The government plans to implement 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. Air-to-air heat pumps are projected to increase without the need for any further policy intervention. The government plans to initiate an educational and awareness-raising campaign to encourage households to invest by highlighting the benefits of SWHs/HPWHs.

The Maltese NECP states that several policies and measures have been put in place to promote energy efficiency in buildings. Predominantly, these have taken the form of financial incentives or grants. The enforcement of energy efficiency measures in new buildings will be addressed when a new Building and Construction Authority becomes statutory and established.

Malta possesses no sustainable sources of biomass and does not have the land area or resources required to cultivate energy crops to any practical extent. Furthermore, given Malta's low heating demand, targeting increased efficiency in the H & C sector is deemed more appropriate than promoting the importation of biomass. No specific measures have been planned to promote the use of energy from biomass.

In 2015, a comprehensive assessment of the potential for the application of high-efficiency co-generation and efficient DHC in Malta was presented to the Commission in accordance with Article 14(1) of the EED. This report concluded that DHC systems are not technically viable or cost-effective solutions for Malta. This makes it more challenging to address the H & C sector.

([146]) Excluding solar PV.

A1.19. Netherlands

The TFEC for H & C was 27 000 ktoe in 2018, which was 54 % of the country's FEC.

In the period 2020–2030, the FEC in the H & C sector is expected to decrease from 25.5 to 24.5 Mtoe.

The share of RESs in the H & C sector was 5.9 % in 2018, and it is expected to be 13.0 % in 2030. This is below the recommended increase in RESs in the H & C sector of 13 percentage points from 2020 to 2030, as suggested by Article 23(1).

Table 62. Target FEC and RES share in the H & C sector and the district heating sector in the Netherlands

	2018 ([147])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	27 014	25 475	NA	24 476
RES energy consumption for H & C (ktoe)	1 601	2 038	NA	3 182
RES share in the total energy consumption for H & C (%)	5.9	7.8	NA	13.0
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.5	0.5
Energy consumption by district heating (ktoe)	1 380			1 810
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

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.

CHP is expected to decrease until 2030. Power production from CHP was expected to be 41 % in 2020 and is expected to be 23 % in 2030. The reduction is due to worsened market conditions for CHP.

Biomass consumption is expected to decrease from 3 310 ktoe in 2020 to 3 200 ktoe in 2030. It is not known how much of this is consumed in the H & C sector. Geothermal and heat pumps account for the largest growths among RESs in the H & C sector.

Table 63. Technology contribution in the H & C sector in the Netherlands, in ktoe (share, % relative to absolute value of overall increase)

	2018 ([148])	**2020**	**2025**	**2030**
Total biomass	1 010	NA	NA	NA
Geothermal	72.8	175	NA	583 (~ 63)
Heat pumps	179	244	NA	482 (~ 37)
Solar thermal	27	31	NA	20
Waste heat	NA	NA	NA	NA
Total	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

([147]) Eurostat SHARES tool 2018 data.
([148]) Eurostat SHARES tool 2018 data.

Table 64. Bioenergy trajectories in the Netherlands, in ktoe

	2018	**2021**	**2025**	**2030**
Bioenergy, total	3 310	NA	NA	3 200
Solid biomass (including biogenic waste and alkalis in district heating)	NA	NA	NA	NA
Biogas	NA	NA	NA	NA
Bioliquids	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The focus of the measures is to remove fossil fuels from the H & C sector and replace them with heat pumps and district heating, as well as improving the energy performance of buildings.

- 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.

A1.20. Poland

The TFEC for H & C amounted to almost 37.7 Mtoe in 2018. This was 50.3 % of Poland's FEC.

Estimated trajectories 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. The estimated trajectories show an increasing share of RESs in the H & C sector, from 17.4 % in 2020 to 28.4 % in 2030.

DHC energy amounted to 2 670 ktoe in 2015. The share of RESs in the DHC sector was 2 % in 2015 (coal made up 90 %) and is projected to increase to 29 % by 2030. Although both the current and the estimated future shares of RESs in DHC are very low, Poland's NECP presents a very ambitious target for the DHC sector. 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.

Heat generation from CHP plants amounted to 186 626 TJ in 2015 and is expected to increase to 230 000 TJ by 2030.

The current economic potential for the application of high-efficiency co-generation is estimated to be 191 PJ.

