Competitiveness of renewable heating and cooling industry and services

Annex B to Part 1 *of the Study on the competitiveness of the renewable energy sector*

Overview of the 2030 targets and policies of the EU Member States in the context of heating and cooling

ENER/C2/2016-501

28 June 2019

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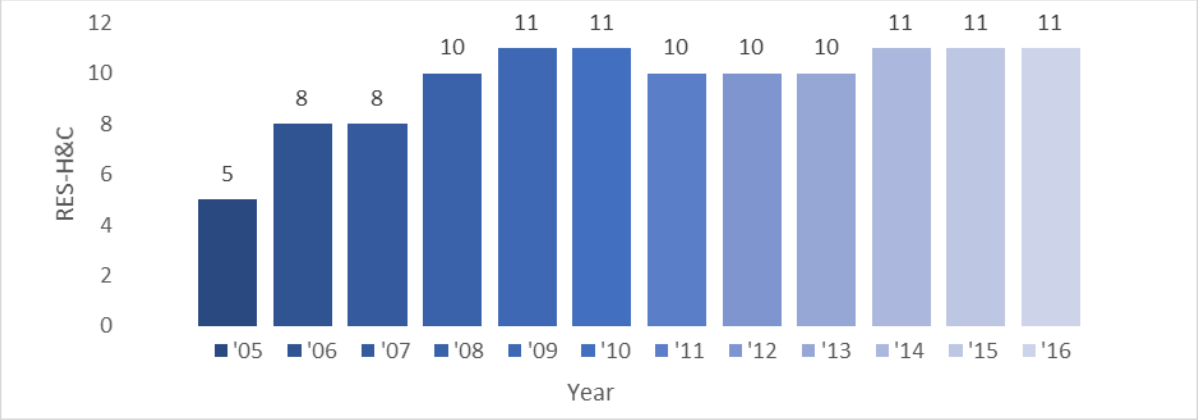
Table of Contents

1 Austria

According to the draft Austrian NECP, neither the RES-H&C nor the interconnectivity 2030 targets have been defined. The planned RES target in gross final consumption of energy in 2030 is 45% and for RES-E in gross final consumption of energy in 2030 it's 93%.

Historic data on the RES in the Austrian H&C sector (in %)



Source: Draft Austrian NECP

As to district heating and cooling and CHP, high-efficiency cogeneration and efficient district heating are already being used to a large extent. There are ongoing network densifications. In the area of households and services, the existing measures scenario includes a slight increase in district heating use.

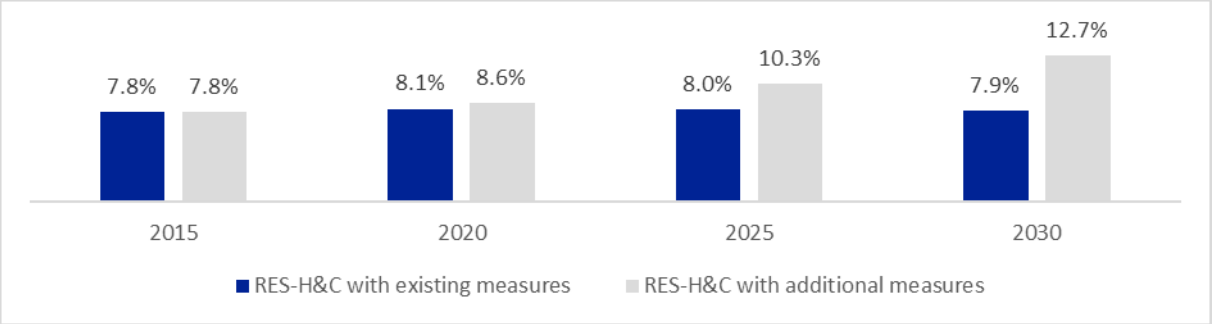
The following legal acts facilitate the heating and cooling framework:

- The heat distribution priority under UFG – Environmental Support Act which includes 10 large-scale projects to feed in waste heat into existing or new local and district heating grids or the installation of waste heat distribution grids which account for around 109 GWh for most of the renewable energy use in this area.
- The WKLG - Heat and Refrigeration Pipeline Expansion Act which will generate CO2 savings and increase energy efficiency on the basis of investment subsidies. The establishment of cooling networks is intended to dampen the increase in power consumption for air conditioning and to make cost-effective use of existing heat and waste heat potential, in particular of an industrial nature.

2 Belgium

The 2030 targets on RES heating and cooling have not yet been defined. The 2030 planned target for RES in gross final consumption of energy is 18% and for interconnectivity it is 15%.

Belgium's projections on RES-H&C (in %)



Source: Draft Belgian NECP

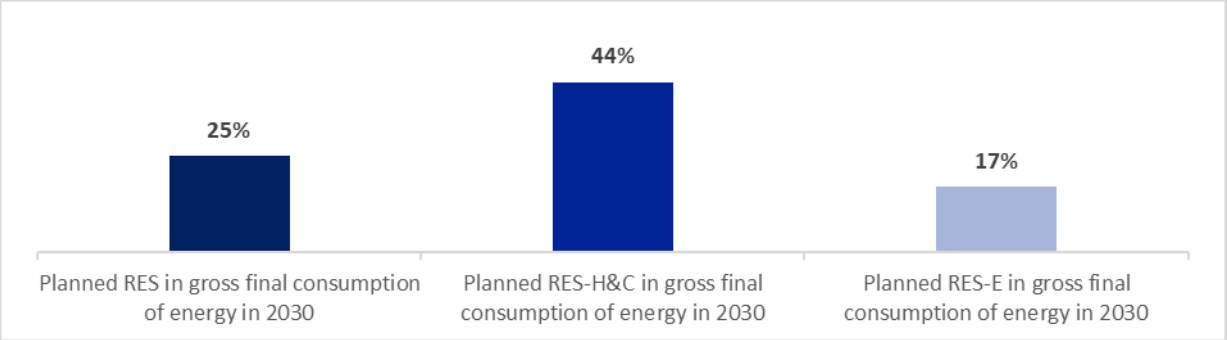
The following policies and measures are supporting RES heating and cooling:

- Obligation of a minimum amount of renewable energy production of 15 kWh per m² for new buildings;
- Extension of energy premiums to the most efficient air-to-air heat pumps;
- State guarantee for technologies posing a high risk, but an attractive return on investment such as geothermal energy, with a return mechanism in the event of a higher than expected revenue;
- Introduction of a financial support mechanism for renewable heat, waste heat, heat networks and decentralised gas networks in the collective housing sector, tertiary sector, industry and SMEs;
- Approval of framework that regulates the use of biomass for energy purposes.

3 Bulgaria

The planned RES in gross final consumption of energy in 2030 is 25% in Bulgaria, whereas the target for the RES heating and cooling is 44% and for electricity from renewable sources 17%. The Bulgarian interconnectivity target for 2030 is 15%.

Bulgarian RES targets



Source: Draft Bulgarian NECP

63% of installed electricity generation capacity can produce heat (i.e. they can operate in cogeneration mode), but only 814 MWe of their capacity for heat production can be defined as high-efficiency cogeneration. There is potential both for heat production in new CHP installations, which could be achieved by switching from separate heat production to high-efficiency CHP, as well as for the use of waste.

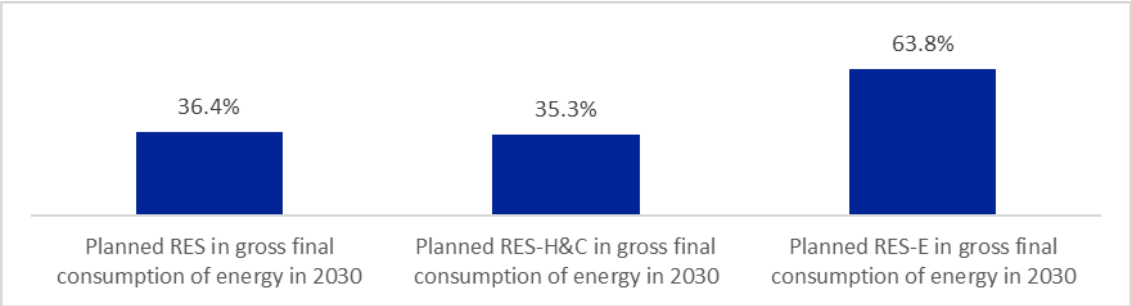
The following policies and measures are supporting RES heating and cooling:

- The Spatial Development Act does not require investment approval for projects with a total installed capacity of up to 30 kW that produce electricity, heating and/or cooling from RES;
- The Renewable Energy Sources Act mentions that at least 15% of the heating and cooling needs for buildings is to be covered from renewable sources by means of: central heating using biomass or geothermal energy, individual facilities for the incineration of biomass (with a conversion efficiency of at least 85% for residential and commercial buildings and 70% for industrial buildings), solar thermal installations, as well as heat pumps and near-surface geothermal systems;
- The draft National Ambient Air Quality Improvement Programme 2018-2020 includes the mandatory phase out of solid fuel stoves and boilers together with their replacement by biomass stoves and boilers.

4 Croatia

The planned RES in gross final consumption of energy in 2030 is 36% in Croatia, whereas the target for the RES heating and cooling is 35% and for electricity from renewable sources 64%. No interconnectivity target is provided for 2030.

Croatian RES 2030 targets (in %)

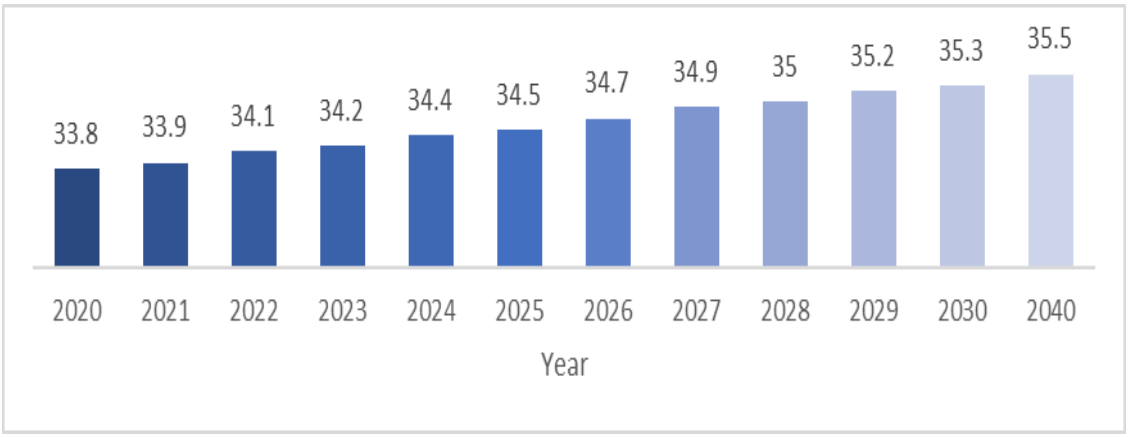


Source: Draft Croatian NECP

The following policies and measures are supporting the renewable heating and cooling sector:

- Use of biogas for biomethane production and electricity and heat generation;
- Establishment of biomass collection and logistic centres;
- Promoting the use of renewable energy sources for production of electricity and thermal energy.

Croatian projections of RES in the H&C sector, with existing measures (in %).

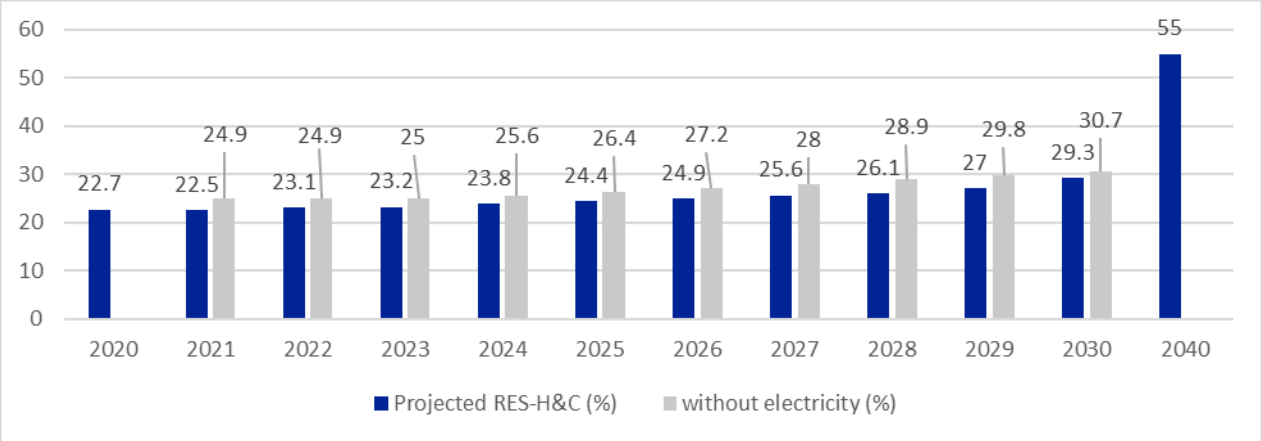


Source: Draft Croatian NECP

5 Cyprus

The Cypriote draft NECP does not contain RES or interconnectivity targets. Nevertheless, the objective of Cyprus is the construction of the EurAsia interconnector (belonging to the project of common interest - PCI list) with a capacity of 2GW which will connect Cyprus with Israel and Greece and whose targeted commissioning year is 2022/2023.

Cypriote projections on RES-H&C (in%)[1]



Source: Draft Cypriote NECP

There are no specific measures that aim at increasing RES in the H&C sector. The best RES research programme under Horizon2020 aims to develop innovative business models for integration of renewable sources by aggregating distributed generation such as wind, PV, biogas, biomass, hydro, combined heat and power (CHP), and combining this with demand side management and energy storage.

