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The European Union's Path Towards Climate Neutrality

An Analysis of Target and Policy Changes in National Energy and Climate Plans

Bachelor's thesis in Global Systems Engineering

Department of Space, Earth and Environment

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Abstract

To minimise the effects of climate change, there are many sets of targets that requires cooperation in order to be met. In 2018 the EU introduced the Regulation on the governance of the energy union and climate action, which described how member states should make the individual and collaborative effort to meet the European Union's 2030 climate and energy targets. The Regulation introduced National Energy and Climate Plans that each member state has to submit, which includes national targets and plans on how the member states are planning to meet the 2030 targets.

This study investigates the progress of EU member states towards their climate and energy targets. This has been done by analysing changes in member states' targets and policies in the 2019 and 2023 National Energy and Climate Plans. Targets and policies regarding greenhouse gas emissions, renewable energy sources and energy efficiency have been analysed. The main findings includes an overall increase in member states' targets. The policy changes differs between dimensions and member states'. Overall there is no clear evidence that the policy changes that have been made between the 2019 NECPs and the 2023 NECPs are enough to meet the strengthened targets.

Keywords: NECP, national energy targets, greenhouse gasses, renewable energy sources, energy efficiency, policies, implementation gap.

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List of Abbreviations

Below is the list of abbreviations that have been used throughout this thesis listed in alphabetical order:

EE	Energy Efficiency
ESR	Effort Sharing Regulation
ETS	Emissions Trading System
EU	European Union
GHG	Greenhouse Gas
NECP	National Energy and Climate Plan
RES	Renewable Energy Sources

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1
Introduction

Climate change is one of the largest challenges that humanity faces today. With consequences such as extreme weather and changes to ecosystems, it will require both adaptation and mitigation from all countries [1]. Cooperation is necessary to make the combined effort needed to minimise the effects of climate change [2]. The European Union (EU) is a central cooperative that has the ability to coordinate and implement the changes, which member states of the EU needs to be able to deal with climate change [3]. As part of this coordinated cooperation, the EU has introduced National Energy and Climate Plans (NECPs) for each member state to submit, which contains national targets and policies that address the country's strategy to reduce its greenhouse gas (GHG) emissions and make the necessary transitions in society [4].

The first NECPs were sent to the EU in 2018 as drafts for the finalised 2019 version [4]. Similarly, draft updates of the NECPs were submitted to the EU in 2023 with new and updated information of how the member states were planning to meet the EU's targets. Between the submission of the 2019 and the 2023 reports, the EU has significantly strengthened their targets in e.g. phasing out the dependence on fossil fuel and increased energy savings [5]. Furthermore it is therefore relevant to analyse the strengthened measures and to what extent member states have increased their targets in the draft updated NECPs.

1.1 Aim and Research Questions

The aim of this report is to investigate how the EU member states are progressing toward their targets concerning GHG emissions, Renewable Energy Sources (RES) and Energy Efficiency (EE). To achieve this aim, we have chosen to study the EU member states' NECPs to see how their national targets and policies have changed between the 2019 and 2023 NECPs. For this purpose, three research questions will be answered:

1. To what extent have member states changed their targets regarding greenhouse gas emissions, renewable energy sources and energy efficiency between 2019 and 2023?
2. How do the member states' targets differ regarding greenhouse gas emissions, renewable energy sources and energy efficiency?
3. What policy measures do member states plan to implement in order to support them in achieving their targets?

1.2 Scope

To aid in answering the research questions, two main categories of delimitations have been chosen. The first category focuses on which countries will be analysed, and the second on what content of the NECPs will be analysed.

1.2.1 Countries Included in the Analysis

The two delimitations of this category refer to whether a country is part of the EU and the size of their electrical system. Since the NECPs are demanded of member states of the European Union, these are the countries of interest. Previous studies have excluded countries who have a total electricity demand, which concludes the country's production minus export plus import, of 30 TWh per year or less, as well as only focusing on larger countries [6, 7]. In this study a similar delimitation has been chosen by excluding member states with a demand of less than 10 TWh per year, in order to analyse in greater detail, see Table 1.1.

1.2.2 Content to be analyzed

In the study there are a number of delimitations regarding what content to analyse. The different dimensions of the NECPs are: *Decarbonisation, Energy Efficiency, Energy Security, Internal Energy Market*, and *Research, Innovation and Competitiveness*, where RES is included in the decarbonisation dimension [53]. In this study *Energy Security*, *Internal Energy Market*, and *Research, Innovation and Competitiveness*, will not be included. For the sake of simplicity, the RES sub-chapter will be treated as its own dimension. The rest of the decarbonisation chapter will be classified as the GHG dimension.