Table 65. FEC and RES share in the H & C sector and the district heating sector in Poland

	2018 ([149])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	37 653.6	37 653.6	35 419.5	33 497.8
RES energy consumption for H & C (ktoe)	5 587.0	6 163	7 604	9 027
RES share in the total energy consumption for H & C (%)	14.84	17.4	22.7	28.4
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			1.06	1.14
Energy consumption by district heating (ktoe)	2 670 ([150])	2 123	1 619	1 391
RES share in the district heating sector (%)	2 ([151])	47 ([152])/4 ([153])	56/12	72/29

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 66 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. With a share of 97.4 %, biomass was the dominant technology in this sector in 2018. The use of biomass is expected to increase by 7.7 % by 2030, compared with 2020. Heat pumps and solar energy are expected to increase largely by 2030, compared with 2020: heat pumps by 195 % and solar thermal by 371 %. Nevertheless, the share of these technologies in the total RES technology mix remains rather insignificant (see Table 65).

Table 66. Technology contribution in the H & C sector in Poland, in ktoe (share, %)

	2018 ([154])	**2020**	**2025**	**2030**
Total biomass	5 265.5 (97.4)	5 574.9 (96.1)	5 766.3 (92.6)	6 007.8 (88.7)

([149]) Eurostat SHARES tool 2018 data.
([150]) 2015.
([151]) 2015.
([152]) Target.
([153]) Projected value; WAM scenario.
([154]) Eurostat SHARES tool 2018 data.

Geothermal	23.7 (0.4)	28.6 (0.5)	30.33 (0.5)	31.5 (0.5)
Heat pumps	59.7 (1.1)	104.9 (1.8)	184.5 (3)	309 (4.6)
Solar thermal	56.9 (1.1)	90.4 (1.6)	244.3 (3.9)	425.8 (6.3)
Renewable solid waste	NA	NA	NA	NA
Total	5 405.8	5 798.8	6 225.43	6 774.1

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Biomass is the most popular source of renewable energy in Poland, and it is primarily used for heating purposes. The use of biomass is projected to increase for two reasons: first, increasing prices of fossil fuels as a result of the CO_2-emission cost in the electricity and heating sectors; and, second, the replacement of old coal boilers with modern biomass-based boilers in households and services.

Table 67. Bioenergy trajectories in Poland, in ktoe

	2015	**2020**	**2025**	**2030**
Biomass boilers	1 069	1 236	1 348	1 460
Biogas plants	0	105	381	657

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Following the conditions of Article 23(1) of RED II, the average annual increase over the periods 2021–2025 and 2026–2030 should be 1.1 percentage points or 1.3 percentage points, starting from the share of renewable energy in the H & C sector in 2020. Poland's NECP does not contain any information on whether waste heat is counted. The share of RESs in the H & C sector in 2020 was below 50 %. Therefore, a reduced increase rate does not apply. Poland meets the requirements for the period 2026–2030 but does not meet them for the period 2021–2025. It does not provide information on any constraints that caused it not to meet the requirements. However, the country's policy objectives suggest that the use of natural gas, which constitutes an important alternative to coal, is one of the reasons.

Regarding policy measures, Poland focuses more on energy efficiency measures than on promoting renewable energy. For the building sector, RESs are promoted in combination with energy efficiency:

— updating regulations by increasing energy efficiency standards for boilers and thermal insulation, and by promoting the use of RESs for new buildings and buildings undergoing renovation (regulation, continuation).

Policies for heating generation focus on energy efficiency.

— 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.

A1.21. Portugal

The TFEC for the H & C sector was almost 6.2 Mtoe in 2018. This was 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 (Eurostat SHARES tool 2018 data). According to Portugal's NECP, this share will increase from 34 % in 2020 to 38 % in 2030.

Portugal does not expect to deploy district heating networks. Specifically, it is stated that the assessment of the need to build new DHC infrastructure from RESs does not apply.

CHP plants produced 7 484 GWh of electricity and 19 249 GWh of thermal energy in 2014. In that year, the share of electricity produced from CHP in gross electricity production was 14 %. For thermal production, co-generated heat represents 36 % of the FEC (based on data from 2020).

Regarding Article 14 of the EED, Portugal conducted a study in 2016 to identify the potential for high-efficiency co-generation with a time frame of 10 years (starting with 2014 as reference year). According to this study, co-generation could supply more than 2 500 ktoe of final energy for the H & C sector.

Table 68. Energy consumption and RES share in the H & C sector and the district heating sector in Portugal

	2018 ([155])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	6 252.3	5 310	5 067	4 916
RES energy consumption for H & C (ktoe)	2 576.4	1 805	1 824	1 868
RES share in the total energy consumption for H & C (%) ([156])	41.2	34	36	38
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.4	0.4
Energy consumption by district heating (ktoe)	NA	NA	NA	NA
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Regarding different technologies for H & C (Table 69), biomass and heat from co-generation make up almost 90 % of the supply from renewables. Energy supplied from heat pumps and solar thermal remains constant over the next decade, whereas renewable gases are expected to represent a 3 % share of the RES supply by 2030.