Regarding CHP, there is legislation for promotion of combined heat and power generation systems and high efficiency standards. 1.17 million Euro have been secured from the EU structural and cohesion funds for pilot projects of combined heat and power generation in public and semi-public buildings. The Ministry of Energy, Commerce and Industry announced in 2017 the operation of a support scheme for the installation of cogeneration systems fuelled by biomass/biogas to produce electricity for self-consumption, as well as a support scheme based on net-billing principle for the installation of high efficiency combined heat and power generation with capacity up to 5MW.

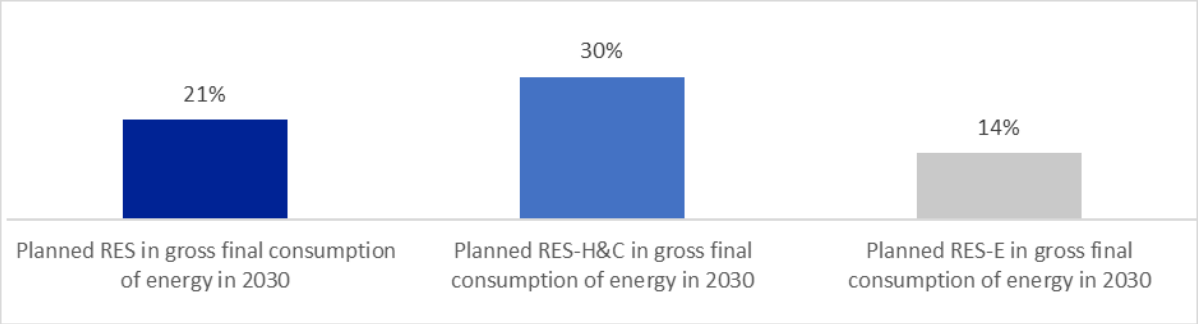
Regarding district heating or cooling, consumers in Cyprus tend to prefer options such as heat pumps. This indicates that the economic potential is going towards the use of more RES in the electrification of heating and cooling sector.

[1] No data has been provided for the 2020 and 2040 RES-H&C without electricity scenarios.

6 The Czech Republic

The planned RES in gross final consumption of energy in 2030 is 21% in the Czech Republic, including a 30% target on RES heating and cooling and 14% target on electricity from renewable sources. The Czech Republic set also the interconnectivity target which is 30% for 2030.

Czech RES targets (in %)



Source: Draft Czech NECP

The following policies and measures are supporting RES heating and cooling:

- Operating aid for heat (biomass, including biogas, biofuels, geothermal energy);
- Investment aid programme for boiler replacement under Environment Operational Programme OPŽP 2014-2020.

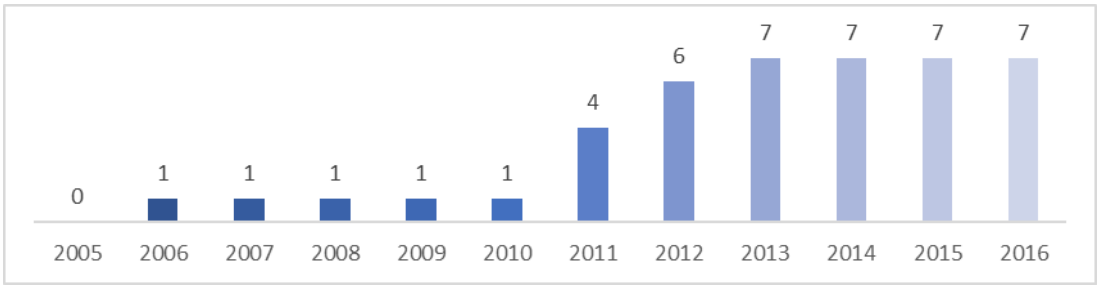
The main objectives related to the heating sector include:

- At least 60% of the heat supply from the heat supply systems is to be covered by high-efficiency cogeneration;
- The renovation, transformation and stabilisation of heat supply systems is to be based in a decisive manner on domestic resources (coal, RES, secondary sources) together with natural gas;
- The support for the transition from small heat supply systems to multi-fuel systems using local available biomass, natural gas or other fuels;
- Creating the conditions for efficient use of heat from renewable and secondary sources of energy available at regional and local level;
- Ensuring in the long term the necessary level of coal supply for the heat sector in the face of decreasing recoverable reserves by means of legislative and regulatory measures;
- Significantly increasing by 2024 the recovery of waste in waste-to-energy plants with a view to achieving a high utilisation rate of the combustible waste component after being sorted;
- Create the conditions to secure the role of district heating plants in the island regions in emergency situations.
- Supporting and developing the capacity of energy supply in local (insular) subsystems in the event of a breakdown due to large-scale events caused by natural events or by terrorist or cyber-attacks.

7 Denmark

The RES-H&C, RES-E and interconnectivity 2030 targets either have not yet been defined or there is no data. Nevertheless, the planned 2030 RES target in gross final consumption of energy is 55%.

Historic data on the RES in the Danish H&C sector (in %)



Source: Draft Danish NECP

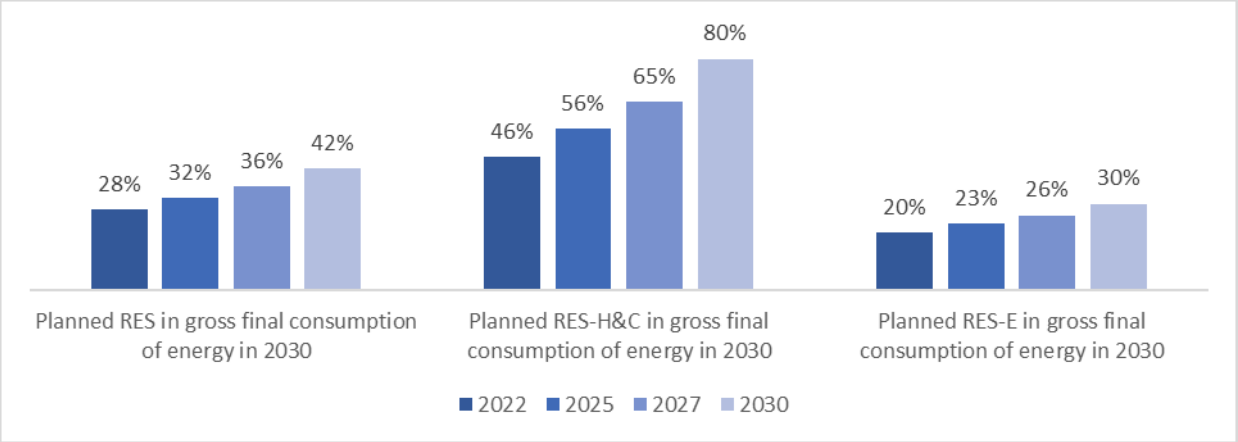
To ensure that renewable energy becomes both Denmark's predominant source of electricity within the foreseeable future, as well as an increasingly utilised primary energy source for heating, technology-neutral tender processes will be conducted in the coming years that will involve solar PV, onshore and offshore wind, and other technologies. Some of the policies and measures are mentioned below:

- Electricity tax reduction to encourage more people to choose green solutions such as heat pumps;
- The inclusion in the policy package of 13.4 million EUR per annum earmarked for the promotion of use of waste heat;
- Fixed premium for electricity and heat from solid biomass: The policy agreement of June 2018 establishes the future support system after April 1, 2019. There are in total 3 support schemes:
  - Existing non-depreciated installations will continue to receive a fixed premium of 2 EUR cent/kWh during the entire depreciation period;
  - Depreciated installations will be supported by a fixed premium calculated on the basis of the difference in operating cost of using biomass compared to an alternative fossil reference;
  - For new installations after April 1st 2019 a grant pool will give the possibility of aid for new capacity to produce electricity using biomass, biogas and other green gasses.

The 2030 target for district heating consumption is that least 90% is based on sources other than oil, gas and coal.

8 Estonia

Estonian RES targets and trajectories (in %)



Source: Draft Estonian NECP

Neither projections nor historic data exist on heating and cooling.

Some policies and measures are mentioned below:

- Development of heating systems: the measure includes fuel switch from oil fuels to renewable and/or local energy sources like biomass, peat, etc. Also reducing the losses in district heating networks. Investments will be made to renovate heat networks and reduce losses. District heating networks that operate inefficiently (the amount of MWh sold per meter of heat pipes is less than 1.2) will be restructured to local and place heating;
- Additional development of heating systems: the measure includes further development of heating systems that includes renovation of heat networks and fuel switch to local energy sources.

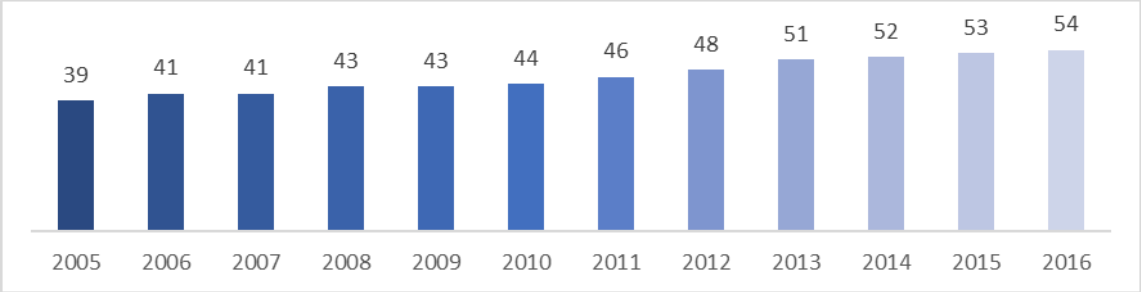
Subsidies for renewable energy and efficient heat and electricity cogeneration: the measure includes further development of heating systems that includes renovation of heat networks and fuel switch to local energy sources.

Estonia has the objective of producing 75 MW more of heat in district heating network in high-efficiency cogeneration compared with 2014. In 2017, the installation of a second plant in the Tallinn power plant with a thermal power of 76 MW started operation and in the near future a 25 MW efficient CHP plant with a thermal power is expected to be commissioned in Tallinn.

9 Finland

Some of the 2030 targets have not yet been defined or there is no data. Nevertheless, Finland has set a target for RES in gross final consumption of energy in 2030 at 50% and for interconnectivity it is above 15% for 2030.

Historic data on the RES in the Finnish H&C sector (in %)



Source: Draft Finnish NECP

Some policies and measures are mentioned below:

- The distribution obligation will be extended to apply to light fuel oil used in heating and machinery so that the share of bioliquids must be at least 10% by 2028;
- Aid for forest chips and wood-based fuels;
- Energy taxes: energy taxation will provide an incentive for the use of forest chips and forest industry by-products in CHP production and building-specific heat production.

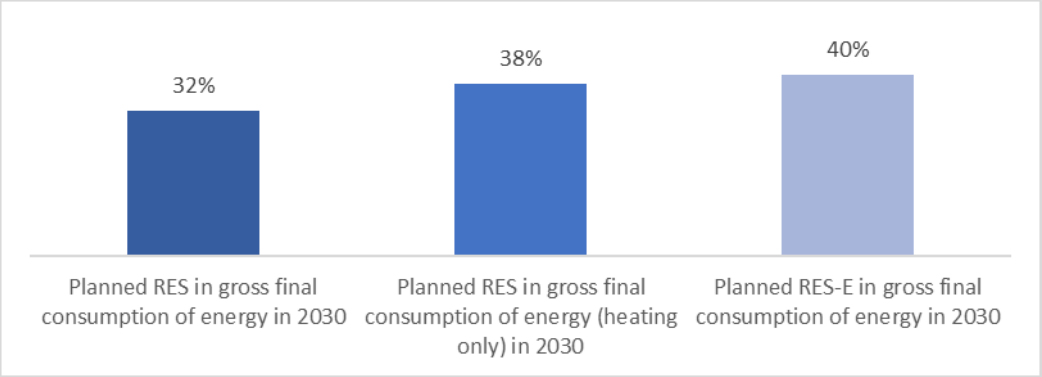
District H&C and CHP

Finland is able to exploit the CHP and district heating potential given that a significant part of the building stock in cities and densely populated municipalities is connected to the district heating network. Energy efficiency agreements also cover energy production and energy services that serve the achievement of the indicative national energy efficiency target. The National Energy Efficiency Action Plan 2017 (NEEAP-4) estimated that the energy saving effects of the measures implemented within the scope of agreement activities in the energy sector will total almost 1.7 TWh in 2020.

Banning of coal in energy production will have an impact on the energy system, as coal-based CHP plants will mainly be replaced by heat only boilers using biomass. The use of forest chips is expected to increase by 2.0–2.8 TWh. Market based development of coal use would lead to 200 MW decrease in coal CHP generation capacity during years 2025-2030. The ban of coal in 2029 based on legislation will further decrease the CHP generation capacity by 300 MW, whereas the flexibility of the electricity system and the generation adequacy between supply and demand will be tighter. The ban of coal will also have a marginal impact on power prices, EUR 0.1–0.3 per MWh depending on the fuel price scenarios.

10 France

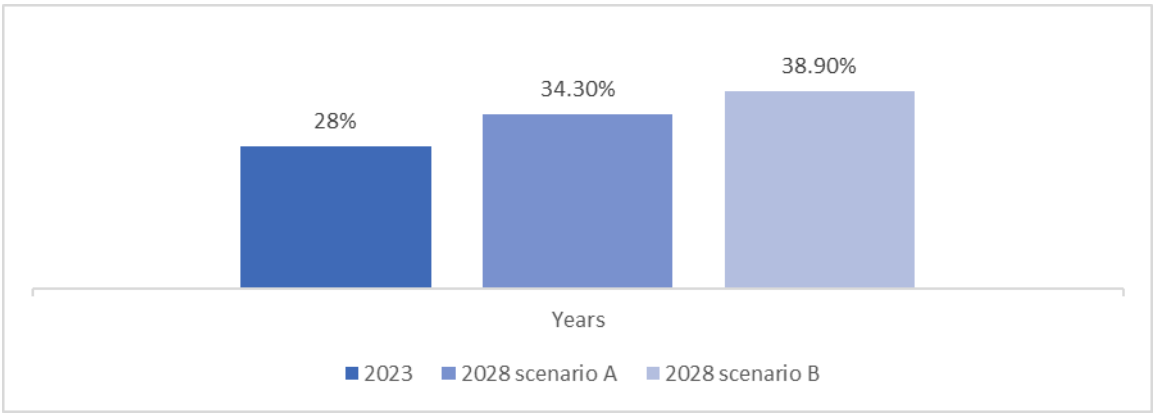
French RES targets (in %)



Source: Draft French NECP

The Energy Transition for Green Growth Act (LTECV) has set a target of 38% renewable energy in the final consumption of heat by 2030. To achieve this goal, the rate of growth of renewable heat must be increased to an average of 1.2% per year (i.e. 1.5 times higher than the growth rate between 2010 and 2016). LTECV also set a target of achieving 5 times the amount of renewable heat and cooling and recovery delivered by heating and cooling networks by 2030 compared to 2012. The 2030 interconnectivity target has been set to 26GW of cumulated transmission capacity.