There are areas in the dimensions GHG, RES and EE that are excluded from the report. Land use, land use change, and forestry, as well as agriculture, will not be included in the study. For the RES targets, the study focuses only on the production of electricity from photovoltaic panels, wind, and hydro. When compiling the results, the focus is primarily on targets and policies regarding 2030.

EU Member State	Included/ Excluded	Reason	NECP 2019	NECP 2023
Austria	Included	-	[8]	[9]
Belgium	Included	-	[10],[11]	[12]
Bulgaria	Included	-	[13]	[14]
Croatia	Included	-	[15]	[16]
Cyprus	Excluded	Total electricity demand < 10 TWh	-	-
Czech Republic	Included	-	[17]	[18]
Denmark	Included	-	[19]	[20]
Estonia	Excluded	Total electricity demand < 10 TWh	-	-
Finland	Included	-	[21]	[22]
France	Included	-	[23]	[24]
Germany	Included	-	[25]	[26]
Greece	Included	-	[27]	[28]
Hungary	Included	-	[29]	[30]
Ireland	Included	-	[31]	[32]
Italy	Included	-	[33]	[34]
Latvia	Excluded	Total electricity demand < 10 TWh	-	-
Lithuania	Included	-	[35]	[36]
Luxembourg	Excluded	Total electricity demand < 10 TWh	-	-
Malta	Excluded	Total electricity demand < 10 TWh	-	-
Netherlands	Included	-	[37]	[38]
Poland	Included	-	[39]	[40]
Portugal	Included	-	[41]	[42]
Romania	Included	-	[43]	[44]
Slovakia	Included	-	[45]	[46]
Slovenia	Included	-	[47]	[48]
Spain	Included	-	[49]	[50]
Sweden	Included	-	[51]	[52]

Table 1.1: EU member states included and excluded in the study.

2
Legislative Review

There are some regulations that affect all EU member states. These are important to include in this study in order to understand changes in targets and policies in the member states. This chapter reviews these.

2.1 Background of the National Energy and Climate Plans

The foundation for the NECPs is based of the Paris Agreement. The EU and its member states have committed to reduce their domestic GHG emissions by 40% from 1990 to 2030 [54].

To make the transition just it must align with the Energy Union strategy which ensures sustainable, affordable and secure energy for all EU member states and their citizens. To implement this, the European Commission introduced a set of legislative proposals called *Clean Energy for all Europeans* in 2016 [55]. As a part of this package, *The Regulation on the Governance of the Energy Union and Climate Action* was introduced in December 2018 [56].

The Regulation describes how member states should make the individual and collaborative effort to meet the EU's 2030 climate and energy targets. It also ensures that the member states' commitments align with the Paris Agreement. *The Regulation on the Governance of the Energy Union and Climate Action* have introduced the NECPs, which each member state submitted in 2019 and a draft in 2023 [54]. The final versions of the draft NECPs are to be submitted in June 2024. These 10-year plans outline how member states intend to meet the agreed EU 2030 energy and climate targets. Each state follows a framework set by the Regulation to ensure that they include the five dimensions of the Energy Union:

- Energy efficiency
- Energy security, solidarity and trust
- An integrated international energy market
- Decolonisation of the economy
- Research, innovation and competitiveness

The structure of the plans is also set by the EU Commission to enable comparison and policy consistency between the different NECPs [4].

2.2 The European Green Deal and Fit for 55

The *European Green Deal* is a comprehensive road map introduced in 2019 by the European Commission [57]. It aims to make EU's economy sustainable and to achieve climate neutrality by 2050. This target is also set in the *European Climate Law*. It includes a range of policy measures, legislation, and approaches designed to decrease GHG emissions, increase the adoption of renewable energy, encourage EE, and stimulate environmentally friendly innovation and economic development [57].

Fit for 55 is a package of legislative proposals introduced in 2021 by the European Commission [58]. These proposals aim to align EU legislation with the more ambitious climate targets set forth in the *European Green Deal*. It summaries the EU's climate and energy policies with the objective of achieving climate neutrality by 2050. The proposal aims to reduce GHG emissions by at least 55% compared to 1990 levels by the year 2030. It includes a wide range of sectors, such as energy, transportation, industry, and agriculture, with the aim of a sustainable economy while ensuring a just transition for the involved stakeholders. Central to *Fit for 55* is the EU Emissions Trading System (EU ETS) mentioned in section 2.4 [58].

Fit for 55 also includes revisions and updates to directives and regulations, such as: the *Carbon Border Adjustment Mechanism*, the *Renewable Energy Directive*, and the *Energy Efficiency Directive*. The directives sets binding targets for EU member states [58].

