

Critical Analysis on the Renewable Heating and Cooling plans in Croatia, Germany, Greece, Poland and Portugal

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Abstract

Heat is half of the total energy demand; far more than that required for fuel, transport and electricity. Despite this, only 10% of the heat worldwide is generated from renewable energy sources. The decarbonisation of heating and cooling is therefore of utmost importance for the energy transition. The REDI4Heat project supports the decarbonization of heating and cooling and provides assistance for the implementation of the EU Directives and national regulations. This work presents the main results, concerning the assessment of the EU heating and cooling policy framework and the national regulations in Croatia, Germany, Greece, Poland and Portugal. The study begins with the analysis of the heating and cooling demand, the existing regulations and the decarbonization targets and the progress. Then, the barriers for the further deployment of the renewable heating and cooling in each country are identified and recommendations and priority actions for faster decarbonization are proposed. This study reveals that establishing an effective legal framework, making clean heating and cooling accessible to all, addressing the local dimension of H&C, prioritizing energy efficiency measures, making more data available and overcoming technical obstacles could tackle the remaining barriers in the way of a transition to renewable heating and cooling.

Keywords: National Energy and Climate Plans, Decarbonisation, Heating and Cooling, Energy Efficiency, Renewable Heating and Cooling

Introduction

Heating and Cooling (H&C) represents half of EU energy consumption. The decarbonisation of the sector is critical to achieve the EU legally binding targets of 55% reduction of greenhouse gas emissions by 2030 and climate neutrality by 2050, which are enshrined in the EU Climate Law (EC d). More importantly nowadays, the uptake of renewable and efficient H&C technologies reduces Europe's dependence on energy imports, increasing energy security and contributing to the objectives of REPowerEU (EC i).

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

Therefore, it is of paramount importance that the EU and its Member States step up their efforts to decarbonize H&C. To this end, specific targets for 2030 and 2050 have been set up by the EU and the Member States, accompanied by policies and regulations, both at EU and national level. In this sense, the National Energy and Climate Plans (NECPs) (EC f) and their ongoing revision are key to translate EU policies and targets into national legislation and concrete actions. Member States were due to submit the draft revision by June 2023 and receive

feedback and recommendations by the European Commission by December 2023, with the updated version due by 2024.

The REDI4Heat European project provides technical assistance to Member States and local authorities for the implementation of the relevant EU Directives, such as the Renewable Energy Directive (RED), the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED), and the National Climate and Energy Plans (NECP). The present work focuses on the H&C sector of the five target countries participating in the REDI4Heat project (Croatia, Germany, Greece, Poland, Portugal) and aims at assessing their current H&C plans and the uptake of RES and EE technologies, with the view to identify the challenges and to propose priority actions for the wide deployment of renewable H&C solutions.

1. Analysis of EU Framework

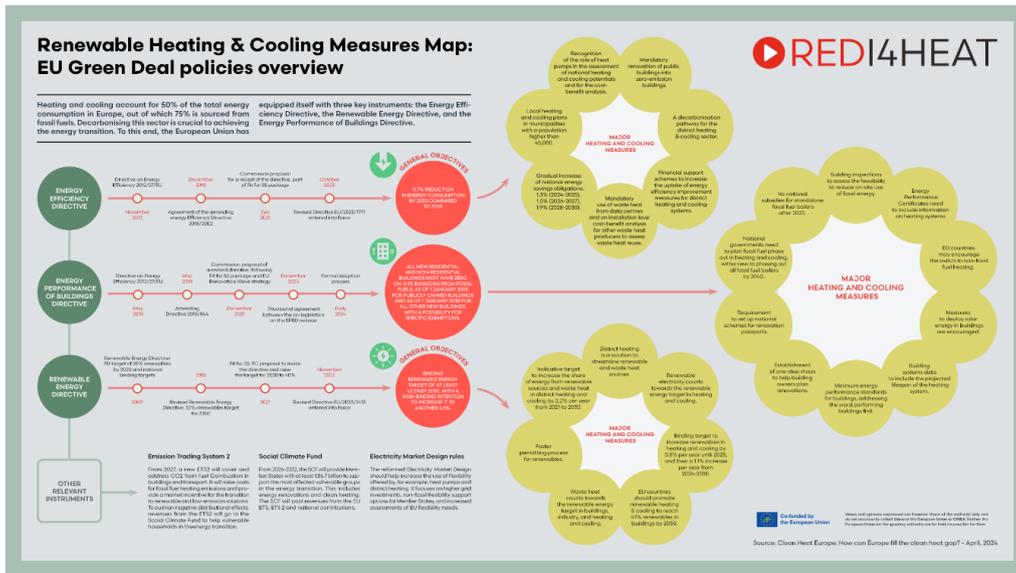


Fig. 1: Mapping of the new Renewable Heating and Cooling measures (REDI4Heat European project)