Table 69. Technology contribution in the H & C sector in Portugal, in ktoe

	2018 ([157])	**2020**	**2025**	**2030**
Total biomass	1 830.6	963	965	953
Geothermal	1.7	NA	NA	NA
Heat pumps	649.6	101	102	102
Solar thermal	94.4	91	89	86

([155]) Eurostat SHARES tool 2018 data.
([156]) Portugal will revise these numbers to reflect new data (ambient heat for heat pumps has not been taken into account).
([157]) Eurostat SHARES tool 2018 data.

Renewable municipal solid waste	0	NA	NA	NA
Heat from co-generation	NA	650	655	677
Renewable gases	NA	0	12	50
Total	2 576.4	1 805	1 824	1 868

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The total bioenergy consumption was 2 986 ktoe in 2020 (including heat, electricity and transport). Bioenergy includes biomass, heat from co-generation and renewable gases. Between 2020 and 2030, bioenergy is expected to increase by almost 32.65 % in all sectors. Overall, 54 % of the total bioenergy was used in the H & C sector in 2020. The bioenergy consumption in this sector is expected to remain more or less stable until 2030.

Table 70. Bioenergy trajectories in Portugal, in ktoe

	2018	**2020**	**2025**	**2030**
Bioenergy, total	NA	2 986	3 261	3 961
Bioenergy for H & C	NA	1 613	1 632	1 680

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Following the conditions of Article 23(1), the average annual increase over the periods 2021–2025 and 2026–2030 should be 1.1 percentage points, compared with 2020 (waste heat and cold are not counted). Since the share of RESs in the H & C sector in 2020 was lower than 50 %, a reduced increase rate does not apply. Looking at the scenario results, Portugal does not meet the requirements.

Portugal does not include consumption by heat pumps in its calculation of the share of RESs in the TFEC for H & C. Thus, this can result in the country not meeting the requirements of Article 23 of RED II. It is said that Portugal will revise these numbers by taking into account ambient heat for heat pumps.

With regard to Portugal's specific measures, one of the measures is dedicated to the promotion of the efficient use of renewable energy in H & C systems. It focuses on residential, service and industrial sectors. In the renewable energy dimension, the main measure is to promote the acquisition and renewal of systems for producing H & C from RESs, such as solar thermal systems, renewable boilers, and hybrid systems combining two or more technologies.

Portugal's NECP does not provide any information on the type of instrument that has been used to promote these technologies.

In the energy efficiency dimension, measures focus on the promotion of the uptake of more efficient technologies, including ventilation, combustion, heat recovery and industrial cooling.

However, H & C are not mentioned explicitly, as they are embedded in concepts such as efficient energy technologies (heat recovery or industrial cooling) and co-generation based on renewables.

A1.22. Romania

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

The share of renewable energy in FEC in the H & C sector was 25.4 % in 2018. According to WAM scenarios, this share is expected to increase from 25.2 % in 2020 to 33 % in 2030.

According to the available data and 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.

Table 71. FE and RES share in the H & C sector and the district heating sector in Romania

	2018 ([158])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	13 641.5	14 116.7	14 051.3	13 363.1
RES energy consumption for H & C (ktoe)	3 469.5	3 557.4	4 117.0	4 409.8
RES share in the total energy consumption for H & C (%)	25.4	25.2	29.3	33
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.82	0.74
Energy consumption by district heating (ktoe)	NA	NA	NA	NA
RESs in the district heating sector (ktoe)	31 ([159])	NA	NA	45

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 72 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. In Romania, biomass plays a key role in the production of renewable energy, followed by renewable energy from delivered heat.

Table 72. Technology contribution in the H & C sector in Romania, in ktoe

	2018 ([160])	**2020**	**2025**	**2030**
Total biomass	3 435.4	3 481.2	3 892.1	4 026.5
Geothermal	31.3	NA	NA	NA
Heat pumps	0	0	55.0	119.6
Solar thermal	0.7	NA	NA	NA
Renewable municipal solid waste	2	NA	NA	NA
RESs from delivered heat	NA	76.2	170.0	263.7
Total	3 469.5	3 557.4	4 117.0	4 409.8

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

([158]) Eurostat SHARES tool 2018 data.
([159]) In 2016.
([160]) Eurostat SHARES tool 2018 data.