2.2.1 REPowerEU

REPowerEU is a plan introduced in 2022 by the European commission as a part of the Fit for 55 package [5]. They lay forward ideas for member states to discuss, and the purpose of it is to take joint European action for more secure, affordable and sustainable energy. The plan was a response to Russia's invasion of Ukraine, with the aim of decreasing member states' dependency on Russian gas. To implement the replacement of fossil fuels, the plan includes measures to save energy, accelerate the deployment of renewable energy, and diversify energy supplies. Cross-border projects and planning is supported financially by the Recovery and Resilience Facility. It includes targeted amendments to include *REPowerEU* in Member states' own recovery and resilience plans [5].

An important part of the REPowerEU is saving energy. Between August 2022 and March 2023 it was agreed between member states to reduce their demand of gas by 15% compared to the last five years consumption [5]. The reduction between August 2022 and March 2023 was 18%, and in March 2023 EU member states extended the voluntary commitment to reduce gas consumption a year [5].

2.2.2 Carbon Border Adjustment Mechanism

The *Carbon Border Adjustment Mechanism* is a tool introduced by the EU as a part of the *Fit for 55* package to ensure that a fair price is put on the CO_2 emissions from the production of carbon intensive commodities being imported into the EU, with the addition of promoting cleaner production in non-EU countries. The mechanism is slowly being phased in, with the start of its transition phase in 2023 and definite implementation planned for 2026 [59].

2.2.3 Renewable Energy Directive

The *Renewable Energy Directive* was introduced in 2009 [60]. It sets binding renewable energy targets for the EU member states and establishes a framework for promoting the use of RES in the EU. So far there have been two amendments to the *Renewable Energy Directive*, and the latest amendment to the directive entered into force on 20 November 2023 [61]. It includes a target of having a 42.5% share of renewable energy in energy consumption by 2030 [60].

In 2010 the share of renewable energy in energy consumption in the EU was 12.5%, and in 2022 this had increased to 23% [60]. In 2018 the 2030 target of the share of renewable energy in energy consumption in the EU was set to 32%. As a part of the *Fit for 55 package*, there was a proposal in 2021 to increase this target to 40%. The 42.5% target in the *Renewable Energy Directive III* is a consequence of Russia's invasion of Ukraine. This means that the RES target in the *Renewable Energy Directive* has increased between 2019 and 2023. Most of the provisions in the *Renewable Energy Directive III* introduced in 2023 must be transposed into national law by member states under a period of 18 months [60].

2.2.4 Energy Efficiency Directive

The *Energy Efficiency Directive* is a EU directive that aims to promote EE improvements across various sectors [62]. It sets binding EE targets for EU member states and requires them to implement measures to achieve these targets, such as energy audits and energy performance standards for buildings. There is also an article in the directive that requires member states to introduce *Energy Efficiency Obligations Schemes*, which includes annual energy saving obligations [62].

The *Energy Efficiency Directive* was first adopted 2012, and was amended in 2018 and 2023. The amendment in 2018 had the binding EE target of a 32.5% reduction in final energy consumption by 2030 compared to the 2007 projected values [62]. In 2021, there was a proposal increase this target to 36%. This corresponds to an EE target of 9% by 2030 compared to the anticipated energy consumption projections for 2030 (2020 Reference Scenario). In May 2022, as part of the *REPowerEU* package, a proposal of raising this binding target to 13% was given. In 2023, the amendment of the *Energy Efficiency Directive* changed this target to a reduction

of energy consumption of 11.7% by 2030, compared to the projections of the EU reference scenario 2020 [62]. This means that the EE target in the *Energy Efficiency Directive* has increased between 2018 and 2023.

The 2023 amendment also established the principle of Energy Efficiency First, which means that EE must be considered in all decisions regarding major investments and relevant policy [62].

2.2.5 Energy Performance of Buildings Directive

The Energy Performance of Buildings Directive aims to improve EE of buildings and to achieve a decarbonised building stock by 2050 [63]. The directive was revised 2018, and one new requirement was that all member states should submit a long-term renovation strategy. The strategy should include plans to support the renovation of the building stock in the states, with the aim of reaching a fully decarbonised building stock by 2050.

To conclude, all these directives are interconnected because they all contribute to the overarching goals of the *European Green Deal* and Fit for 55 initiatives. They address different aspects of energy transition, and work together to reduce GHG emissions, promote renewable energy deployment, and enhance EE.