French projections regarding RES-H&C (in %)



Source: Draft French NECP

France formulated targets and projections for heating only, with detailed information on technologies. There is no quantitative objective on waste-to-energy generation.

Policies and Measures

Some policies and measures are mentioned below:

- From 2020 there is a mandatory share of renewable heat in all new buildings;

- Biomass: set the importance of biomass in buildings above high efficiency CHPs, replace old wood stoves with more efficient installations, support boiler development in buildings and industry;
- Support from the Heat Fund for air and geothermal installations for investments and resource mapping.

Projections of technology deployment in the heating sector. All figures in TWh

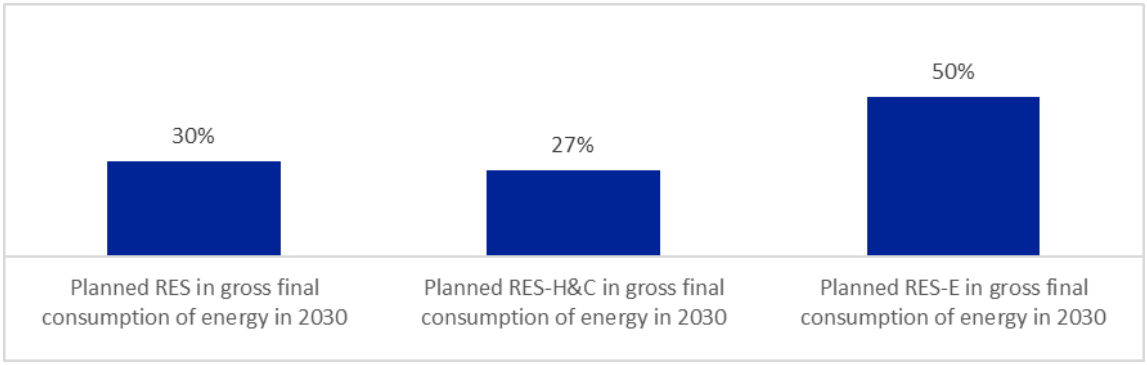
Year	2016	2023	2028
Solid biomass	123	145	157
Air source heat pump	22	35	Scenario A: 39
			Scenario B: 45
Ground-source heat pump	3.1	4.6	Scenario A: 5
			Scenario B: 7
Geothermal energy	1.57	2.9	4-5.2
Solar heating	1.17	1.75	Scenario A: 1.85
			Scenario B: 2.5
Heat recovery system	3	4.47	Scenario A: 12
			Scenario B: 18

Source: Draft French NECP

11.Germany

The use of renewable energies for district heating only changes slightly over time. Biomass remains the most important renewable energy source for the generation of grid-bound heat, even if the district heating generated by biomass in reference development is declining. The decline in biomass use is offset by increasing heat generation from waste heat and geothermal energy, as well as a slight increase in solar thermal generation.

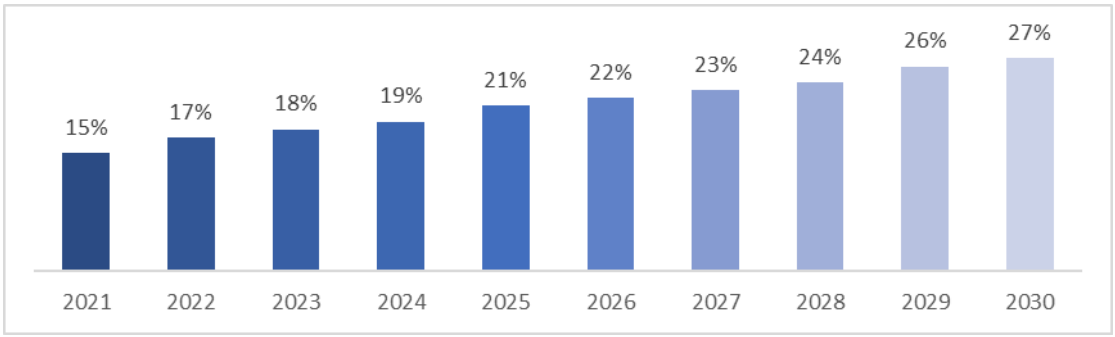
German RES 2030 targets (in %)



Source: Draft German NECP

Concerning the generation of decentralised space heating, the use of renewable energies will increase by 20% between 2020 and 2030. In the period from 2021 to 2030, biomass use will rise slightly by about 4 percent.

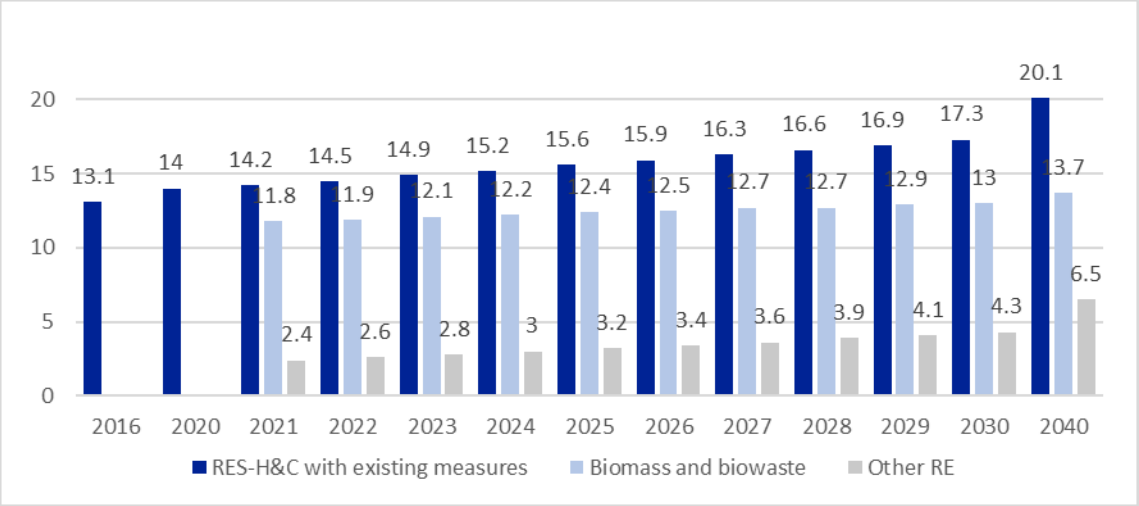
Estimated trajectory for RES in final energy consumption in the German H&C sector (in %)



Source: Draft German NECP

Modernised CHP plants can make an important contribution to reducing GHG emissions by 2030. To do so, they must save emissions in the electricity and heating market and react flexibly to the fluctuating feed-in of renewable energies. For instance, in times of high input of renewable heat and electricity, the production of the CHP plant is reduced, thus saving fuel and emissions.

German projections with regard to RES-H&C (in%)

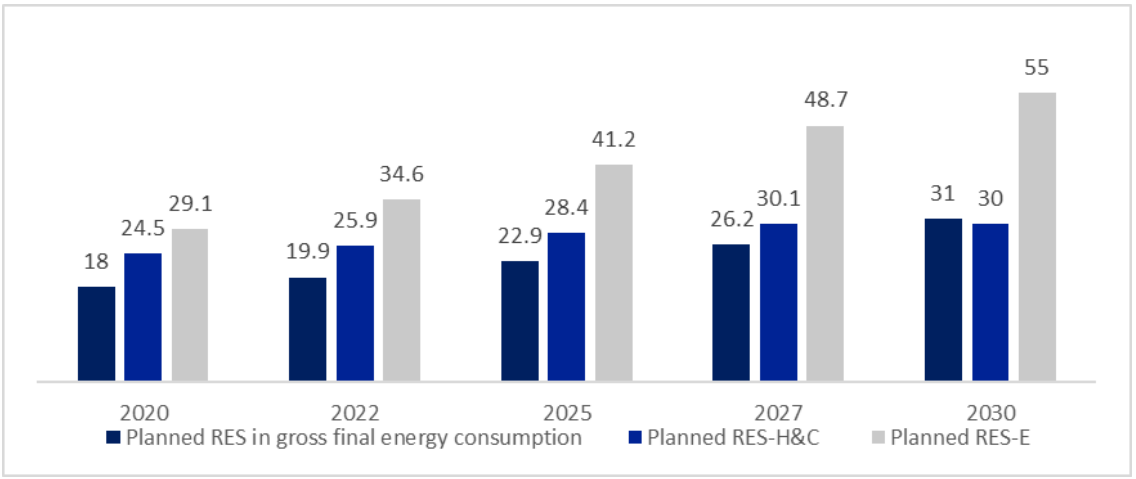


Source: Draft German NECP

With a large supply of renewable electricity and low market prices, the electric heat generator can also relieve the electricity market. The technology transforms rigid, heat-related minimum generation into flexible electricity demand. To solve acute network bottlenecks, the technology is also used in the context of the "benefit instead of abatement" scheme.

12. Greece

Greek RES targets (in %)



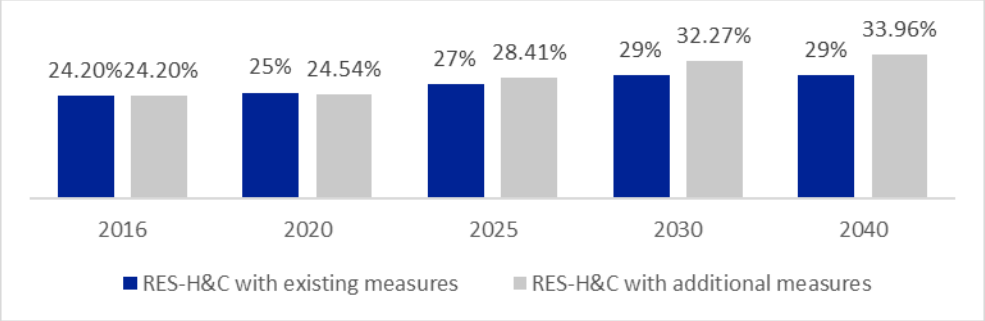
Source: Draft Greek NECP

The 2030 target for RES-H&C is 32.3% and for RES-E is 56.4%. The 2030 interconnectivity target for Greece is 15%.

The program 'Promotion of RES and CHP systems for own consumption of heat for own consumption' aims to install H&C systems from RES and CHP for self-consumption to improve energy efficiency. It includes the financing of RES H&C production systems,

i.e. using biomass, biogas, geothermal, solar thermal and other RES and high-efficiency cogeneration installations using RES.

Greek projections with regard to RES-H&C

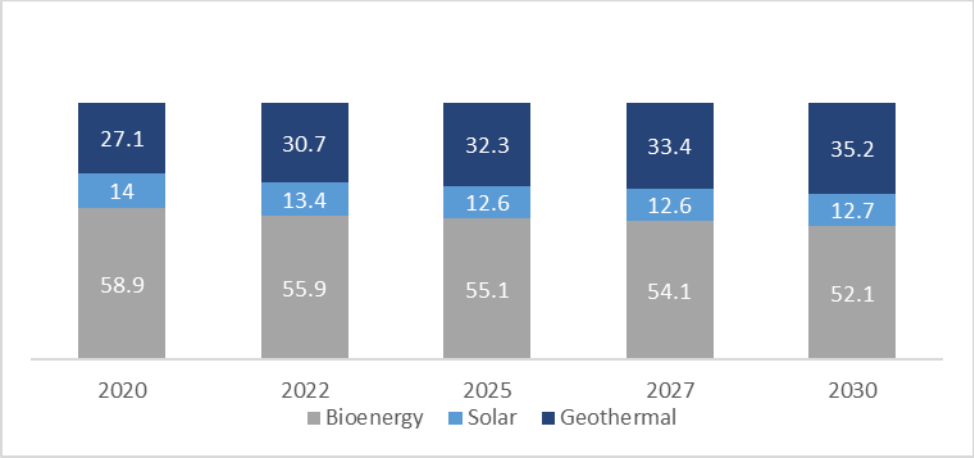


Source: Draft Greek NECP

Regulatory measures have contributed to the promotion of RES for heating and cooling, such as the mandatory coverage of 60% of the hot water needs of solar thermal systems in new and newly renovated buildings.

In addition, regulations for the promotion of biomass, geothermal and heat pumps and solar thermal have already been introduced by making a significant contribution to the existing RES penetration for heating and cooling through the removal of specific barriers. As regards the promotion of biomass, a Ministerial Decision has been issued to regulate the operation of combustion stoves to heat buildings and water and to adopt specifications for solid biomass fuels for non-industrial use.