With regard to Article 23 of RED II, Romania must endeavour to increase the annual share of RESs in the H & C sector by 1.1 percentage points or 1.3 percentage points over the periods 2021–2025 and 2026–2030. Since the share of RESs in the H & C sector in 2020 was lower than 50 %, a reduced increase rate does not apply. The country's NECP does not contain any information on whether waste heat is counted. According to the scenario results, Romania will fail to meet the requirements in both periods. Romania cites the following constraints with regard to the country's failure to meet the requirements.

- The share of RESs in the H & C sector is already relatively high; it was estimated at 25.6 % in 2020. This is due to the share of biomass. However, it is stated that the national statistics on biomass are incomplete. Houses in rural areas use firewood, which is difficult to count.
- The calculation assumptions took into account the most cost-effective investments to cover the national heat demand. That is why the use of natural gas in heating processes is expected to increase. The dispersion of housing/inhabitants in Romania's rural areas is another constraint.
- There may be uncertainties about the prediction of gross FEC, which may be affected by various factors, such as weather conditions and the volume and type of industrial activity.

In the renewable energy dimension, there are two measures supporting the increase in RESs, both of which address buildings.

- New buildings are to be built as NZEBs after December 2020. 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 supporting the increase in heat pumps and solar thermal installations.

The main measures in the energy efficiency dimension are as follows.

- 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).

There is a lack of information on concrete instruments.

A1.23. Slovakia

The TFEC for H & C was 6 062 ktoe in 2018, which was 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 RESs in the H & C sector was 10.6 % in 2018, and it is expected to be 19.0 % in 2030. This does not meet the target specified in Article 23(1) of RED II. No particular constraint caused this Member State not to meet the requirements of the H & C trajectory of Article 23 of RED II.

Table 73. Target FEC and RES share in the H & C sector and the district heating sector in Slovakia

	2018 ([161])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	6 062	NA	NA	4 926
RES energy consumption for H & C (ktoe)	643	NA	NA	936
RES share in the total energy consumption for H & C (%)	10.6	12.5	16.1	19.0
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.72	0.58
Energy consumption by district heating (ktoe)	155	NA	NA	NA
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

It is said that waste heat will be used, but there are no targets or trajectories provided. CHP supplied 984 ktoe of heat in 2014; in 2025, it is expected to supply 1 160 ktoe.

The biomass FEC grows by 23 % until 2030. Of the total increase in RESs in the H & C sector, biomass contributes 48 %. Heat pumps account for the largest growth among RESs in the H & C sector. Of the total increase in RESs in the H & C sector, heat pumps contribute 32 %.

Table 74. Technology contribution in the H & C sector in Slovakia, in ktoe (share, % relative to absolute value of overall increase)

	2018 ([162])	**2020**	**2025**	**2030**
Total biomass	610	NA	NA	750 (48)
Geothermal	5.0		NA	50 (15)
Heat pumps	0		NA	94 (32)
Solar thermal	5.6		NA	43 (13)
Waste heat	NA	NA	NA	NA
Total	643		NA	936

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 75. Bioenergy trajectories in Slovakia, in ktoe

([161]) Eurostat SHARES tool 2018 data.
([162]) Eurostat SHARES tool 2018 data.

	2018	2021	2025	2030
Bioenergy, total	610	NA	NA	750
Solid biomass (including biogenic waste and alkalis in district heating)	575	NA	NA	650
Biogas	45	NA	NA	100
Bioliquids	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

The focus of the measures is to remove fossil fuels from the H & C sector as well as improving the energy performance of buildings.

- 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.

A1.24. Slovenia

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

The share of renewable energy in FEC in the H & C sector was 31.61 % in 2018. According to the NECP scenario, it is expected to increase from 36.4 % in 2020 to 41.4 % in 2030.

The production of heat in district systems was 213 ktoe in 2017. According to the NECP scenario, the use of DHC energy will decrease to 178 ktoe by 2030.

Table 76. FEC and RES share in the H & C sector and the district heating sector in Slovenia

	2018 ([163])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	1 860.8	1 807.7	1 619.3	1 480.7
RES energy consumption for H & C (ktoe)	588.2	658	604	613
RES share in the total energy consumption for H & C (%)	31.61	36.4	37.3	41.4
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.18	0.82
Energy consumption by district heating (ktoe)	213 ([164])	NA	NA	178
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 77 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. With a share of 89.9 %, biomass was the dominant technology in this sector in 2018. According to the NECP, the use of biomass will 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.