2.3 Effort Sharing Regulation

The *Effort Sharing Regulation* (ESR) sets individual national targets for GHG emission reduction by 2030 for all EU member states [64]. The ESR covers a range of sectors which collectively account for 60% of the EU's total emissions. The sectors included in the ESR are buildings, agriculture, domestic transport (excluding aviation), waste and small industry. The regulation was originally established in 2018 and was amended in 2023, and the revised national targets aim to collectively contribute to an overall 40% GHG emission reduction by 2030, compared to 2005 levels. The ESR applies to sectors that are not included in the EU ETS [64].

2.4 EU Emissions Trading System

The *EU Emissions Trading System* (EU ETS) is an international system for trading carbon emission allowances [65]. It generates financial incentives for EU member states to reduce emissions, and is the foundation of the European Union Strategy [66]. Besides all EU member states, Norway, Iceland, Liechtenstein, and Northern Ireland participate when it comes to electricity generation. The EU ETS further covers GHG emissions from aviation within the EU and aviation departing to Switzerland and the UK, manufacturing industry and around 10 000 installations in the energy sector. Maritime transport will also be included from 2024.

The ETS has set a number of allowances for companies that should cover their emissions each year [65]. Companies thereby receive some allowances for free. One allowance equals the right to emit one tonne CO_2. The ETS requires monitoring of these emissions, and if a company emits more than their allowances over a year they receive heavy fines. The allowances are the currency in the system. If an emitter does not have enough allowances to cover their emission, they can buy allowances from another operator which is also covered by the system. Companies can thereby trade emissions, and if they have spare allowances they can either sell them on the EU carbon market or use them another year. Furthermore, member states can use the revenues from the EU ETS to invest in technologies, renewable energy and EE improvements to continue the reduction of emissions. A part of the revenues from the ETS goes into the EU ETS funds for energy transition and low-carbon innovation.

The EU ETS covers around 3/4 of the international carbon market and half of the emissions in the EU [67]. The system has helped reduce GHG emissions by 37% from industry and power plants compared to 2005 levels. To ensure a continuous decline in GHG emissions, the set caps on the total permitted amount are reduced each year. In the years 2021-2030 the cap will continue to decrease at an annual rate of 2.2% [65].

3
Policy Literature

In this section relevant literature for the report is included. There is one section regarding *Policy Change* and one section regarding *The Ambition Gap and the Implementation Gap*. In the section about policy change there is a study by Sewerin et al. [68], which discuss properties of a policy that affects its discontinuation, replacement or intensification. There is also a study by Ollier et al. [69], that discusses how policy priorities changes as the maturation of the RES progresses. Furthermore a study regarding policy change by Pavlenko et al. is included [70] that examines how policies can accelerate the energy transition. The section regarding *The Ambition Gap and the Implementation Gap* discusses how there is a gap between implementation of policies and targets, and how to avoid it.

3.1 Policy Change

This section includes 3 studies on policy change. These studies are included because they contribute with previous research on policy changes, which can help with the analysis of the policy change between the 2019 NECP and 2023 NECP.

The first study by Sewerin et al. [68] investigates what factors make a policy "stick", what affects whether or not it is discontinued, and how they either increase or decrease in ambition, i.e ratcheting up or down. They use two key terms; intensity and specificity. Intensity describes the extent of a policy's objective, scope, integration, budget, implementation, and monitoring. Specificity describes a policy's targeted focus. Sewerin et al. hypothesises that a more intense policy should lead to discontinuation, i.e. a ratcheting down effect. A more specific policy, meanwhile, should lead to the implementation of more intense policies with other words a ratcheting up effect.

They investigated 627 low-carbon energy policies from 8 different countries. Their study did not find any signs that policy intensity or specificity might affect policy continuation. The study did find that more intense policies were more likely to be replaced with less intense policies, i.e. ratcheting down, and that more specific policies were more likely to be replaced with more intense policies, i.e. ratcheting up.

Sewerin et al. discuss that their findings might imply that powerful actors affected by more intense policies may lead to a stronger push to ratchet down. More specific policies, meanwhile, could create a kind of strategic blindness in which powerful

actors do not realise that a stable niche with more powerful actors could emerge, which may allow ratcheting up. By including the article in this report it will be possible to compare the policy change that is found in the member states with the factors that Sewerin et al. mentions. It is also possible to see if these factors have an effect in the policies of the member states, or if the factors does not apply to the policies in this study.

As mentioned above, the hypothesis presented in Sewerin et al. is that a more intense policy should lead to a ratcheting down effect, whilst a more specific policy should lead to the implementation of more intense policies, or a ratcheting up effect. Since the study did not find any signs that policy intensity or specificity might affect policy continuation, this study contributes by testing this hypothesis further, to see if a different result is found.

Another article included in this thesis is by Ollier et al. [69]. Based on a comparative analysis on six EU member states they examined, as the maturation of RES progresses, how governments change their policy priorities. According to the article, change in technology is an important contribution to defining/redefining policy priorities. Social and technological challenges as a result of successfully adopted new technologies can lead to a shift in policy priorities [69].