This analysis refers to the comparison of articles relevant to heating and cooling in the Energy Efficiency Directive (EED), the Renewable Energy Directive (RED) and the Energy Performance of Buildings Directive (EPBD). A map has been produced (Fig. 1) that visualizes in one page all the new RHC measures and three high level policy briefings for RED, EED and EPBD, that are all available at the REDI4Heat project website. For the EED, relevant articles are 25 and 26 and for the RED the relevant articles are 3, 15, 15b, 15c, 22a, 23, 24 and 29.

1.1. EED

The analytical comparison between the old (2018) and new (2023) EED showed that there are four new important provisions: Alignment of the comprehensive heating and cooling assessment with the NECPs, the requirement for local heating and cooling planning for towns and cities with more than 45,000 inhabitants, the redefinition of the efficiency criteria for district heating networks and the stronger consideration for waste heat and recommendation for data centres to connect. Furthermore, the SWOT analysis highlighted better synergies between the EED articles and the RED articles, the obligatory nature of certain provisions with precise deadlines (especially for the definition of heat networks), local planning, as well as the definition of heat networks as efficient that will potentially unlock public and private investments.

However, the analysis revealed important weaknesses and in particular:

- The lack of specifications regarding exceptions, criteria and sometimes, timelines. And this in a context where Member States still have a large margin of maneuver to interpret the text during its transposition in the two years following publication.
- An increased risk of disparity between Member States both on the share of renewables in heat networks,

in particular on the issues of considering waste heat, and on the way of making local heating and cooling plans.

- The capacity and skills of Member States to achieve the outlined targets.
- The indicative character of certain key targets which might not serve as a strong driver to the Member States to be achieved.
- The timetables are too tight and the Member States risk not having time to carry out their study for this revision in 2024 and will therefore have to delay them.

To sum up, the EED can make a major contribution for all Member States to achieve the 2030 targets and set their path towards carbon neutrality by 2050. However, two important parameters may jeopardize this contribution; the degree of freedom that MS have in interpreting the text when transposing it into national law and the technical and financial support mechanisms that will be adopted to enable these measures.

1.2. RED

The 2023 revision of the RED has significantly increased its overall ambition, as well as the sectoral efforts for heating and cooling. Certainly, the energy crisis triggered by the Russian invasion of Ukraine played a crucial role, with the EU facing the consequences of its reliance on imported fossil fuels in terms of energy security and affordability for its citizens and businesses. Nonetheless, especially regarding heating and cooling, the new measures introduced are far from sufficient to meet the urgency of the climate challenge, as demonstrated by the SWOT analysis, and should therefore be considered as an encouraging starting point. The new RED set some important targets for renewable sources, including:

- The headline target for the share of renewables in the EU energy mix in 2030 (article 3), was raised to 42.5%, more than ten percentage points higher than the previous one.
- The sectoral target for the share of renewables in heating and cooling (article 23) was made binding; while the target per se is close to a business-as-usual scenario, its mandatory nature is a crucial step to ensure compliance by Member States.
- The new indicative target for the share of renewables in buildings in 2030 (article 15a) was set at 49%.
- The new indicative target for the share of renewables in industry (article 22a), requiring an average annual increase of 1.6% for the periods 2021-2025 and 2026-2030.
- The target for the share of renewable energy in district heating, while maintained indicative (non-binding), was raised from a 1% average annual increase to 2.2%.

The new RED has also introduced several articles aimed at streamlining and accelerating permitting procedures for renewable energy installations, through the identification of renewable acceleration areas and dedicated measures for specific technologies. These new articles are included through a targeted amendment presented by the Commission in May 2022, as part of the REPowerEU package, to speed up the deployment of renewable technologies and reduce dependency on Russian fossil fuels.