Table 77. Technology contribution in the H & C sector in Slovenia, in ktoe (share, %)

	2018 ([165])	**2020**	**2025**	**2030**
Wood biomass	528.4 (89.9)	515 (78.3)	434 (71.9)	387 (63.2)
Biogas	NA	NA	0.1 (0.02)	0.4 (0.1)
Geothermal	48.9 (8.3)	NA	NA	NA
Heat pumps (ambient energy)	0	78 (11.9)	97 (16.1)	114 (18.6)
Solar thermal	10.9 (1.9)	12 (1.8)	14 (2.3)	17 (2.8)
Heat other	NA	53 (8.1)	59 (9.8)	94 (15.4)
Total	588.2	658	604	612

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

([163]) Eurostat SHARES tool 2018 data.
([164]) 2017.
([165]) Eurostat SHARES tool 2018 data.

The total bioenergy consumption is expected to decrease over the period 2020–2025 and slightly increase over the period 2025–2030. Approximately 70 % of the total bioenergy was used for heating in 2020. The use of biomass is expected to decrease in this sector.

Table 78. Bioenergy trajectories in Slovenia, in ktoe

	2018	**2020**	**2025**	**2030**
Bioenergy, total	NA	728	680	703
Bioenergy for heating ([166])	NA	500–520	400–420	360–390

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Following the conditions of Article 23(1), the average annual increase over the periods 2021–2025 and 2026–2030 should be 1.1 percentage points or 1.3 percentage points, compared with 2020 (it is unclear whether waste heat and cold are counted). The share of RESs in the H & C sector in 2020 was lower than 50 %. Therefore, a reduced increase rate does not apply. Looking at the scenario results, Slovenia does not meet the requirements.

Slovenia does not provide any information as to the constraints that may have caused it not to meet the requirements. The lack of concrete measures supporting RESs in this sector might have had an impact on it not reaching the targets.

With regard to measures for the renewable energy dimension, Slovenia intends to ban heating oil in new constructions in 2021; a ban on the sale and installation of new boilers fired with heating oil is supposed to come into effect in 2023. Slovenia has been developing a comprehensive H & C strategy based on efficient H & C potential. The strategy aims to define clear medium- and long-term H & C targets and measures, and finally develop a mapping tool, including both an up-to-date database and a tool to support local planning (the deadline for the mapping is 2022).

In the energy efficiency dimension, an objective of Slovenia for 2030 is to help mitigate and reduce energy poverty by accelerating the implementation of social policy measures and general housing measures (e.g. a subsidy for apartment buildings). The NECP, in the field of energy poverty, defines the following main activities.

- By 2021 at the latest, define energy poverty in the sectorial legislation and lay down an obligation to periodically measure the scale of the phenomenon (estimates of the numbers of energy-poor households in the country).
- Develop an action plan to tackle energy poverty by 2022.

([166]) The numbers were taken from a chart and are therefore given as a range.

A1.25. Spain

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

The share of renewable energy in FEC in the H & C sector was 17.5 % in 2018. It is expected to increase from 18 % in 2020 to 31 % in 2030.

The FEC in the heat and cold networks in Spain was 1 777.29 TJ (approximately 42.5 ktoe) in 2017, which equated to 0.15 % of the TFEC in the H & C sector. There are no projections for DHC or for the RES share in DHC.

Although Spain's NECP does not provide data for the efficient CHP potential and projections, it states that the installed capacity of CHP plants is to decrease over the period 2020–2030.

Table 79. Energy consumption and RES share in the H & C sector and the district heating sector in Spain

	2018 ([167])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	30 165	NA	NA	NA
RES energy consumption for H & C (ktoe)	5 273.7	NA	NA	NA
RES share in the total energy consumption for H & C (%)	17.48	18	25	31
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			1.4	1.2
Energy consumption by district heating (ktoe)	42.5 ([168])	NA	NA	NA
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 80 shows the contribution of renewable technologies in the H & C sector in 2018, 2020, 2025 and 2030. With a share of 79.3 %, biomass was the dominant technology in this sector, followed by heat pumps (14.1 %). According to the NECP's projections, 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 have not been provided.

Table 80. Technology contribution in the H & C sector in Spain, in ktoe

	2018 ([169])	**2020**	**2025**	**2030**
Total biomass	4 184.2	NA	NA	NA
Geothermal	18.8	NA	NA	NA
Heat pumps	742.1	NA	NA	3 523
Solar thermal	324.3	NA	NA	NA
Renewable municipal solid waste	4.2	NA	NA	NA
Total	5 273.7	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

([167]) Eurostat SHARES tool 2018 data.
([168]) Data for 2017, data source: NECP.
([169]) Eurostat SHARES tool 2018 data.