The results include that governments adapt their policy priorities in response to shifts in the socio-technical systems. The results indicate that governments adhere to a particular order of policy priorities in the energy transition. In the beginning of the development in renewable energy in the socio-technical system the cost concern is low, but as the system develops it increases. When the growth of renewable energy stagnates the priorities changes. One thing that is prioritised in a stagnated renewable energy socio-technical system is system flexibility. This is especially relevant in the later transition stages for in states that experiences challenges in balancing the energy supply. It is also mentioned in the article that a smaller, gradual adaptions in the renewable energy policies gave the socio-technical system stakeholders a more stable policy environment. This could be compared with the policy change in this thesis between the NECPs 2019 and 2023 as renewable energy develops.

As mentioned above, technological challenges as a result of adopted new technologies can lead to a shift in policy priorities [69]. In the beginning of the development of renewable energy in the socio-technical system the cost concern is low. As the renewable energy in the socio-technical system develops the cost concern increases, which can be connected to a study done in 2023 by Pavlenko et al. [70]. They investigate whether policies, especially REPowerEU, can accelerate energy transitions. According to the study, REPowerEU, the *Fit for 55* package, the *European Green Deal*, and related plans are part of a policy shift that began in 2018. According to the study, policy objectives prior to 2018 were strongly affected by costs and technological uncertainties, and did not have a strong connection to long-term climate targets. They did not become more ambitious with time and adhered to historical patterns. As stated by Pavlenko et al., policies post 2018 are clearly linked with the

2030 renewable targets.

Pavlenko et al. state that no policy driven acceleration associated to the EU RES targets were done before 2018. Post 2018 is, especially for onshore and offshore wind, probably a beginning of an acceleration. The reason for this shift is, according to the study, probably three changes in the policy process that happened during this time. One of them is that there was a shift from a weak link between long-term climate targets and short-term RES targets to a strong one.

According to Pavlenko et al., it is not clear if the new policies are possible to implement, even though they aim at accelerate the transition. Acceleration of energy transitions driven by policies is more rare than not and requires a specific combination of capacities and motivations. Benchmarks for the achievable pace of transitions can be found in historical parallels, but the study states that more research need to be done of how policies can affect low-carbon technologies. This study is included in the thesis because it can investigate if there has been a change in policies between 2018, or in this case 2019, and 2023 in the case of renewable energy. It could analyse if the policies in the 2023 NECP has a stronger connection to long-term climate goals compared to the policies in 2019, and to see if the ambition in policies has increased.

3.2 The Ambition Gap and the Implementation Gap

One issue with having ambitious targets and working with policies is the ambition gap and the implementation gap. A study done by Perino et al. [71] discusses this subject. In the article, the ambition gap is described in relation to the carbon budget by the Paris Agreement, and it is a gap between the states pledges on emission reductions and the agreed targets in, for example, the Paris agreement. The implementation gap is the gap between the set targets on emission reductions, and the actual reductions based on the current policy instruments, also known as the policy outcome.

According to Perino et al., the reasons for the implementation gap can be divided into two groups [71]. First, the level of strictness in policy outputs may not align with the objectives. Secondly, policy outputs may not effectively result in the desired policy outcomes. One obstacle relating to closing the implementation gap is because when different policies interact they may become counter-productive. The article states that overlapping policies are sometimes not effective on reducing emissions. As an example, the EU ETS can sometimes be counterproductive when interacting with policies regarding EE measures, coal phase-out, or renewable energy support. In 2018 changes were made to the EU ETS in order to increase the effect of overlapping policies. When overlapping policies occurs, some allowances can be reduced and countries can cancel allowances to support coal phase-outs. However, Perino et al. states that allowing countries to cancel allowances themselves is not effective.

Another article that discusses the implementation gap is by Fransen et al. [72]. They describe the implementation gap further by dividing it into two parts, the policy adoption gap and the policy outcome gap. The policy adoption gap implies the difference that can occur between the pledges of policies and the current policies that has been adopted. This is the part of the implementation gap that Fransen et al. states has been 'quantified to date in the literature'. Further, the policy outcome gap exists between the adopted current policies and what the policy achieves, or the policy outcome. This can only be quantified after the policy outcome data has been collected.

4
Methodology

The project was divided into three main parts: *Data collection, data processing* and *data analysis*. The majority of the project was centred around desktop research where the primary sources were the NECPs. Scientific publications and EU legislation were used to broaden the understanding of the NECPs. There are 22 EU member states within the project's scope, where each state has already submitted or will submit two reports, one finalised in 2019 and one draft update in 2023.