1.3. NECP

The qualitative assessment implemented for the NECPs in the five REDI4Heat Member States (EL, DE, HR, PL and PT) showed that the NECP vary strongly concerning the content, the structure and the quality of drafting across MS and that the Member States are making real efforts to reach EU targets for 2030 and beyond. It also revealed though that the outlined specific strategies often lack clear measures to reach individual targets and timelines and often, there is a need for the targets and strategies to become stricter. One of the biggest challenges seems to be the phase-out of fossil fuels, since clear and strict measures are lacking. Furthermore, local heating and cooling planning is not properly addressed, along with the related support measures that would help local authorities towards this direction. Last but not least, more efforts are needed concerning the easing of administrative procedures and support to connect to DHC networks.

2. Assessment of Target Countries

2.1. Croatia

The total final energy consumption (TFEC) for H&C was 3,253 ktoe in 2018, with 8% increasing tendency for 2030. The share of RES in the H&C sector was 36.5% in 2018, however the projected number for 2030 is almost the same, so basically no growth in RES H&C is expected.

Croatia claims that it meets the requirements set out in Article 23 of the Renewable Energy Directive (RED) II, as more than 60% of the district heating (DH) networks are supplied by cogeneration of heat and power (CHP) systems. Though, their fuel source is not specified.

The RES target in the H&C sector has been increased from 38.1% to 47.1% in the draft revision of the Croatian NECP (EC a). The most important measures for the H&C sector in the NECP are: the upgrade of the DH systems through insulation, RES integration (mainly geothermal, solar thermal and heat pumps) and boilers replacement with CHP systems; the wide renovation of public and private buildings with replacement of old heating systems; the CO₂ emission tax for non-ETS stationary sources emitting more than 30tn CO₂ annually; the provision of financial incentives for the development of RES projects for thermal needs (mainly geothermal and biomass) and the participation in the Covenant of Mayors program for reducing emissions by 40%.

Solid biomass is the dominant source of RES, since it covers the 45% of the heating loads in households, followed by natural gas boilers (20%) and electric heaters. However, most of the biomass devices are traditional wood stoves, which are inefficient and uncontrolled and result in high particle emissions. For this reason, a reduction of biomass and an increase in heat pumps is expected in the upcoming years. Today, in Croatia the potential of heat pumps is largely untapped and the market is dominated by air-to-air heat pumps, used mainly for cooling in the coastal region. In continental Croatia, heat pumps are installed in refurbished and newly built buildings. District heating in Croatia has 10% share in the RES H&C sector and it is supplied by natural gas CHP systems. The 80% of the total DH systems are in the City of Zagreb. Decarbonisation of DH systems is a key measure for the NECP and the most promising technology is deep geothermal whose exploration has already secured finance.

2.2. Germany

The TFEC for the H&C sector was 109 Mtoe in 2018 (REDI4Heat). The share of RES in the H&C sector was 13.6% in 2018 and the projected number for 2030 is 24.2%, so a fair growth is expected.

The targets for the H&C sector in the 2019 NECP are (EC f): reduction of GHG emissions at least 55% by 2030 compared to 1990 levels; 30% RES in gross energy consumption by 2030 and 30% reduction of primary energy consumption by 2030 and 50% by 2050 compared to 2008. Other national goals include: achievement of climate neutrality by 2045 and 50% increase of RES heat by 2030. The recent Renewable Heating Act (EC h) mandates a 65% RES heat share for all new heating system installations and an extensive subsidy program is released, supporting heat pumps and the decarbonisation of district heating networks. Specific measures tackling energy poverty should be highlighted, since the energy poverty risk has been increased from 14.5% in 2021 to 25.2% in 2022 (iwkoeln).

The uptake of RES and EE in Germany is still hindered by several obstacles, including regulations, initial costs and lack of skilled labor. According to projections, a mild increase in the use of biomass and waste heat is foreseen between 2020 and 2030 (from 13 to 14 Mtoe), while other RES are expected to experience a more robust growth, from 2 to 6 Mtoe (Climate Change Laws a).

Biomass boilers are broadly available, with 14 million boilers being installed in Germany in 2023 (umweltbundesamt). Heat pumps are already installed in every third new building today and this number is expected to increase in the coming years. However, more support programs and campaigns are needed to accelerate the uptake. The main obstacles are long delivery times and lack of skilled labor. Solar thermal is widely deployed in Germany, with 15.5 GWth of installed capacity in 2022 (Solar Heat Europe). The 2019 NECP (EC f) foresees that solar thermal production will grow from 900 ktoe in 2020 to more than 2000 ktoe by 2030. While the residential market remains the main segment, the use of solar thermal in district heating and industrial processes is growing rapidly. Geothermal energy only accounts for 4% of RES in Germany (zdf). Currently, there

are only 42 deep geothermal plants in Germany with very limited capacities (geothermie).