Expected contribution from RE energy sources in the Greek H&C sector (in %)



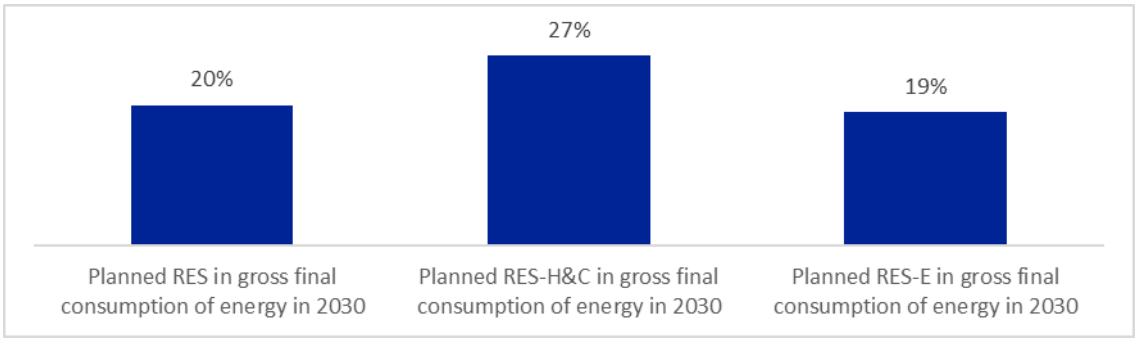
Source: Draft Greek NECP

Greece is aiming to build new district heating networks that can provide 30-40 MWth and that will be powered with solid biomass and geothermal. No information for district cooling systems. This is based on an assessment of the technical and economic potential for this kind of systems, which according to the study is concentrated in North Greece and some of the North Aegean islands where there is RE potential and heating demand.

13.Hungary

The replacement of the existing gas-based district heating production by renewable heat generation in Hungary does not take place on market terms but can only be facilitated by substantial investment aid. In the period 2014-2020 Hungary benefits from investment aid for the construction of renewable heat production facilities, which will contribute to a significant increase in the production of biomass and geothermal based heat production.

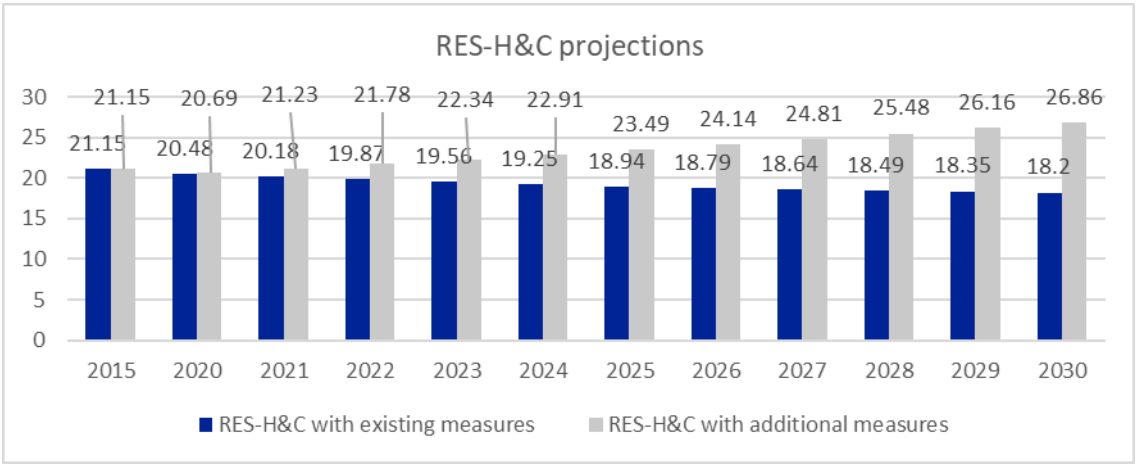
Hungarian RES targets (in%)



Source: Draft Hungarian NECP

Government Decree 1772/2018 entails the decision to develop a policy that would allow consumers to benefit from the supply of district heating that is both affordable in the long term and guarantees a high level of security of supply.

Hungarian projections regarding RES-H&C (in%)



Source: Draft Hungarian NECP

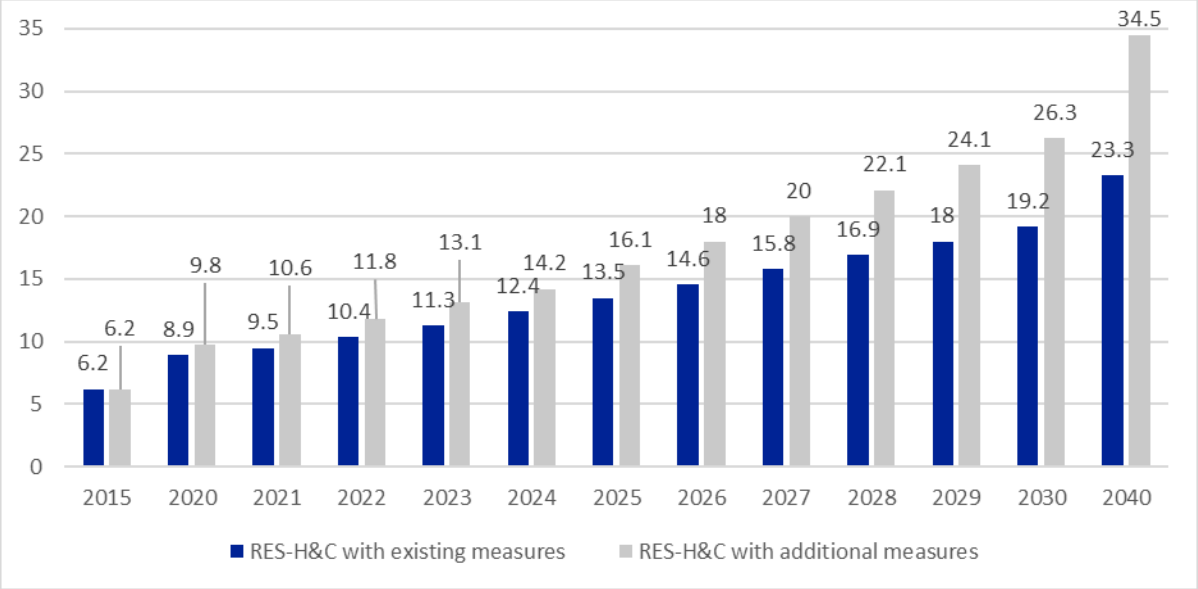
Even after the 2014-2020 programming period, the country would seek to incentivize the building of new biomass and geothermal heat generation capacities with non-reimbursable subsidies. Hungary wants to help the energy content of non-recyclable waste to be used for district heating purposes.

14.Ireland

Support Scheme for Renewable Heat: In December 2017, the Government approved the introduction of the Support Scheme for Renewable Heat which will financially support the adoption of renewable heating systems by commercial, industrial, agricultural and other non-domestic heat users in the non-emissions trading (non-ETS) sector. District heating schemes, including those supplying heat to domestic users, will also be eligible for the scheme.

The scheme is designed to increase the energy generated from renewable sources in the heat sector by three percentage points and consists of two phases: the first phase of the scheme, the installation grant for heat pumps is up to 30% of the installation cost. The second phase of the scheme (operational support for biomass boilers and anaerobic digestion heating systems) will be a multiannual payment (for a period of up to 15 years) on the basis of prescribed tariffs. The potential for the third phase of the scheme that would provide support for biomethane grid injection is being considered.

Irish projections on renewable heat - generation (in%)



Source: Draft Irish NECP

By 2030, biomethane grid injection has the potential to make a significant contribution to increasing the level of renewable energy in the heat sector. The National Development Plan, published in February 2018, sets out an allocation of €300m for the rollout of the Support Scheme for Renewable Heat for the period 2018 to 2027.

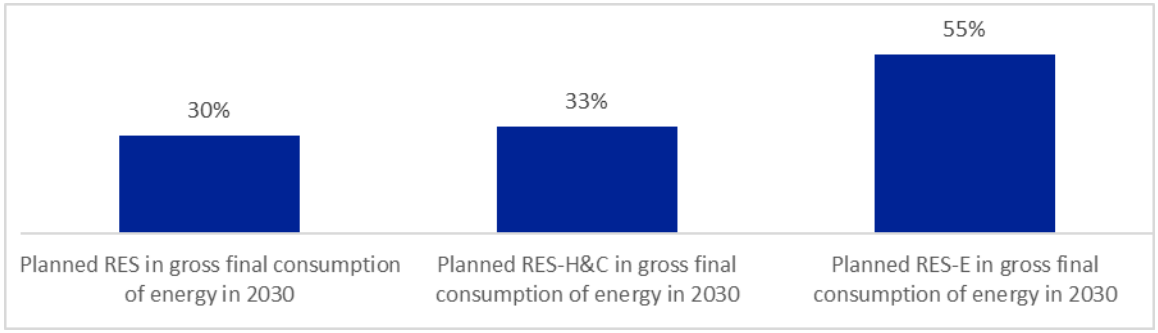
The Energy White Paper 'Ireland's Transition to a Low Carbon Energy Future 2015-2030' sets out the need to develop a policy framework to encourage the development of district heating. The heat demand in Ireland is generally low density in nature. The heat mapping and analysis of linear heat density demonstrates that around 90% of the heat demand is at densities too low to make DH a viable proposition.

If the heat density was lowered, the technical potential may increase, but the proportion which is uneconomic is likely to increase. The relatively small potential for heat networks will mean that CO2 and primary energy savings at a national level will not be significant. The most likely potential appears to be based around two types of district heating schemes: large scale schemes (in Dublin) which have a small cost benefit over the counterfactual technology options, and which are reliant on a source of waste heat from power stations for economic viability. Small scale schemes (potentially outside of Dublin), where there is a much larger cost benefit in terms of levelised cost, but the overall heat provision potential is very limited. These types of scheme are likely to be located where more expensive existing heating sources prevail (potentially off the gas network). The predominant heat network heat source is boilers due to the small scale of the schemes.

Future priorities for Ireland should be generally concentrated around the deployment and incentivising of building scale technologies including building scale CHP.

15.Italy

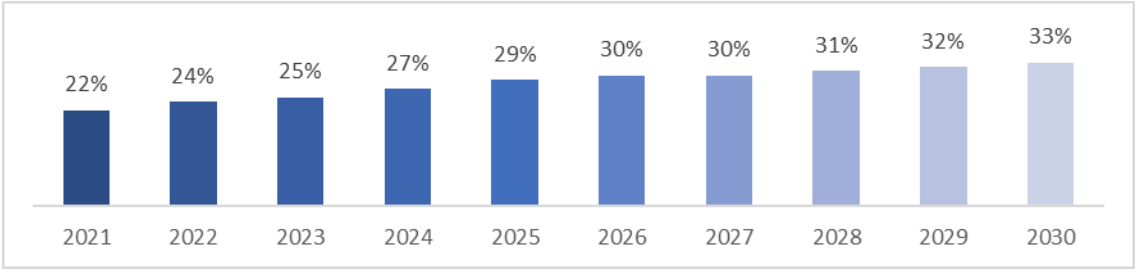
2030 Italian RES targets



Source: Draft Italian NECP

Italy will implement a minimum threshold of generation of heat from RES in new buildings. Main new policy is the economic reserve that will be confirmed in order to provide guarantees for the deployment of district heating and cooling networks, included in the National Energy Efficiency Fund, and the implementing decree already provided for by Law No 172/2017 will be issued.

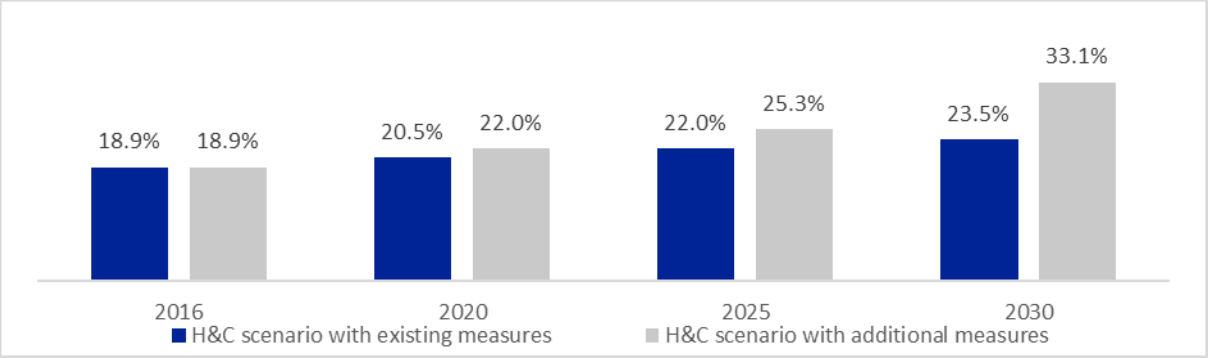
Estimated trajectory for RES in final energy consumption in the Italian H&C sector



Source: Draft Italian NECP

Italy has carried out an assessment on the national potential for the application of high-efficiency cogeneration and efficient district heating (under Article 14 of the EED). The economic potential to extend district H&C is currently estimated at approximately 900 km, additional to the current approximately 4,100 km.

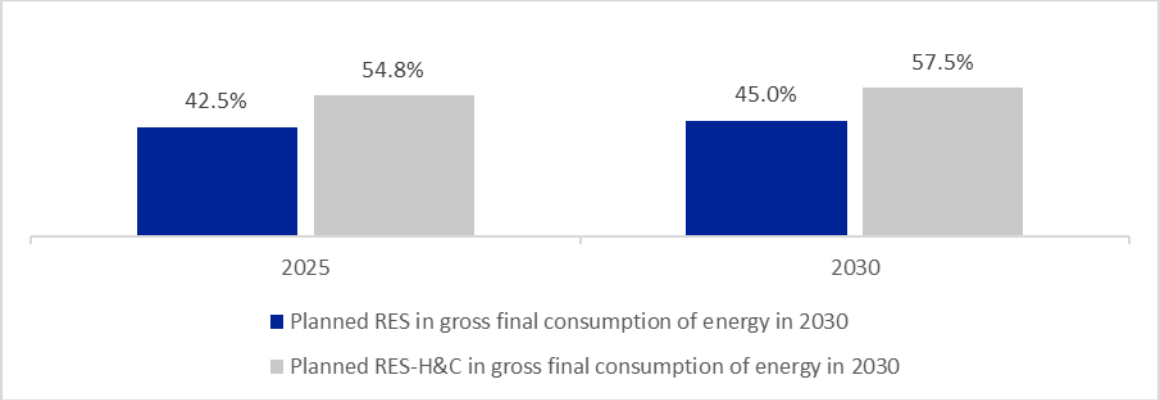
Italian projections with regard to RES-H&C



Source: Draft Italian NECP

16.Latvia

Latvian RES targets (in %)



Source: Draft Latvian NECP

The interconnectivity target for Latvia was set at 15%.