The end product of this project is two datasets that can be used for further research. The datasets will include, as described in chapter 5:

- A dataset of targets gathered from the NECPs in the dimensions of GHG, RES and EE.
- A dataset of policies gathered from the NECPs in the dimensions of GHG, RES and EE.

4.1 Data collection

The NECPs were downloaded from the European Commissions website [4], and the 22 member states were divided equally among the authors of this report. First, all the targets were collected. These were, in turn, sorted into three documents: One for GHG targets, one for RES targets and one for EE targets.

The next part was the collection of policies. Everyone collected their assigned countries' policies from the GHG, RES, and EE dimensions. When the policies had been gathered, they were compiled in a Google Sheet. First one sheet for each country and then all of these were added to the final dataset with all member states included. For The number of policies in the 2019 NECP refers to the number of planned and implemented policies. Further the number of policies included in this study from the NECP 2023 refers to the number of new or updated policies introduced in the NECP, not the total number of policies. This also applies for the number of measures categorised by types of policy instruments or sectors.

4.2 Data processing

When the the data collection was finished, the next step of the project was the processing. This was done by forming a more refined dataset for both targets and

policies with headings and categories.

4.2.1 Target processing

For more detailed descriptions of what target data was collected, which units used, and how the data was structured, see chapter 5, which discusses the produced datasets in greater depth.

4.2.2 Categorisation of Measures

In order to analyse the policies, two methods of categorisation were chosen: Type of policy instrument and Sector.

Type of policy instrument:
Two systems were combined and simplified to create the three types of policy instrument below:

- Command and control
- Economic
- Information

The categorisation is based on *Policy Instruments and Modes of Governance in Environmental Policies of the European Union*, but with inspiration from *Classification of Instruments* [73, 74]. The first report uses a system with five different categories:

1. Legislative/regulatory instruments,
   Policies with binding requirements, such as laws. They can be either prohibitive or prescriptive.
2. Economic/fiscal instruments,
   Policies that influence market mechanisms such as loans and taxes.
3. Agreement based/co-operative instruments,
   Polices where actors and/or government together decide on a mutual behaviour.
4. Information/communication based instruments,
   Give actors information and hope for change.
5. Knowledge instruments,
   Policies where actors together cooperate to learn or spread information.

With a base in said classification the categorisation used in this report has been narrowed down to three different categories, in a similar way as the Classification of Instruments [74]. Legislative/regulatory instruments is compressed into Command and Control which describes the action in a broader manner. Economic/fiscal instruments is shortened into Economic. Agreement based/co-operative instruments, information/communication based instruments and knowledge based instruments all group together to form Information. This was made since there is a lot of nuance in

the information category which could lead to incorrect labelling. In order to minimise the risk they were merged into one subcategory.

Sector:
The category of Sector specifies which societal sector the policy will be implemented. The categories were taken from the 2022 IPCC report [75] and consist of the following sectors: Industry, Transport, Building, Energy, Agriculture, Forestry, and Land use. Due to our chosen delimitations, Agriculture, forestry and other land use was removed. A sector named Other was added to include policies which did not fit into any of the four other sectors. This resulted in the five sectors below.

- Industry
- Transport
- Building
- Energy
- Other

More information describing the structure of the policy datasets can be found in chapter 5.

4.3 Data analysis

The method of analysis is comparative. It includes a quantitative analysis in terms of both changes to each member states' individual targets from 2019 and 2023, and also comparing different states with each other. By comparing all member states together in both 2019 and 2023 it was also possible to see where they, as a collective, are heading.

4.3.1 Division of the analysis

The analysis was divided into two main parts, one qualitative and one quantitative.

4.3.2 Quantitative Analysis

The quantitative analysis is focused on numbers and overall change. By displaying how the targets have changed between the years and counting the number of polices in different categories, it is possible to find patterns that point to how the member states have progressed. It relies on the categorisation and makes conclusions if there is a shift in what kind of policies that are used.

4.3.3 Qualitative Analysis

The qualitative analysis is an eight part case study type III, since it has both a temporal and within-unit variation [76]. This thesis studied eight key countries and analysed the changes within the country from the 2019 NECP to the 2023 NECP with a heavy focus on polices. This is in order to understand how transitions can vary in different member states with different starting points. It is also a way to deeper analyse specific policies and understand the changes member states are making.

4.3.3.1 Target Analysis

Normalisation
In their GHG emission targets, member states either used emission values from 1990 or 2005 as comparison values for their reductions. In order to analyse these targets, all 1990 compared targets were converted to a comparison with the states' 2005 emission values. This was done using historical data from Climate Watch [77]. The 1990 emission value for each country was divided with the 2005 value. The targets compared to 1990 were then multiplied with the factors to convert them to a comparison of the 2005 value.