2.3. Greece

The TFEC for the H&C sector in Greece was 5 Mtoe in 2018, with a 30.18% share of RES in the H&C sector. The latter is expected to reach 43% in 2030. With a share of 60%, biomass is the dominant RES technology in the H&C sector in 2018, followed by heat pumps (21%) and solar thermal (18%). A substantial growth in RES heat is expected, almost 114%, until 2030. This growth is not expected to be covered by biomass. Solar thermal technology will cover part of this growth, since the projection is a 39% increase by 2030. Notably, the RES share in the DHC sector is expected to be decreased; from 43 ktOE in 2020 to 39 ktOE in 2030.

The targets for the H&C sector in the 2023 draft revision of the Greek NECP (EC e) include 54% reduction in GHG emissions compared to 1990; 45% share of RES in final gross energy consumption; 46% share of RES in heating & cooling and 44%-49% increase in energy efficiency. Available information indicates that these targets will be slightly higher in the updated NECP that will be submitted in 2024. Further specific measures for H&C are outlined, including:

- wide energy upgrade of the building stock. The annual share of renovation in residential buildings will increase to 1.4% in 2030 (from 0.8% today) and will reach 1.7% in 2050, contributing to the renovation of 43% of residential buildings.
- wide deployment of heat pumps: 17% of residential buildings are expected to meet thermal needs by heat pumps by 2030 and 91% by 2050.
- promotion of decarbonised H&C, such as solar thermal systems and heat pumps.
- mixing of 12-15% biomethane in the natural gas transmission system.
- deduction in income tax for H&C investments with solar thermal, biogas/biomass, geothermal and heat pumps. The deduction is 10% of qualifying project costs up to a maximum of 3,000€ (Greek Law 4399/2016).
- subsidies and tax breaks for investments in RES H&C by private enterprises or social co-operatives.

Particular attention has to be paid in the energy poverty issue. Greece has particularly high levels of energy poverty due to low incomes and high energy needs stemming from old energy-inefficient housing (EC c); 65% of the country's buildings were constructed prior to 1980 (EU Climate-ADAPT), with practically no thermal protection systems.

From 2010 to 2021, renewable H&C increased from 50 PJ to 67.5 PJ and from 19% to 31.1% of total H&C demand. This growth was driven mainly by increased use of heat pumps (from 3 PJ to 18.3 PJ), of solar thermal (from 10 PJ to 12.7 PJ) and biogas (from 0.1 PJ to 1.4 PJ). The use of solid biomass for H&C declined from 45 PJ in 2011 to 34.7 PJ in 2021. However, solid biomass still accounts for the largest share of renewables in H&C (51.4% in 2021), followed by heat pumps (27.1%), solar thermal (18.8%), and biogas (2.1%). It has to be mentioned that Greece has the highest use of solar thermal heating among the International Energy Agency country members, as it covers 5% of demand in buildings, compared to the IEA average of 0.6%.

Biomass in the H&C sector corresponded to 868 ktOE, (54% of the total renewable H&C mix of the country) (Eurostat). Out of this, the largest share is attributed to households as direct consumption (646 ktOE) followed by industry (130 ktOE). Solid biomass is the predominant renewable energy source for residential heating and is currently used in the form of firewood (in older appliances), pellets or agrobiomass, mainly as residues connected to the olive industry. Unfortunately, in the latest version on the NECP there are no major provisions for biomass and this represents a missed opportunity.

Regarding heat pumps, higher penetration of air conditioning units in residences and increase of cooling demand was shown in 2021, when the electricity covered 50% of total energy demand from buildings: 36% for residential buildings and 83% for service sector buildings. Wide electrification is expected to further increase the heat pumps share in the residential sector to 47% in 2030 and to 81% in 2050. Support measures for the electrification of heating demand are already taken (subsidies, loans, tax breaks).

As for solar thermal, Greece is a global leader, being among the top 5 countries by installed capacity per 1,000

inhabitants in 2023 (IEA b). In 2021, the installed capacity in operation was 3,606 MWth, representing 5,152,200m² of solar thermal collectors' area. The solar thermal market in Greece, which started 40 years ago, is still growing, by 18% in 2021 and 17% in 2022.