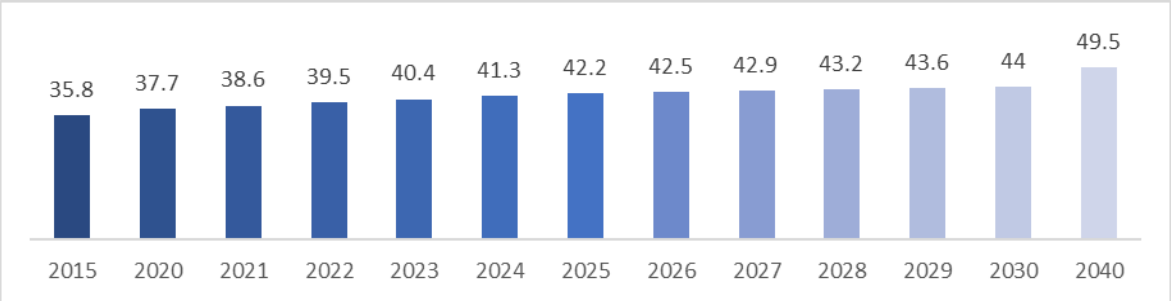
Implementation of new activities of programmes of EU funds: 30% more non-emission RES installations (solar, wind, heat pumps, cooling pumps) or biomass combustion plants installed by district and local heating systems, taking into account the need to comply with air quality standards and conditions.

Implementation of new activities of programs of EU funds:

1. Introduction of RES technologies in cooling systems, especially in public buildings

2. Adaptation of the existing heat supply infrastructure for the provision of cooling system in buildings;
3. Renovation of a small complexes of buildings (multi apartment and private), including the switch to RES in the water heating and heating;
4. Installation of biogas purification (to biomethane) equipment for heating and cooling systems;
5. The assessment of the possibility of reducing the real estate tax, personal income tax and value added tax, burden on households for the purchase and installation of solar collector, heat pumps or cooling pumps.

Latvian projections of RES-H&C (in %)

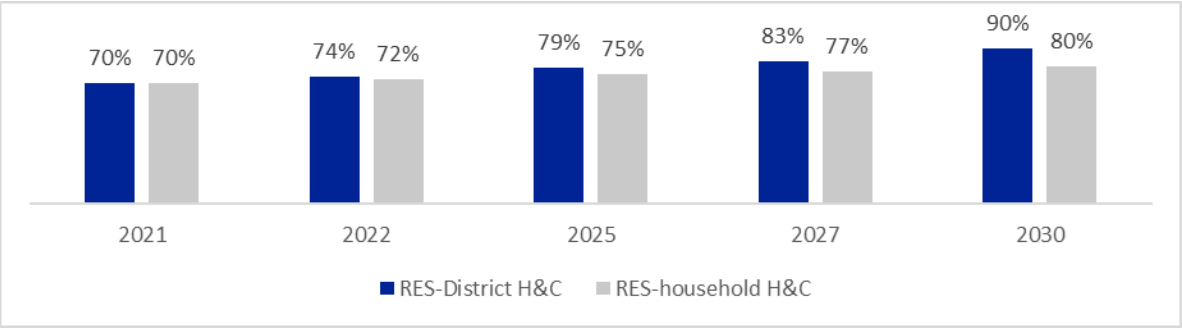


Source: Draft Latvian NECP

17.Lithuania

Lithuanian RES target for 2030 is set at 45% and the interconnectivity target at 15%.

Lithuanian projections regarding RES-H&C



Source: Draft Lithuanian NECP

The share of district heat supply (DHS) RES (including waste) will be 70% by 2020 and 90% by 2030. The development of high-efficiency solid biomass CHP plants will continue, and both non-recyclable municipal waste and non-hazardous industrial waste that have an energy value will be effectively used for energy production. After creating a favourable regulatory environment, households with independent heating will gradually switch to clean, zero GHG technologies and the share of RES in households will reach 70% by 2020 and 80% by 2030.

Estimated trajectories for the renewable energy (incl. waste) technologies in district H&C for Lithuania

Year	2021	2022	2025	2027	2030
Non-recyclable municipal waste and non-hazardous industrial waste, ktoe	116	116	116	116	116
Waste fired CHP plants total capacity, MW	180	180	180	180	180
Solar power and heat pumps, ktoe	7	14	35	37	40
Solar power and heat pumps total capacity, MW	15	30	76	88	105
Biomass, ktoe	496	492	481	485	491
Biomass CHP plants and boilers total capacity, MW	1778	1801	1842	1869	1909
Biogas, ktoe	13	12	11	10	9
Biogas CHP plants total capacity, MW	34	33	29	28	24

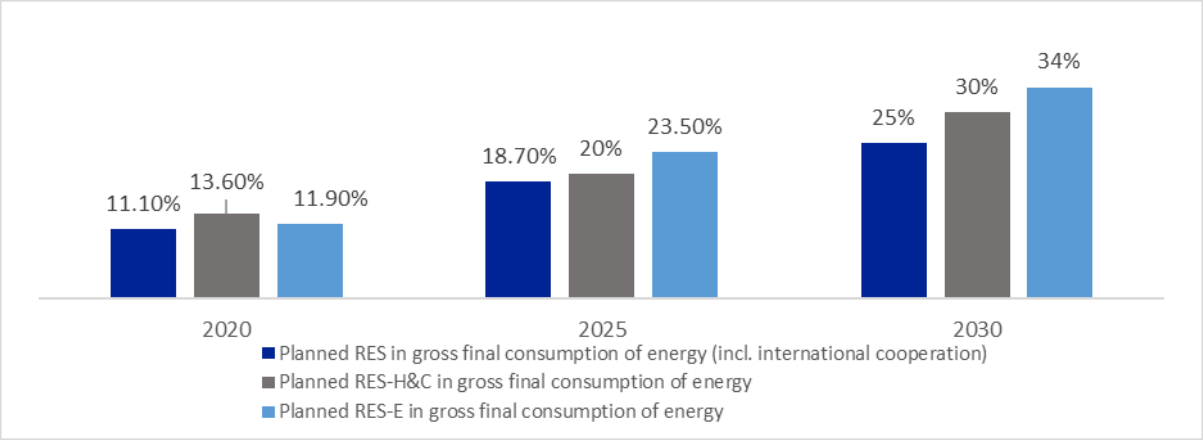
Source: Draft Lithuanian NECP

In 2016, 3.6 TWh of heat energy was generated in CHP plants. It accounted for about 41% of the total heat energy produced in the DH system. The installed electric capacities of biofuel and waste fired CHP plants are 79 MW. In implementing the National Programme for Heat Sector Development in 2015–2021 (i) a high-efficiency biofuel and municipal waste-fired Vilnius CHP plant with a heat capacity of 229 MW and an electricity capacity of 92 MW, (ii) a waste-fired Kaunas CHP plant with a heat capacity of 70 MW and (iii) an electricity capacity of 24 MW power plant by 2020 Kaunas waste heat generating power plant burning waste are expected to be built. These CHP plants are expected to satisfy around 40% of Vilnius and Kaunas district heat needs. The centralised cooling network in Lithuania is not developed. Residential and commercial premises are individually cooled by using electricity. The preliminary annual cooling demand in Lithuania ranges from 5 to 6 TWh. The need was determined based on the assumption that the cooling demand in Lithuania, given its climatic conditions, is approximately 60 kWh/m2 per year.

18.Luxembourg

Both grid-connected (in line with the power generation in biomass-CHP-plants) as well as decentralised biomass use deliver substantial contributions to the projected share in 2030. At a decentralised level, the heat pumps and solar thermal collectors for hot water supply are increasingly used.

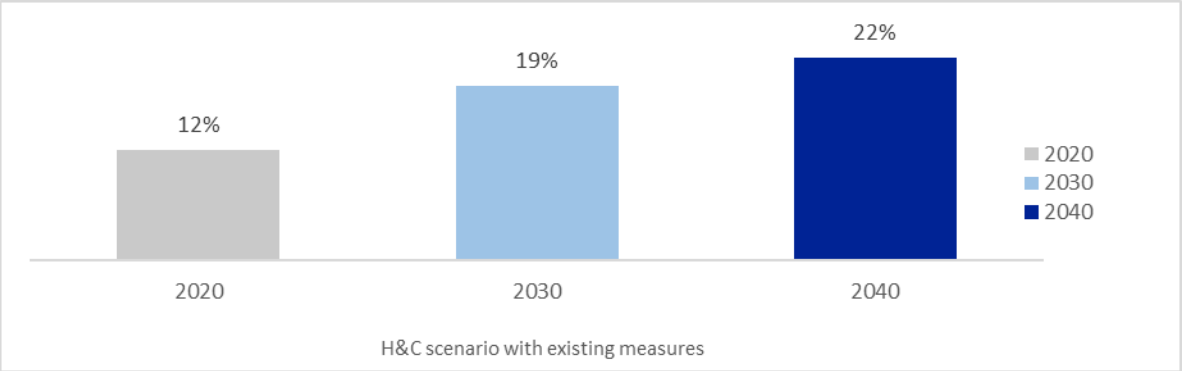
2030 RES targets Luxembourg (in %)



Source: Draft Luxembourgish NECP

In 2015, CHP technology generated just under 326 GWh of electricity and 527 GWh of heat in Luxembourg. Further potentials for the highly efficient use of cogeneration lie in the areas of 1) decentralised cogeneration plants in buildings, 2) use of cogeneration in industry and 3) heat supply and centralised cogeneration plants.

Luxembourg projections with regard to RES-H&C (in %)

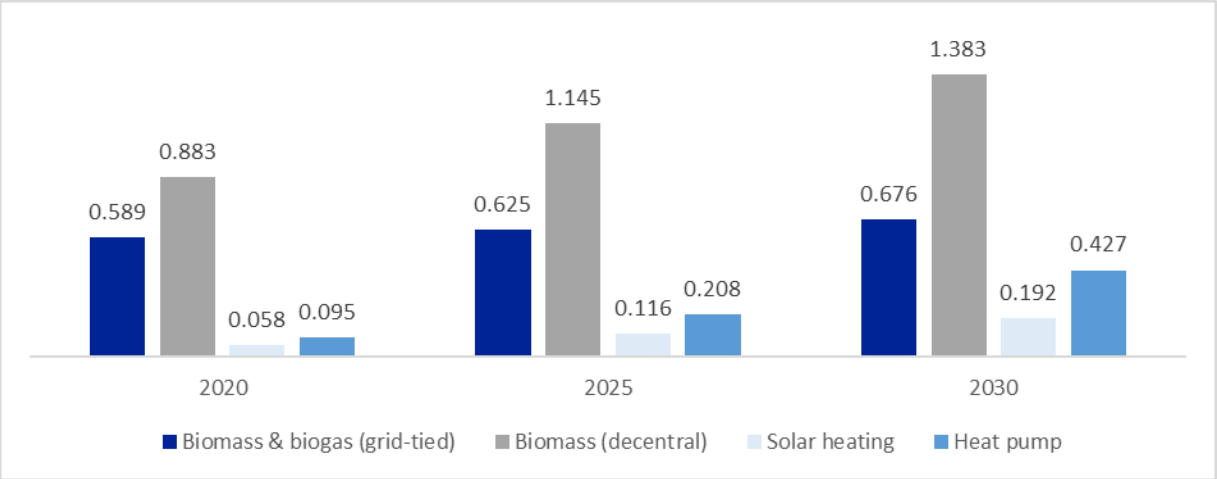


Source: Draft Luxembourgish NECP

The economic potential for the use of CHP plants and heat network-based supply largely depends on the development of refurbishment activities in the building sector and thus on the overall heat demand of the buildings. In the field of decentralized building supply, the CHP use is based on the power range below 500 kW of electrical power.

The economic CHP potentials in the building sector have been tapped to about 50%. Thus, there currently is an economic CHP potential of around 1,170 GWh of useful energy in the building sector. At the same time, there is a limited economic potential of about 500 GWh of final energy and 425 GWh of useful energy by 2030 estimated in the industrial sector, e.g. in the chemical, wood and food industries. To realize this industrial potential, however, good site conditions with long system running times are absolutely necessary.

Technology specific trajectories for H&C. Figures in TWh

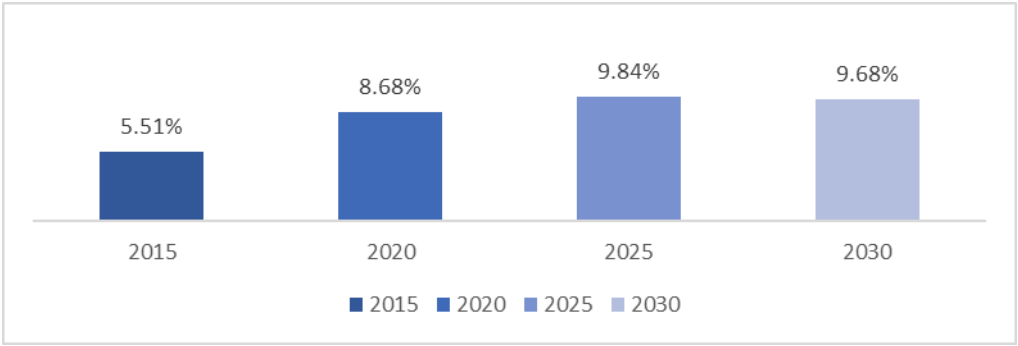


Source: Draft Luxembourgish NECP

19. Netherlands

The government is making considerable efforts to increase the share of renewable energy in the energy mix between 2020 and 2030. Specific ambitions and trajectories for the share of renewable energy in energy consumption are still being worked out in the Climate Agreement. The planned RES in gross final consumption of energy in 2030 is 27% and the 2030 interconnectivity target is 37%.