Following the conditions of Article 23(1), the average annual increase over the periods 2021–2025 and 2026–2030 should be 1.1 percentage points or 1.3 percentage points, compared with 2020 (there is no information on whether waste heat and cold are counted). Since the share of RESs in the H & C sector in 2020 was below 50 %, a reduced increase rate does not apply. The scenario results suggest that Spain meets the requirements.

According to the NECP, the increase in end-use renewable energy, such as biomass, biogas and thermal solar energy, has a significant impact on the development of RESs in the H & C sector. The same holds true for the increased use of heat pumps for air conditioning.

With respect to Article 24 of RED II, the share of DHC in TFEC for H & C was 0.15 % in 2017 (i.e. well below the 2 % specified in Article 24(10)(a) of RED II). Therefore, Spain is not required to apply Article 24(2–9). However, given the identified potential for the development of H & C networks, Spain expects renewable H & C networks to play a much more significant role in 2030. Specific regulatory and economic measures are to support the development.

Overall, electrification and an increase in the use of thermal renewables are the main goals in the H & C sector.

The following measures are intended to promote the wider adoption of RESs for thermal uses in both the building sector and DHC:

- revision and update of the minimum requirements of thermal installations for all new and renovated buildings;
- loan schemes and grants supporting the renewal of the installed solar thermal parks, high-efficiency ambient energy equipment, the retrofitting of biomass equipment with high performance, geothermal energy installation and NZEBs (instruments: direct subsidies; fiscal framework to put in place signals to incentivise electrification; elimination of an indirect subsidy of 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).

The main policy measures in the energy efficiency dimension are as follows.

- 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.
- 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.

A1.26. Sweden

The TFEC for H & C was 14 700 ktoe in 2018, which was 42 % of the country's FEC.

In the period 2020–2030, the FEC in the H & C sector is expected to increase from 16 to 17 Mtoe.

The share of RESs in the H & C sector was 69 % in 2018, and it is expected to be 72 % in 2030. Since the share in 2018 was already above the 60 % threshold of Article 23(1), a further increase in the H & C sector is not required.

Table 81. Target FEC and RES shares in the H & C sector and the district heating sector in Sweden

	2018 ([170])	**2020**	**2025**	**2030**
TFEC for H & C (ktoe)	14 736	16 000	NA	17 000
RES energy consumption for H & C (ktoe)	9 634	11 100	NA	12 300
RES share in the total energy consumption for H & C (%)	69.1	69.2	NA	72.2
Average annual increase in the RES share in the H & C sector by 2025 and 2030 (percentage points)			0.3	0.3
Energy consumption by district heating (ktoe)	4 700	NA	NA	4 400
RES share in the district heating sector (%)	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Heat demand in the district heating sector is expected to decrease by 300 ktoe in Sweden, although 700 ktoe of new customers has been added. This is due to lower heat consumption from existing customers. There are no targets for new DHC in Sweden, although district cooling is expected to increase from 86 to 258 ktoe. Waste heat was not discussed.

The potential for CHP by 2030 is 648 ktoe, of which 62.5 % is for district heating and the rest is for industry.

Biomass consumption is expected to increase from 9 500 ktoe in 2020 to 10 700 in 2030. Of the total increase in RESs in the H & C sector, biomass contributes 82 %. Heat pumps account for the largest growth among RESs in the H & C sector with 17 % during the period 2017–2030.

Table 82. Technology contribution in the H & C sector in Sweden, in ktoe (share, % relative to absolute value of overall increase)

	2018 ([171])	**2020**	**2025**	**2030**
Total biomass	7 620.9	9 500	NA	10 700 (~ 80)
Geothermal	NA	NA	NA	NA
Heat pumps	1 451	NA	NA	1 700 (~ 17)
Solar thermal	11	NA	NA	NA
Waste heat	NA	NA	NA	NA
Total	NA	NA	NA	NA

([170]) Eurostat SHARES tool 2018 data.
([171]) Eurostat SHARES tool 2018 data.

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

Table 83. Bioenergy trajectories in Sweden, in ktoe

	2018	**2021**	**2025**	**2030**
Bioenergy, total	9 948	NA	NA	12 898
Solid biomass (including biogenic waste and alkalis in district heating)	8 461	NA	NA	NA
Biogas	37.6	NA	NA	NA
Bioliquids	NA	NA	NA	NA

NB: data for 2018 is based on the SHARES Tool (Eurostat); data for 2020, 2025 and 2030 is taken from the NECP report. Data sources: Eurostat (2018), European Commission (2019).
NA – not available

There was no particular requirement for this Member State to meet the requirements of the H & C trajectory of Article 23 of RED II, since it had already exceeded 60 % of RESs in the H & C sector.