Exploitation of geothermal energy for heating and cooling purposes is limited and no major provisions exist in the latest version on the NECP. DH in Greece is also limited with 5 installations relying on lignite and natural gas. The decommissioning of the lignite factories has raised public debate on the operation of DH networks. Due to climate conditions, this technology is not expected to gain significant growth in the forthcoming years.

2.4. Poland

The TFEC for H&C amounted to 37.7 Mtoe in 2018 and the projections show a decrease of almost 11% from 2020 to 2030. The share of RES in the H&C sector was 14.5% in 2018 and is expected to grow to 28.4% in 2030. With a share of 97.4%, biomass was the main renewable technology in the sector in 2018; its use is expected to increase by 7.7% by 2030, compared to 2020. Heat pumps and solar energy are expected to increase largely by 2030, compared to 2020, by 195% and 371% respectively. DH energy amounted to 2670 ktoe in 2015. The share of RES in the DH sector was only 2% in 2015 (coal was 90%) but it will increase to 29% by 2030. Poland has a wide set of regulations on H&C:

- Increase energy efficiency standards for boilers and thermal insulation,
- Promote the use of RES in all buildings.
- Upgrade of heating plants, support for high-efficiency CHP plants,
- Promote energy-efficient and low-carbon DH, upgrade and expand the DH network.
- Especially for new buildings, the WT2021 Technical Guidelines have been released, which limit the annual primary energy consumption of designed buildings to 70 kWh/m². This requirement cannot be met without covering, at least partially, the energy demand for heating with RES.

In Poland, energy poverty rates are high. In 2022, the amendment of the Energy Law included the definition of energy poverty (CEE Bankwatch). "Poland's Energy Policy until 2040" aims to reduce energy poverty to 6% by 2030. However, Poland lacks a comprehensive, unified strategy to tackle energy poverty, despite substantial funding allocated for vulnerable groups.

Biomass and waste heat accounts for almost 90% of the share of RES in H&C and will continue to perform well in households. With 2.4 MWth of cumulative installed capacity in 2022, Poland is the 6th largest European market for solar thermal. In Poland, a solar collector produces 100% of the hot water in the summer (a storage tank is required) and can supplement the energy from the primary source to some extent during the rest of the year. Solar collectors are considered as a complementary source to the primary source. The heating energy production from solar thermal is expected to grow from 45ktoe in 2015 to 426ktoe in 2030 and 564ktoe in 2040 (Climate Change Laws database b). Heat pumps are becoming increasingly popular in households, though low winter temperatures can affect the efficiency of air-source heat pumps. Geothermal energy has not been exploited so far, but an upward trend is expected.

2.5. Portugal

The TFEC for the H&C sector was almost 6.2 Mtoe in 2018 and the projections show a decrease of 7.4% from 2020 to 2030. The share of RES in the H&C sector was 41.2% in 2018 and it is expected to grow to 47% by 2030. Bioenergy is the dominant renewable in the sector and its consumption is expected to remain stable until 2030. Energy supplied from heat pumps and solar thermal remains constant over the next decade. Portugal does not expect to deploy DH networks. Specifically on H&C, the main policy instruments are:

- Development of professional training programs for the technicians and installers,
- Wide building renovation strategy, including integration of energy efficiency and RES "easy win" solutions,
- Promotion of RES H&C systems, such as solar thermal systems, biomass boilers and hybrid systems,
- Development of a National Action Plan to accelerate the uptake of heat pumps in buildings and industry,

with the framework of the EU Heat Pumps Action Plan,

- Establishment of the requirements for the improvement of the buildings energy performance and regulation of the Energy Certification System for buildings.

As regards the H&C sector, energy efficiency measures and electrification of consumption are stepped up (EC g). In this context, the share of RES in H&C may be increased, but it should be noted that Portugal is one of the countries of the European Union where it may not be possible to increase the share of renewable energy sources by 1.3% or 1.1% per year in the H&C sector, in accordance with Directive (EU) 2018/2001. However, given that renewable gases, such as biomethane and renewable hydrogen, are expected to play a greater role by 2030, this outlook could change in the short to medium term.