Dutch projections with regard to RES-H&C



Source: Draft Dutch NECP

After the sharp rise in combined heat and power (CHP) installations in agriculture and horticulture between 2007-2010, hardly any new CHP installations have been added. The number of installations has remained fairly stable in recent years, but there has been a decrease in the production of electricity and heat (water/steam). This is due to the price ratio between natural gas and electricity. Based on the figures for 2016, the share of CHP compared to the total electricity production is approximately 35%. Approximately 60% of the supplied heat and electricity is produced from natural gas and mainly from fuel waste, process gas and a small part from coal. The efficiency advantage based on total fuel consumption in 2016 compared to separate generation can be roughly estimated at 20%.

District heating has a small share in the Netherlands. Due to the extensive gas infrastructure in the Netherlands, natural gas is the most used form to heat buildings. In 2015, a total of 19.6 PJ of heat was supplied via 17 large networks and another 2 PJ via small networks.

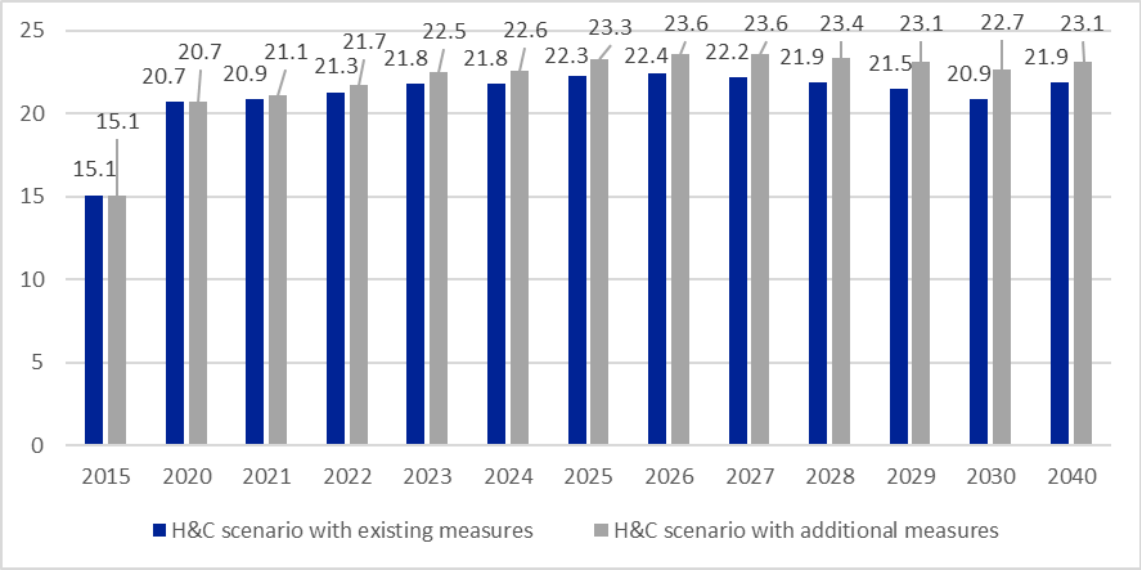
In total around 400,000 homes are connected to a heat network, which corresponds to 5.5% of the number of homes in the Netherlands. The number of connections has grown since 2010 (4.6%) mainly due to the completion of a number of large new-build projects. Based on the expectations of heat network operators for projects that are currently being developed, a 15% growth is expected between 2015 and 2020. Further growth thereafter will depend heavily on new policy measures. To achieve the long-term climate goals, the Environmental Assessment Agency (PBL) expects that 20-30% of the homes in 2050 should be connected to district heating. This potential is achievable only if natural gas is available to a limited extent for homes.

20.Malta

Malta has an interconnectivity target of 24% for 2030.

The country does not have any district heating networks as past studies indicated and confirmed that district heating networks would not be cost-effective given the type of climate and capital costs, thus making such an investment economically unfeasible. In 2017, the consumption of RES in the heating and cooling sector is estimated to have reached 183 GWh, which represents an increase from 166 GWh in the previous year.

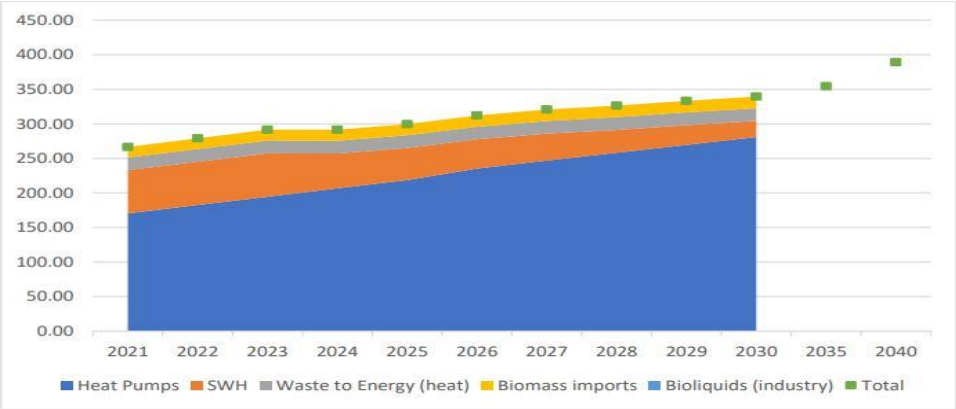
Maltese projections with regard to RES-H&C



Source: Draft Maltese NECP

Heat pump technology is projected to have the most significant contribution to the increase of RES in the heating and cooling sector. The affordability of this technology combined with the continual rise in expectations of thermal comfort ensures sustained growth also reflecting demographic changes. For instance, the number of heat pumps imported in 2016 and 2017 was above average due to increased activity in the construction sector.

RES consumption in Malta's H&C, projections under reference 1 scenario, in GWh



Source: Draft Maltese NECP

As for RES consumption from centralized air conditioning units, Malta is in the processes of analysing the consumption of renewable heat from variable refrigerant flow (VRF) systems for integration into the final NECP. The projections for heat pumps include a share of reversible centralised units; this is based on a preliminary assessment, which will be further studied in 2019 and is therefore subject to revision for inclusion in the final plan.

By contrast, solar water heaters (SWH) are unlikely to be installed if grant schemes to promote uptake are not maintained due to their high capital cost (compared to alternatives such as electric boilers) and long payback period. Indeed, in recent years, Malta has observed a downward trend in new SWH installations despite the availability and promotion of grants. In the reference scenario, it is assumed that there will be no installations of new SWH post-2020, and consumption of RES-H from SWH follows a steady decline from 2025 onwards, as units reach their end-of-life and are not replaced. An assumption of 20 years was made for the technical lifetime of SWH in Malta.

Biomass imports, used for space heating by a small number of households, is not projected to increase significantly; capital costs for such infrastructure is relatively high, and heating by LPG heaters and heat-pumps is likely to remain the preferred mode of space heating. Bioliquid use in industry in the period 2011-2017 was rather low and is projected to be negligible in the post-2020 period. The existing substitution obligation on fuel suppliers will expire at the end of 2020 and it is assumed that suppliers will not continue to import bioliquids should biofuel obligations in the transport sector no longer apply. Generation of renewable energy in the form of heat from waste treatment is projected to remain largely constant. It is assumed that waste treatment plants reaching their end-of-life will be replaced by those of a similar capacity.

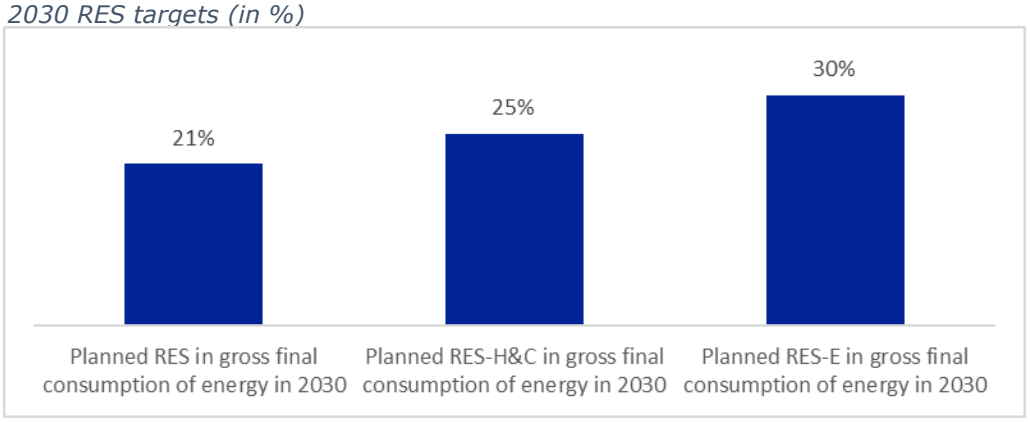
Since 2005 a number of grant schemes to promote the use of SWH for households have been launched and completed. Previous schemes were restricted to specific households, mainly those that meet social assistance criteria. The current National Scheme provides a grant of 50% up to 700 EUR and is not restricted by social criteria. Malta will extend its existing framework, stipulated in subsidiary legislation 545.27

beyond 2020. The existing schemes, focusing on a grant and operating aid, will be extended in order to increase the deployment of renewable energy. Malta will also design schemes to encourage battery integration in PV systems where appropriate.

Split-unit heat pumps in the residential sector are expected to increase from 204,500 at the end of 2017 to 403,000 in 2030 and 527,000 in 2040. In the non-residential sector, installation of new heat-pumps is also expected to increase in line with the country's economic activity. The construction of new or modernisation of office spaces, hotels, and other commercial spaces will create a continued demand for the importation of air conditioning systems employing heat pump technology. In both cases, it is also assumed that units will be replaced once they reach their end-of-life.

21. Poland

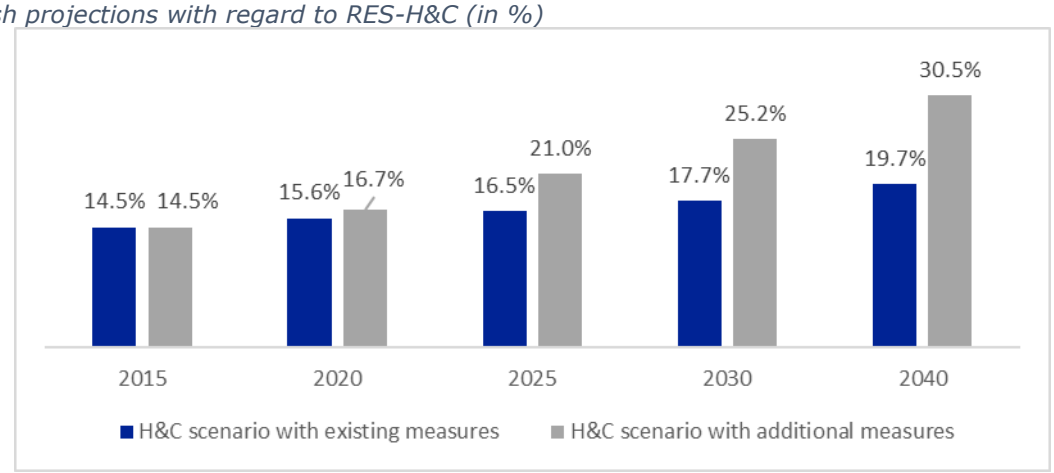
Polish 2030 RES targets (in %)



Source: Draft Polish NECP

Support to renewable energy to meet local energy needs (heat, electricity, transport) but also waste management (compatible with the waste management hierarchy) and to tap local potential (among others) in the form of: auctions, feed-in tariffs, grants, guarantees of origin, and aid schemes targeted at specific technologies.

Polish projections with regard to RES-H&C (in %)



Source: Draft Polish NECP

Development of heat generation installations from RES: The new Directive on the promotion of the use of energy from renewable sources (RED II) introduces new obligations for increasing the share of renewable energy in the heating sector. Due to its local nature, heat will be generated by the need for investment at local government level, which means financing the development of RES sources mainly by municipal companies whose financial health does not always ensure that financial surpluses are provided for investment purposes.

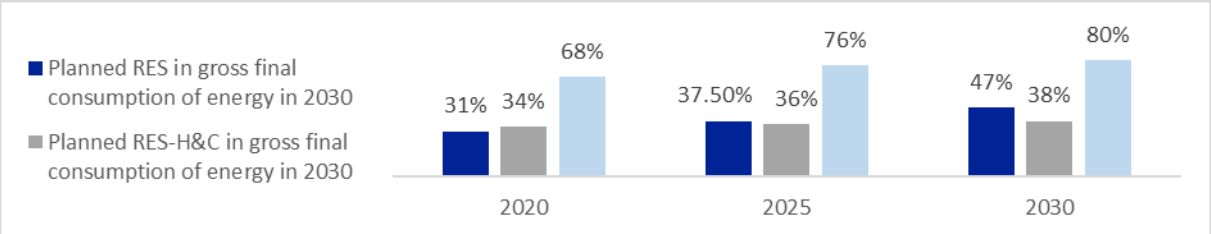
District heating and connecting new customers: Given the need for comprehensive measures to ensure air quality, the development of district heating networks in urban areas leads to improvements and reductions in low emissions from local inefficient boilers. The use of financial support for the development of district heating networks is designed to increase its coverage and allow new heat customers to join. The action is necessary to improve air quality in Poland by eliminating individual heat sources and replacing them with heat networks. It is possible to provide financial support for the modernisation of the infrastructure inside the building necessary for the removal of heating network.

A parallel action necessary to increase efficiency in the use of primary energy carriers and reduce CO2 emissions from the heating sector is the reduction of district heating network losses. Measures for this action should be aimed at the modernisation of thermal nodes and the replacement of heating pipes for pre-insulated heating pipes.