The focus of the measures is to remove fossil fuels from the H & C sector as well as improving the energy performance of buildings.

- Taxes on energy and CO_2 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.

Annex 2. Investments

Member State	Measure	Cost (EUR)
Belgium	Green heat	3.4 billion
	Renovation of buildings	~ 40 billion
Bulgaria	Households	11.8 billion
	Services	4.2 billion
	Industry	2.1 billion
Czechia	Solar power plants	490 million
	Heat pumps	460 million
	Biomass and stoves	430 million
		Total: 19.5 billion
Denmark	Installation of heat pumps for individual buildings and district heat	
	Phase-out of natural gas, oil and biomass boilers in individual heating sector	20 million
	Building renovation	
Germany	Not available for H & C	
Estonia	Energy sector (only partially heat)	350 million
	Reconstruction of building stock	1.0 billion
Greece	Energy efficiency	11 billion
Spain	Savings and energy efficiency (not only H & C)	83 billion
	Renewables (not only H & C)	92 billion
France	Heat Fund	3.5 billion
	Renewable production equipment	8 billion
	Lower VAT for district heating networks	0.75 billion
	Buildings	~ 35 billion
Croatia	Heating	79 m
	Solar thermal	400 m
	Renovations of buildings	1.73 bn
	New construction of NZEB buildings	5.1 bn
Italy	Heat pumps	4 billion
	District heating	6 billion
	Co-generation and boilers	1 billion
	Heat recovery	3 billion
Cyprus	H & C sector	0.91 billion
Latvia	Improving energy efficiency in buildings	1.7 billion
	Energy efficiency and RES technologies in the H & C industry	1.7 billion

Member State	Measure	Cost (EUR)
Lithuania	Heat generation and modernisation of heat grid	570 million
Luxembourg	Renewable energy (not only H & C)	210 million
Hungary	Building energy application programme	11 million
Malta	Heat pumps	300 million
Netherlands	Expansion of DHC networks	50–350 million
	Built environment	6.8–13.5 billion
	Removal of gas connections	0.5–1.5 billion
Austria	District heating and networks	1.7 billion
	H & C (buildings and industry)	29.7 billion
	Thermal refurbishment of building envelopes	16.3 billion
	Heating and system renewal	8.7 billion
	Energy efficiency and waste heat use	0.7 billion
Poland	High-efficiency cogeneration	8.2 billion
	District heating	0.1 billion
	Energy efficiency in buildings	0.03 billion
	Energy efficiency in enterprises	0.1 billion
Portugal	Buildings	117 billion
Romania	Total (not only H & C)	150 billion
Slovakia	Heat recovery	0.3 billion
	Renovation of residential and service sector buildings	1.6 billion
	Optimisation of district heating	0.1 billion
	Restructuring heat plant	0.1 billion
Slovenia	NA	
Finland	Investments in cities	34 million
	Equipment in cities, e.g. multifuel boilers	4 million
Sweden	Co-generation	20 billion

Data source: European Commission (2019).

Annex 3. National policies and measures

Member State	Measure	Instrument	Amount of avoided greenhouse gas emissions	Cost (EUR)
Belgium	Replace fossil fuels in industry (non-ETS)			
	Move away from heating oil by 2025 and natural gas by 2030			
	Renovation of and efficiency improvements in buildings	Economic		
	Increase use of energy service companies and energy performance contracts			
Bulgaria	Increased use of biomass in CHP	Financial, legal		
	Renovation of building stock and promotion of RESs in buildings	Financial, legal		
	Increasing energy efficiency of DHC infrastructure		38 ktoe	
	Renovation of building stock			
Czechia	Support the installation of gas-condensing boilers in the residential sector	Economic		
	Support the installation of biomass boilers and heat pumps	Economic		
	Aid for high-efficiency co-generation	Economic		
Denmark	Installation of heat pumps in individual households, companies and district heating producers	Economic		24 million
	Reduce electrical heating tax	Financial		
	Phase-out of oil and natural gas in individual heating sector	Regulatory, economic		
Germany	Promote renewable heating technologies in buildings	Economic		
	Decarbonisation of district heating	Economic	7.3 Mtoe	
	Support for building construction and renovation and heat boilers	Financial, regulatory	13.7 Mtoe	
Estonia	Renovation of building stock			
	Increasing share of RESs in district heating supply			
Greece	Support for heat pumps and solar thermal systems	Economic, financial		