Portugal is in the top 5 of EU countries for the inability to keep home adequately warm (EC c), therefore it experiences substantial energy poverty. The Long-Term Strategy to Combat Energy Poverty, approved in January 2024, will monitor the evolution of the energy poverty at the national level, through the creation of the National Energy Poverty Observatory. Also, in the framework of the National Strategy, action plans to combat energy poverty will be developed and proposed to the government, with a periodicity of 10 years, that will be reviewed every 3 years.

Heat pumps represent a small fraction of the market since they have high upfront costs and their integration to the existing poorly insulated buildings limit their effectiveness. Solar Thermal has a strong presence, especially in single family houses. The use of solar thermal is indirectly incentivised by the national obligation for new buildings. However, the installation procedures and licences acquisition for existing buildings is a challenging issue that hinders the new installations. Biomass and geothermal systems are present but not widespread and this is not expected to change in the future. DH systems will also not experience any growth or upgrade.

3. Challenges and Priority Actions

3.1. Unambitious RES targets

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

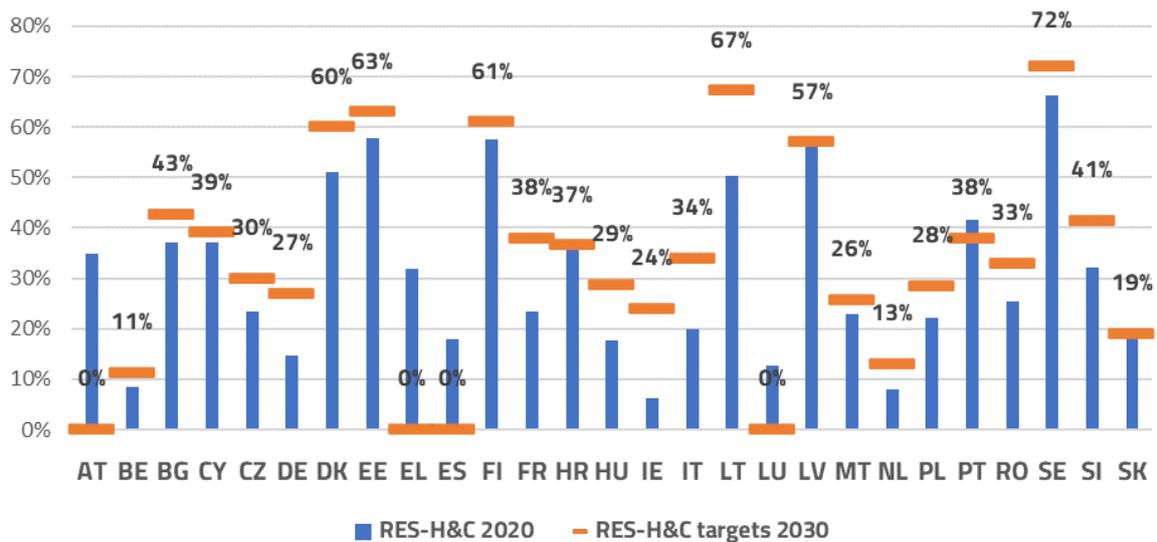


Fig. 2: Share of RES in EU Member States in 2020 (blue) in comparison to the targets for 2030 (orange)

The graph shows that the 2030 targets are unambitious and often reflect a business-as-usual scenario. More

specifically, there are 4 countries without RES targets for H&C at all and there are 17 countries with RES targets lower than 40%. The draft revisions of the NECPs seem to confirm this tendency. While the energy crisis and the political efforts to reduce EU dependency on Russian fossil fuels triggered a significant increase in the RES targets in electricity and transport, this increase is significantly more modest for H&C.

3.2. Ineffective legal framework for H&C

The decarbonisation of H&C should be a top priority for EU, national, and local policymakers, considering it represents the lion's share of Europe's energy consumption. Furthermore, the recent energy crisis has highlighted the urgent need for transitioning into RES solutions that are reliable and secure. However, the sector is still dominated by fossil fuels.

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

Special attention has to be paid in the NECPs, which tend to focus on matters that are directly in the hands of central governments. Most NECPs dedicate limited space and few specific measures to the H&C sector. In fact, the parts on H&C are often scattered and split between the chapters on the renewable energy and energy efficiency dimensions, as well as significantly shorter than the sections on electricity, renewable gases, or transport.