Work is currently being finalised on the introduction of a new support mechanism for electricity from high-efficiency cogeneration, which will both stimulate the construction of new cogeneration units and maintain the production of electricity from high-efficiency cogeneration in existing units that would not operate without support due to a financial gap in operating costs. The new mechanism will be implemented as of 2019. The support scheme will be active as long as the market is in need of intervention. In the longer term, systemic heat should only be produced in CHP.

22.Portugal

Portuguese 2030 RES targets and trajectories (in %)



Source: Draft Portuguese NECP

Portugal has an interconnectivity target of 15% for 2030.

Total effective contribution (final energy consumption) of each renewable energy technology in Portugal in the H&C sector (ktoe)

Year	2020	2025	2030
Solar heating	88	86	83
Biomass	952	956	937
Biomethane	0	20	80
Heat pump	175	200	215
CHP heat (RE)	715	200	215
Hydrogen (RE)	0	4	11
Total	**1,930**	**1,936**	**1,952**

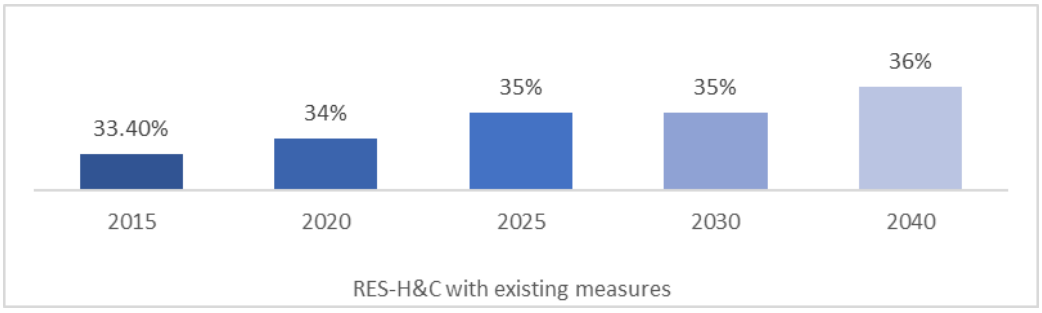
Source: Draft Portuguese NECP

The following policies and measures are in place to increase both RES-H&C and RES-E:

1. Promote the decarbonisation of the generation segment including the closure of coal-fired power plants by 2030;
2. Accelerate the production of electricity from renewable energy sources with a focus on solar;
3. Promote the use of renewable systems in heating and cooling;
4. Encourage investment in domestic production of advanced biofuels through the recovery of waste and endogenous resources;
5. Promote electrification of all sectors of the economy;
6. Encourage the acquisition and use of decentralized production systems. Implement mechanisms to promote and expedite investment and revise the tariff model;
7. Create the regulatory environment conducive to the participation of new players in the market, including local energy communities;
8. Optimize, simplify and review the legal and regulatory framework associated with licensing;
9. Encourage investment in energy transition and introduce innovative mechanisms;

Encourage R&D&I, particularly in the field of storage, low carbon, hydrogen and other 100% renewable fuel technologies.

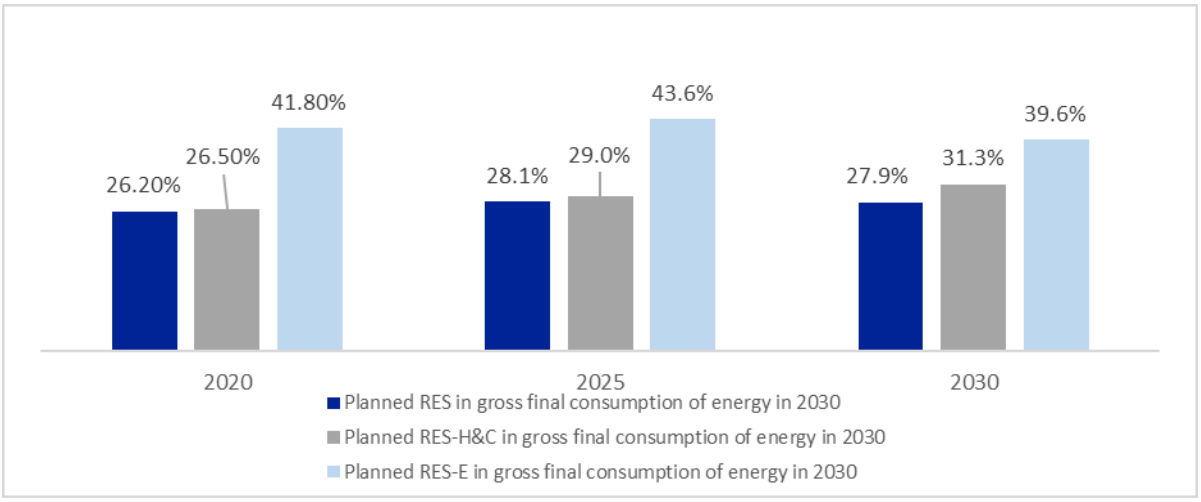
Portuguese projections with regard to RES-H&C (in %)



Source: Draft Portuguese NECP

23.Romania

Romanian RES targets and trajectories (in %)

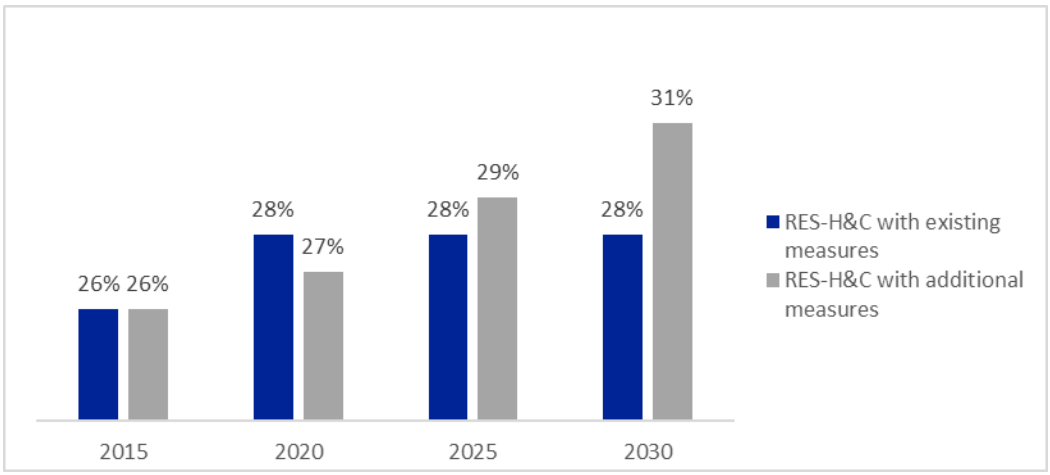


Source: Draft Romanian NECP

The following policies and measures are in place to increase both RES-H&C:

1. Attract investment in network infrastructure, to encourage heating from electrical sources in the residential sector;
2. Promote efficient solutions in residential communities, such as heat pumps in the residential sector.

Romanian projections regarding RES-H&C (in %)



Source: Draft Romanian NECP

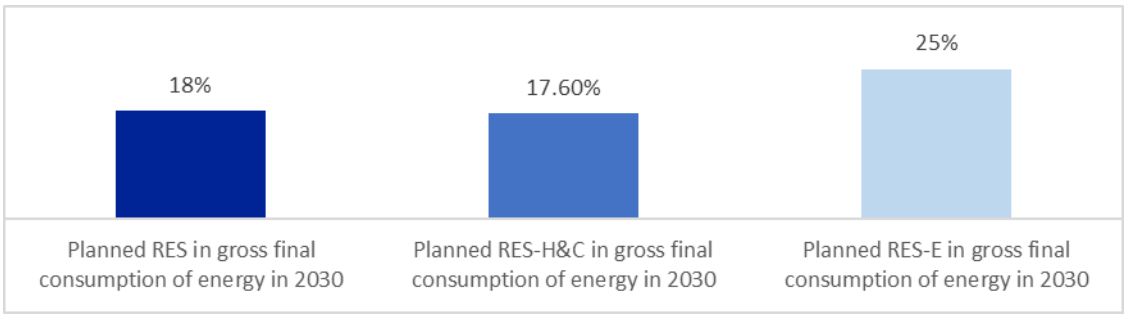
Under Operational Objective OP9 Increase Energy efficiency, several policies and measures concern district heating:

1. Integrated approach to the district heating sector, with coordination of investment projects throughout the supply chain - production, transport and the efficient heat usage (P1);
2. Opportunity analysis for efficient, non-polluting district heating systems (P1);
3. Investments in high-efficiency cogeneration, district heating and cooling (P4).

In addition, the Ministry for Regional Development and Public Administration is carrying out the program 'District heating 2006-2020 heat and comfort' related to the central heating systems of the cities. The results of this program materialized in improved energy efficiency by streamlining the production, transmission and distribution of heat.

24.Slovakia

Slovakia 2030 RES targets (in %)



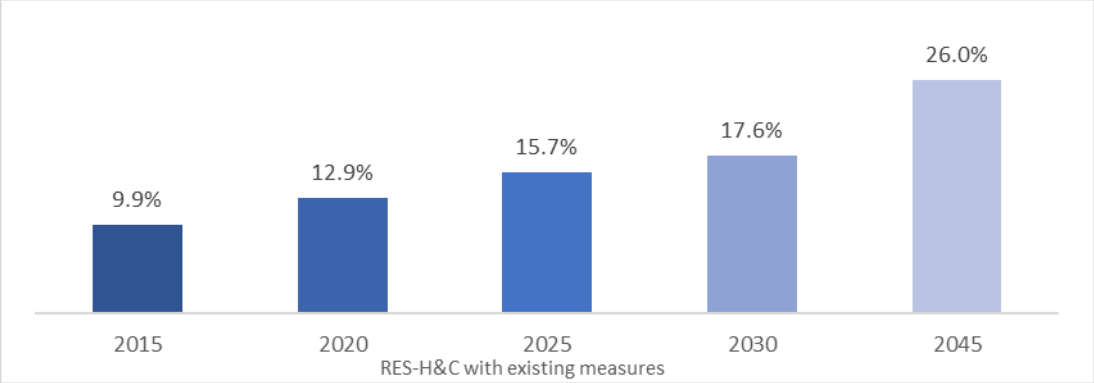
Source: Draft Slovakian NECP

Slovakia has interconnectivity target of 52% for 2030.

In 2017, the total installed capacity for high efficiency cogeneration was 1241 MW with electricity produced at 2545 MWh representing 9% of the total electricity production in Slovakia. Electricity generation is currently predominant in vapour

sampling or back-pressure turbines, according to the combined heat and power technologies. The share of these installations in total installed capacity is 58% and for heat generation 83% of total heat produced by high-efficiency cogeneration of electricity and heat.

Slovakia projections with regard to RES-H&C (in %)



Source: Draft Slovakian NECP

In large sources with steam and gas turbines, only a slight increase in installed capacity is expected to be achieved with the necessary reconstructions of the existing combined heat and power technology. This segment of producers of electricity by cogeneration, in particular heat plants with condensing sampling frames, in addition to the refurbishment and modernisation of these plants, has the effect of replacing those technologies with gas internal combustion piston engines with an electrical power of a single engine of up to 10 MW. The highest potential of additional high-efficiency cogeneration of electricity and heat is foreseen in the existing systems of CZT, from which the supply of heat to final customers is ensured.

Estimated economic potential of heat production by cogeneration in Slovakia

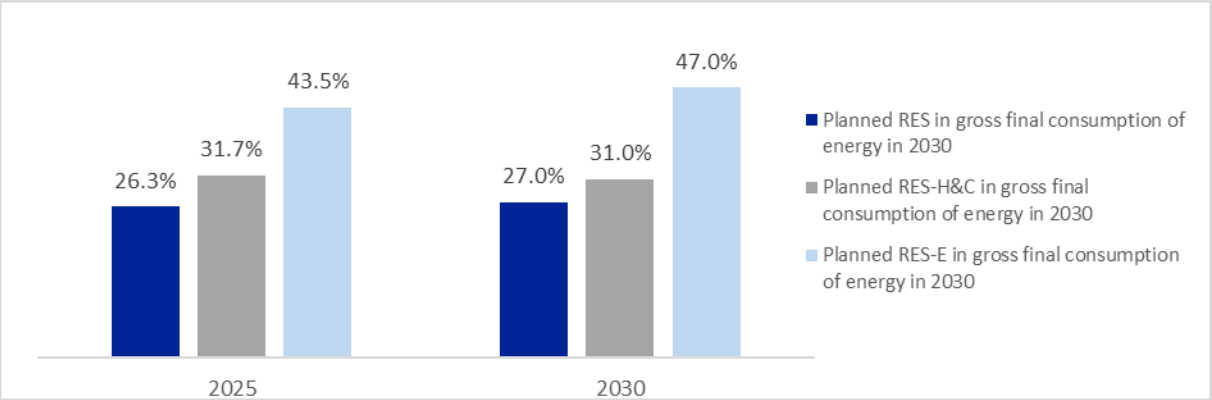
Year	**Actual**				**Assumption**			
	2011		2014		2020		2025	
CHP technology	Installed power	Heat supplied	Installed power	Heat supplied	Installed power	Heat supplied	Installed power	Heat supplied
	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)
Combined-cycle gas turbine	332,0	748,2	332,0	773,2	346,2	806,4	353,4	823,2
Steam backpressure turbine	1854,0	5359,2	1818,2	5118,0	1891,9	5325,8	1929,8	5 432,3
Vapour turbine	4873,0	4760,1	4902,0	4118,2	5227,6	4391,8	5279,8	4 435,7
Gas turbine with heat recovery	83,4	262,9	83,4	176,6	105,4	223,2	126,5	267,9
Internal combustion engine	52,9	264,2	206,9	1229,1	296,9	1763,8	386,0	2 292,9
Other technologies	0,0	0,0	4,8	30,7	23,7	151,3	35,5	227,0