Member State	Measure	Instrument	Amount of avoided greenhouse gas emissions	Cost (EUR)
	Support for district heating systems using solar and geothermal			
	Promotion of high-efficiency CHP	Financing		
Spain	Minimum requirements of thermal installations for new and renovated buildings	Regulatory		
	Promoting H & C networks	Regulatory, information		
	Enhance energy performance of buildings, and building performance certificates	Financial	4.8 Mtoe	
	Energy efficiency in cold-generating equipment		3.4 Mtoe	
France	Make more money available for heat in non-economic activities	Economic		3.5 million
	Low VAT on renewable heating equipment	Financial		
	Improve thermal performance of buildings	Economic		
	Use of energy savings certificates	Regulatory		
Croatia	CO_2 emissions tax for non-ETS sources	Financial		
	Energy renovation programmes for buildings; both thermal insulation and replacing heat systems	Economic, regulatory		
	Increase efficiency of district heating systems			
Italy	Tax relief on renewable technologies in buildings	Financial		
	Mandatory integration of RESs in buildings	Regulatory		
	White certificates			
	Renovation of buildings			
Cyprus	Installation of heat pumps	Economic		
	Replacing old existing H & C equipment	Economic		
	Upgrading building envelopes			
	CHP in public buildings			

Member State	Measure	Instrument	Amount of avoided greenhouse gas emissions	Cost (EUR)
Latvia	Reduce building thermal energy consumption by at least 30 %			
	New district heating networks and renovation of the existing ones			
	Limit installation of new fossil fuels in district heating			
Lithuania	Replace gas and coal boilers with new ones by 2030			
	Installation of RES boilers			
	Thermal renovation of multifamily buildings		516 ktoe	
	Thermal renovation of public buildings		95 ktoe	
Luxembourg	Renovation of existing housing stock			
	Removal of fossil heating systems			
	Improved information policy			
	Realisation of geothermal potential			
Hungary	Reduce gas consumption in DHC	Economic		
	Loan programme for energy efficiency and renewables in individual houses	-		
	Modernisation of district heating and construction of mini-heat plants	—		
	Increase energy efficiency in buildings	—		
Malta	Energy efficiency in buildings			
	Support for SWHs, heat pumps and waste-to-energy plants			
Netherlands	Forbid connection of new houses to gas network			
	Switch 1.5 million homes from gas by 2030			
	VAT reduction for energy efficiency investments			
	Increased energy tax on natural gas and reduction on electricity			

Member State	Measure	Instrument	Amount of avoided greenhouse gas emissions	Cost (EUR)
Austria	Ban oil-fired installations in new buildings after 2020	Regulatory	2 Mtoe	
	Replace oil heating systems in existing buildings	Financial	2 Mtoe	
	Phasing out fossil fuel heating systems (including thermal renovation of buildings)		0.096 Mtoe	62.7 million
	Energy services in the public sector	Regulatory, economic	4 ktoe	
Poland	Enhance energy efficiency standards for boilers and thermal insulation	Regulatory		
	Promoting RESs for new buildings			
	Modernise heating and CHP plants			
	Development of energy-efficient district heating and low-carbon district heating			
Portugal	Renewal of systems for producing H&C from RESs, e.g. solar thermal	Economic		
	More efficient ventilation, combustion and heat recovery			
Romania	More RESs in new buildings			
	Support for heat pumps and solar thermal			
	Promote high-efficiency co-generation			
	Modernise district heating systems			
	Thermal insulation of buildings			
Slovakia	Converting to biomass and biogas fuels for CHP			
	Support households in investing in renewable heat generators	Financial		
	Increase energy efficiency in enterprises			
	Reduce energy intensity in buildings			
Slovenia	Ban heating and oil in new constructions			

Member State	Measure	Instrument	Amount of avoided greenhouse gas emissions	Cost (EUR)
	Support local heat planning			
	Develop an action plan to tackle energy poverty			
Finland	Phase out coal by 2025 (affects district heating systems)	Regulatory		
	Phase out oil for heating by 2030	Regulatory		
	Heat pumps for district heating	Financial		
	Energy efficiency in buildings	Economic		
	Efficiency of district heating systems by use of waste heat			
Sweden	Taxes on energy and CO_2 emissions			
	Rural support programmes for farmers and small businesses			
	Support energy efficiency measures in industry			
	Support renovation of rental apartments			

Data source: European Commission (2019).

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