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

An appropriate regulatory framework and the selection of right policies are a prerequisite for a successful transition towards decarbonising H&C. An easy solution would be to make measures legally binding. But this is risky, since mandating RES and EE may hinder people's comprehension of their real value to the environment and public health. Smarter, indirect solutions are needed, such as public campaigns and publicity, financial incentives, new building standards, increasing market availability, redirecting carbon revenue to vulnerable groups. In all cases, deploying measures at various policy levels should be strongly coordinated to ensure coherence between all measures and to avoid contradictory measures, leading to confusion and limited implementation.

3.3. Lack of Local H&C planning

Every region has different climatic conditions, geology, infrastructure, building types and condition, occupancy profile patterns and available energy sources. What works in a Greek city will probably not work in a Polish town. Therefore, H&C planning should happen not only at national level, but also at regional and local level and policies should cater also for settlements below 45.000 inhabitants. In this aspect, more than half of European countries will require a new legislative framework and a new support system for both Regions and Cities. With Regions and Municipalities being often understaffed, this support should include training and upskilling of their personnel, providing guidance and resources to help Municipalities of all sizes draw up a sound and functional plan. More importantly, the effectiveness of these local plans should be monitored, regularly assessed, ensuring mitigation measures in case of misalignments.

3.4. Just H&C transition

Today 41.5 million Europeans, 9.3% of the EU's population, cannot adequately warm their housing (The Cool Heating Coalition). Among the poor, 1 in 5 suffers cold at home, as they tend to live in the worst-performing homes with the highest heating costs. Therefore, making RES H&C accessible to all consumers should be the core intent of any policy action. However, in 2023, only 9 Member States provided a suitable level of energy efficiency subsidies in low-income households (The Cool Heating Coalition). Even though RES costs are falling as they become more widely available, there is still urgent need to support low-income consumers in accessing these technologies. Policies adopted should serve low-income households first and foremost, from a ring-fenced share

of EU and national funds, leaving no one behind.

3.5. Energy efficiency first

The cleanest energy is the one which is not used (EC b). In other terms, reduction of energy demand should be prioritized over the supplying the demand with low emission sources. Higher energy sufficiency can be achieved, among others, through insulation, tree planting, shading, upgrade of equipment, connecting to DH networks, de-steaming in industries, smart energy management and last but not least, through awareness raising campaigns on the methods to improve thermal comfort.

3.6. More data

During the research work in REDI4Heat, the partners revealed a lack of energy-related and spatial data across the target countries. The granularity of available data also varies, with potential misalignments and discrepancies affecting the reliability of findings. Lack of data availability and poor data quality pose significant challenges in analysing and assessing the H&C sector. This obstructs the decision-making process, the identification of policy priorities and the development of new proposals that are meaningful. Good practices are found in Germany, where energy utilities are obliged to share their data in open access databases. The data is then used to evaluate the quality and impact of the plans.

4. Conclusions

The EU heating and cooling policy framework is undisputedly a major contributor for the speed of the energy transition and the path towards carbon neutrality. The new updated EED and RED Directives are moving in this direction, however, especially for the heating and cooling sector, there are still crucial parameters that may jeopardize this contribution; such as the degree of freedom that MS have in interpreting the EU texts when transposing it into national law and the selection of the support mechanisms to enable these measures.

The analysis of the NECPs in the five MS has shown that the MS are making real efforts to reach EU targets for 2030 and beyond. It also revealed though that the outlined specific strategies often lack clear measures to reach individual targets and timelines and often, there is a need for the targets and strategies to become stricter. One of the biggest challenges seems to be the phase-out of fossil fuels, since clear and strict measures are lacking. Furthermore, local heating and cooling planning is not properly addressed, along with the related support measures that would help local authorities towards this direction. Last but not least, more efforts are needed concerning the easing of administrative procedures and support to connect to DHC networks.

On the other hand, RES H&C technologies, such as biomass, solar thermal, heat pumps and DH are ready to drive the decarbonisation efforts. Thanks to their different strengths, these solutions can address the different market needs in different countries; moreover, their combination can often maximise their efficiency and minimize their limitations for the individual installation and/or the energy system as a whole. Their main barriers are higher upfront costs and lack of awareness for the society and the public authorities. Energy transition requires overcoming these barriers and therefore, policymakers should play an active role in the uptake of renewable H&C solutions and the decarbonisation of the H&C sector, which accounts for half of the EU's energy consumption.

5. Acknowledgments

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