Total	**7 195,3**	**11 394,6**	**7 347,3**	**11 445,9**	**7 891,7**	**12 662,2**	**8 111,1**	**13 478,9**

Source: Draft Slovakian NECP

25.Slovenia

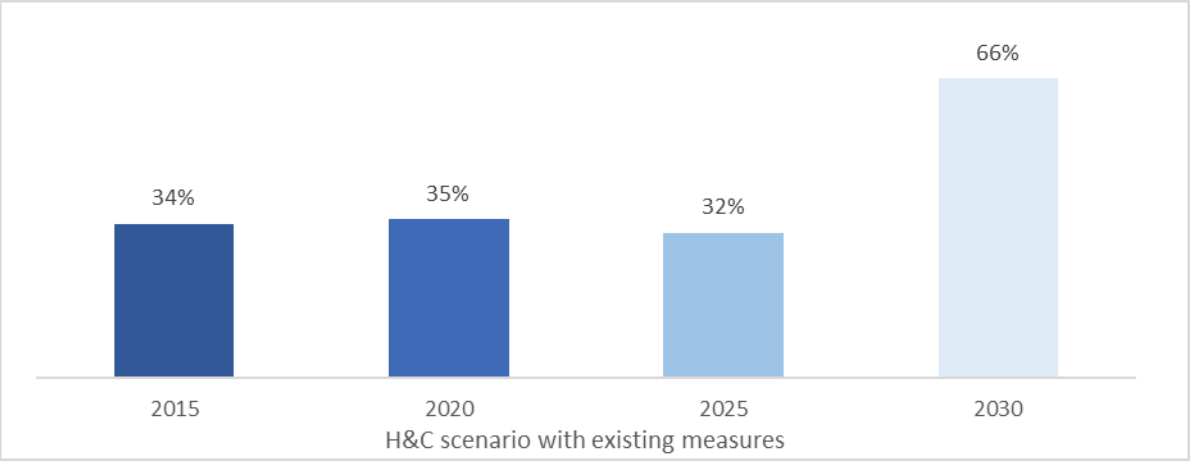
Slovenia 2030 RES targets and trajectories (in %)



Source: Draft Slovenian NECP

A long-term strategy to promote investment in building renovation as an intermediate target by 2030 sets a target of at least two thirds of the energy consumption in buildings from renewable energy sources (this is the share of RES use in the final use of energy products without electricity and district heating).

Slovenia projections with regard to RES-H&C (in %)



Source: Draft Slovenian NECP

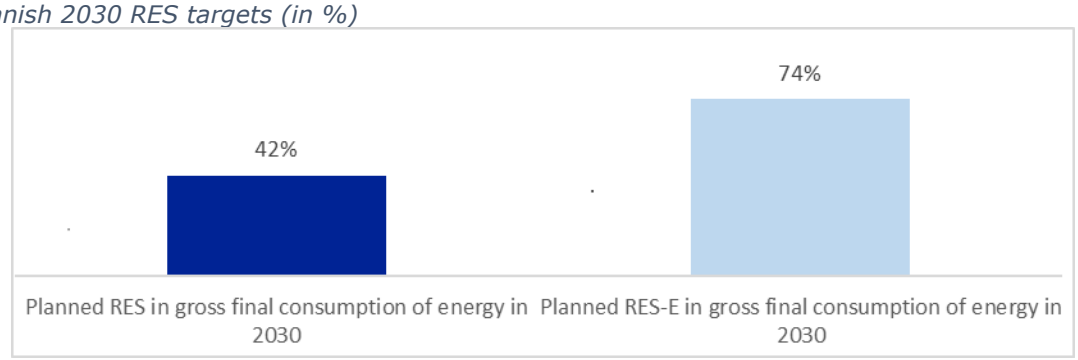
Existing measures only cover a timespan until 2020:

1. Energy rehabilitation of existing buildings, especially in the public sector, and the construction of almost zero energy buildings, which represent the most technologically advanced facilities;

2. Replacement of heating oil with wood biomass and other renewable energy sources;
3. District heating systems for renewable energy sources and high - efficiency cogeneration of heat and power.

26.Spain

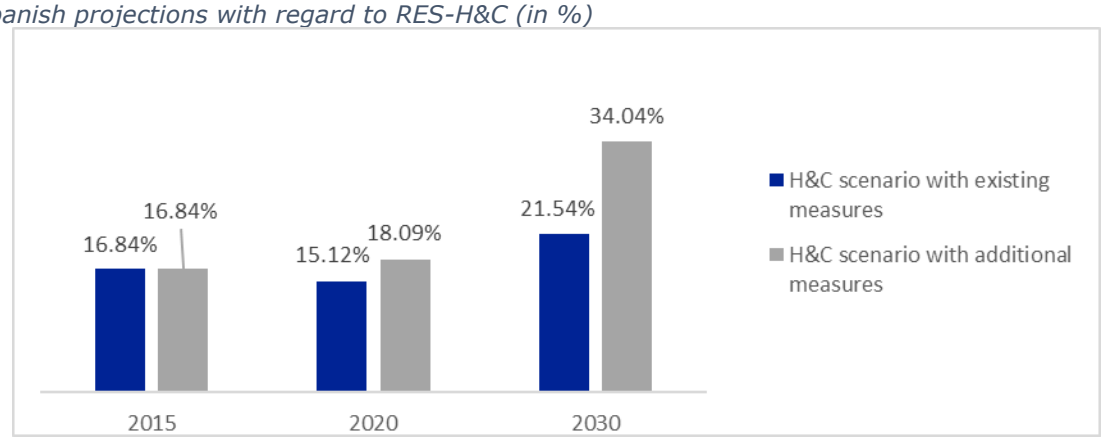
Spanish 2030 RES targets (in %)



Source: Draft Spanish NECP

The interconnectivity target of Spain for 2030 is 15%.

Spanish projections with regard to RES-H&C (in %)



Source: Draft Spanish NECP

In the heating and cooling sector, there are currently no disruptive technologies that lead to decarbonisation. In this case, innovation comes from promoting new actors and investment models. In this regard, the National Plan places the focus on renewable energy communities, proposing the regulatory development that allows them to exercise their right to generate, consume and sell renewable energy. It also proposes an increase in the use of electricity for the generation of heat:

1. Measure 1.4. Support to the industrial sector (relevant for H&C because of lines of support to industries or supporting heat networks, depending on the potential, cost and characteristics of the technology, and the potential to improve their carbon footprint);
2. Measure 1.5. Framework for the development of renewable thermal energy;

3. Measure 1.7. Promotion of renewable gases;
4. Measure 1.10. Specific programmes for biomass utilisation.

27.Sweden

Sweden has an interconnectivity target of 27% in 2030.

There are no policies and measures directly targeting RES-H&C, but the energy and CO_2 -taxes indirectly lead to an increased RES in H&C through taxing heating fuels: Liquid and gaseous heating fuels as well as coal and coke used for heat production is subject to the energy tax as well as the carbon dioxide tax. Sustainable biofuels are exempt from energy tax and the carbon dioxide tax. Fuels used for heat production in combined heat and power plants (CHPs) within the EU ETS have a reduced level of the carbon dioxide tax – 11 percent as of 2018 – and pay 30 percent of the energy tax.

Other heating plants within the EU ETS than CHPs and industrial plants are subject to 100 percent of the energy tax and, since 2018, 91 percent of the carbon dioxide tax. CHPs outside the EU ETS pay 30 percent of the energy tax and, from 1 January 2018, the full carbon dioxide tax rate on fuels used to produce heat. If the industrial activity is part of the EU ETS, no carbon dioxide tax is charged for fuels used for heat production supplied to industrial manufacturing processes.

"In January 2015, the Government introduced a support scheme for biogas production through anaerobic digestion of manure. The support aims to help increase biogas production from manure and thereby gain two-fold environmental and climate benefits through reduced methane emissions from manure and the substitution of fossil energy. The increased digestion of manure offers several environmental benefits. It reduces both emissions of greenhouse gases and eutrophication of fresh and marine waters as well as produces biogas for energy. The biogas generated can be used to generate electricity or heat, or as vehicle fuel. The subsidy amounts to a maximum of 0.40 SEK/kWh of biogas produced. Between January 2015 and September 2016, a total amount of SEK 69 million was shared among 51 biogas plants.

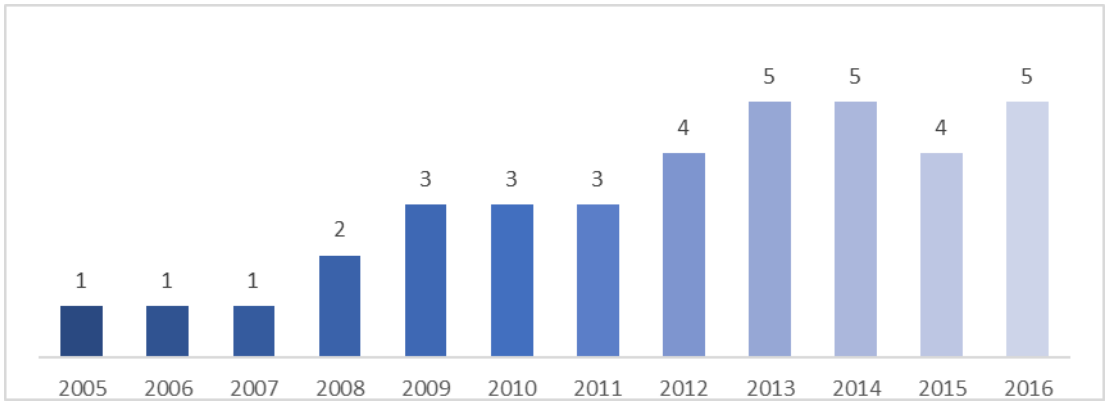
The share of renewables in the heating and cooling sector relative to the energy use is slightly increasing, from 68 percent in 2014 to 69 percent by 2030. By 2040, the share of renewables is 71 percent in the reference scenario. The energy used in the sector today is already largely renewable, but the increased share is due to a slight increase in the use of biofuels, but above all the increased use of heat pumps. In the low-price scenario, the share is the same for 2030, 69 percent, but decreases to 67 percent for 2040.

The Swedish district heating is well developed, and its share of renewable energy is high. The assessment of the necessity and profitability of building new infrastructure is made by the owners.

The combined heat and power potential consist of cogeneration in district heating systems and industrial cogeneration, so-called industrial back pressure. The additional potential for electricity generation from CHP is approximately 15 TWh by 2030, from 10.5 TWh in 2011. This is based on the assumption that district heating supplies will slightly decrease in the long term. Electricity production from the industrial CHP is currently 6 TWh per year. The overall assessment of the potential of industrial back pressure is 8.8 TWh by 2030.

28.United Kingdom

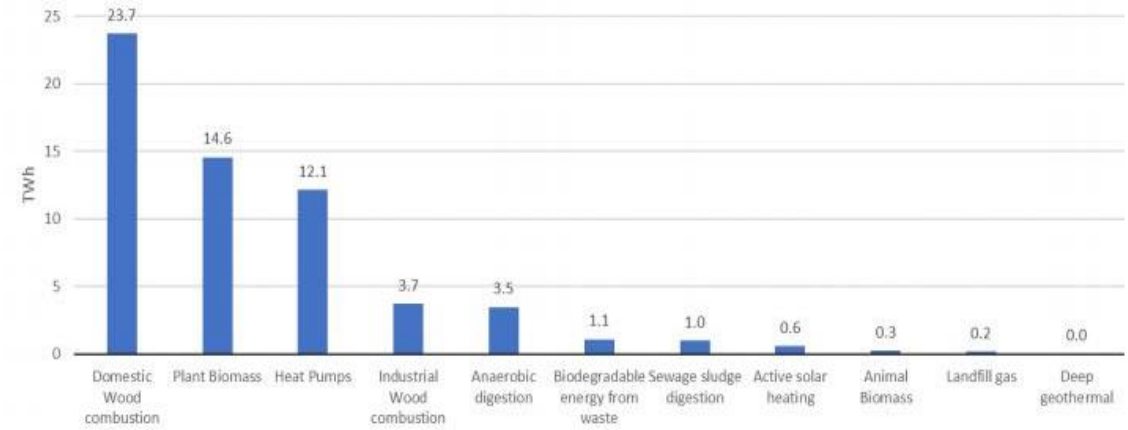
Historic data on the RES in the British H&C sector (in %)



Source: Draft UK NECP

The Non-Domestic Renewable Heat Incentive (RHI) provides financial incentives to increase the uptake of renewable heat by businesses, the public sector and non-profit organisations. Eligible installations receive quarterly payments for 20 years based on the amount of heat generated. The Domestic RHI is a UK Government financial incentive to promote the use of renewable heat. Eligible installations receive quarterly payments for seven years for the amount of renewable heat it is estimated their system produces. In Northern Ireland, eligible domestic RHI installations receive annual payments.

UK Renewable Heat Generation in 2017



Source: Draft UK NECP

In 2013, the UK Government set up the Heat Network Delivery Unit (HNDU) to support local authorities in England and Wales through the early stages of heat network project development. Through HNDU support the UK Government has invested over £17 million in grant funding to more than 200 projects across 140 local authorities.

The UK Government is investing £320 million in efficient heat network projects through the Heat Networks Investment Project (HNIP). The funding will be allocated from April 2019 for up to three years, with £18.5 million of funding already allocated to eight pilot projects.

The Renewable Heat Incentive scheme (RHI) supports the deployment of heat networks by incentivising the take up of those technologies that will play a strategic role in the long-term decarbonisation of the UK such as large biomass and heat pumps. Heat network projects can become accredited to the non-domestic RHI to secure a tariff guarantee, so long as their heat generation plant meets the scheme criteria. The Northern Ireland RHI schemes were suspended for new applicants on 29 February 2016.

In Scotland, the District Heating Loan Fund offers loans to support the development of district heating networks. Since 2011, more than £15 million has been lent to 50 different projects across Scotland.