The RES targets were normalised using the countries' total electricity demand from 2022. The data was taken from world bank [78], and all targets were divided by their respective country's demand to allow comparison between member states.

In their EE targets, countries used either energy consumption reduction by share [%], reduction by amount [GWh], or final energy consumption in 2030 [GWh]. Both the reduction by amount targets and the final energy consumption targets were normalised using each country's final energy consumption in 2015. Through this normalisation, all values were converted to energy consumption by share. The normalisation data was taken from world bank [78].

4.3.4 Case study countries

After collecting and processing the data, eight case study countries were selected to be analysed in this report for various reason. The countries are Finland, Germany, Greece, Ireland, Italy, Portugal, Spain and Sweden.

Finland
Finland is included due to their target to reach net-zero emissions as early as 2035. They also have delays from potential bottlenecks, such as fuel availability, limited raw material availability and manufacturing capacity [79]. Finland are also dependent on import. At the same time, Finland has increased their share of wind significantly in recent years [80].

Germany
Germany is included in the study because it is the biggest emitter of GHG in Europe [81]. They have also high targets and a lot of policies in the NECPs both 2019 and 2023.

Greece
Greece was chosen because they face a unique challenge of decarbonising a large set islands that are not connected to the country's main grid. Many of these islands currently generate electricity through fossil-fuels, and a large part of Greece's NECP focuses on supplying renewable energy to the islands.

Ireland
Ireland was chosen due to their large focus on offshore wind. They set out a clear road map in 2019 regarding the development of offshore wind, and achieved considerable follow-through on these policies by 2023.

Italy
Italy was chosen because it is the third most populated country in the EU, after Germany and France [82]. It is also currently phasing out coal while having a big dependence on imported gas and oil [83].

Portugal
Portugal has an ambitious target of 80% share of RES in electricity by 2030, which is among the highest in Europe [42, 84]. In addition, Portugal has development plans for solar power, and onshore and offshore wind power. For these reasons, Portugal was chosen as a case study country in the analysis.

Spain
Spain was chosen as a case study country because of their plans to phase out both nuclear and coal energy, and at the same time replace it with energy from RES. The authors of this thesis therefore found it interesting to analyse the feasibility of this energy transition.

Sweden
Sweden was chosen as a case study country because the authors of this thesis are Swedish and have Swedish as their native language. Sweden's NECPs were therefore able to be read in their original versions and as a consequence, the risk of translation errors was minimised. In addition, the research was conducted at Chalmers University of Technology in Sweden.

4.4 Assumptions and methodology limitations

Assumptions and limitations are crucial parts of scientific research and needs to be thoroughly analysed in order to draw conclusions [85]. Without limitations, projects would be too large to grasp and without acknowledging the underlying assumptions

there is a greater risk of misunderstanding the results or drawing wrongful conclusions. This section describes the assumptions and limitations faced in this project and how these have been structured to minimise their impact on the result.

One assumption is that if a policy has been described in the NECP it is assumed that it will be implemented. This is because an analysis of the probability of the policy being implemented or not is not possible given the time-frame of this project, and not a part of the scope.

The majority of the reports have an English version which will be the main focus of the study. Austria, Poland and Roumania did not have a English version of the 2023 NECPs. In these cases the translation tool DeepL was used. There have also been cases where parts of the NECPs have not been translated, such as tables and graphs. In those cases, they were also translated using DeepL.

One limitation of this study is that the 2023 NECPs are drafts, which means that the information in them is susceptible to change when the final reports are submitted. Because of this, some member states does not have revised targets. As an example, neither Denmark of Finland have revised EE targets in the NECP 2023. As a consequence it was difficult to analyse how the policies changes to meet the targets, if the targets has not changed yet. In the final version of the NECPs that will be submitted in 2024, some policies that has not been strengthened in the draft might have new measures. The analysis and conclusion in this report can therefore be misleading, if a country changes their targets or policies significantly. The findings of this report is therefore also affected by to what the degree the submission done in 2023 is a draft or a finalised version.

Another limitation with the NECPs being drafts is that some of the countries are missing important values or targets, which makes it more difficult to compare the member states with each other. For example Slovenia did not include any policies in the 2023 NECP.
Another limitation was that if a measure was not included in the 2023 report it was difficult to draw a conclusion whether the measure had been eliminated, achieved or implemented unless specifically written.

A limitation in the categorisation is that it is possible that some policies have been placed in the wrong category. This is a consequence of multiple people working on the same thing separately.

Even though categorisation made the process easier, it is not without fault. The information in each policy is limited and of varying quality. Some policies describe a step by step methodology of how the policy is planned to be implemented, while other policies contain single line statements. With these differences in supplied information there are margins of error that needs to be taken into account when analysing the results. For example, a policy which states that it wants to promote more electric cars can be interpreted as any type of policy instrument based on the lack of

information. It could be command and control, if it is a government regulation, or it could be an economic measure, if there is an underlying economic incentive. Furthermore it could be an informational measure if it were to be an information-campaign. With time being a limited resource, as well as the information in the NECP's being limited, this is unfortunately unavoidable. Continued research could cross-reference different policy collections and better understand what the intended meaning was and thereby decrease the margin of error.

Another part that needs to be taken into consideration is that policies and measures have been categorised based on the overall impression. Therefore nuances of the policies are, in some cases lost, and the results of the categorisation might be misleading, since the measures need to fit into a category. This is not necessarily a bad thing since it is near impossible to study large quantities of data without simplification, although one has to be careful with the conclusions drawn from them. Two policies with the exact same categorisation could be widely different.

5
Description of the datasets

The data collection and data processing has resulted in two datasets, one for targets and one for policies. These have been the base of the analysis in chapter 6. The datasets are attached as separate files to the report. This chapter gives a description of what those datasets contains. The target dataset consists of three sheets in the same excel file with all the targets for all member states included in the analysis. There is one sheet for each of the dimensions GHG, RES and EE. The policy dataset is one file with all the included member states' policies, and GHG, RES and EE is included in this file. In the policy document there is a separate sheet for each country in addition to a sheet that includes all the member states' policies. In the documents the specific member states country code is written in column A, see Table A.1. The member states are sorted in alphabetical order.

5.1 Description of the target dataset

Column B describes which year the target is set. This is either 2019 or 2023, depending on which NECP the target is collected from. Column C describes the year the target should be met. One column in each dataset describes the policy origin, that is either the 2019 NECP or the 2023 NECP. If there is an empty cell in the target document, it signifies that the value for that specific category was not found.

5.1.1 Greenhouse Gas

There are two columns, column E and F, for targets on GHG emission reduction in percentage, one applies to total reduction of GHG emission and one applies to reduction in ESR sectors. Column G called *Comparison year*, which is the year the reduction is compared to. If a member state has set a target on reductions for total GHG emissions, it can be found in column H, in the unit Mt CO_2-eq. If the target is set as an interval, column J describes if it is the lower or upper value of the interval, and any miscellaneous comments are left in column K.

5.1.2 Renewable Energy Sources

In the RES document, there are columns for different categories of RES. The ones included in the document are photovoltaic on column E and F, wind on column G and H, hydro on column I and J, wind offshore on column L and M and wind onshore

on column N and O. Photovoltaic, wind, hydro, wind offshore and wind onshore all have two columns each which describes in the target set applies to electricity that can be generated, in GWh, or the electricity capacity, in GW. Column P describes the share of RES in the total electricity production as a percentage, and column Q describes the total capacity of RES in the state in the unit GWh. If the target is an interval, column S describes if the target is the lower or upper value of the interval, and any miscellaneous comments are left in column T.

5.1.3 Energy Efficiency

In the document for EE targets, column G is for a reduction in primary or final energy consumption in percentage. Column F includes a comparison value in GWh, of which the percentage in energy consumption is based on. Column H describes the target on total energy consumption reduction in GWh. There are two columns, column J and K describing the primary and final energy consumption targets in GWh. Italy and Czech republic have total annual reduction targets in GWh which is given in column L. There is also a percentage in total annual reduction in energy consumption which only Czech republic have in column M.

5.2 Description of the policy dataset

The policy document contains one excel sheet with all the included member states' policies sorted alphabetically by country. As well one sheet for every state within the scope that contains only that states' gathered policies. Column B describes the name of the policy. This is taken directly from the NECP if possible. However if a name of the policy does not exist, a description of the policy or the sector has been assigned as a name. There are two columns, C and D, called *2019 Measures* and *2023 Measures*, these contain measures from policies in the 2019 NECP and 2023 NECP. Column E is called *Policy Changes*, where the change between 2019 and 2023 is described in short. This implies the number of new measures in the 2023 report. Sometimes it is stated no change or it is left blank, which means that the policy in 2019 is not included in the NECP 2023 or there is no change. Column F describe the start year of the policy, which sometimes is included in the NECP. If it is not mentioned in the NECP this is left blank.

The policy documents also include classification of the type of policy instrument. Column G, H, I, J, K and L are for command and control, economic, and information for 2019 and 2023. One number is added for each measure in the policy. For the 2023 column only new measures are categorised. So for example if there are three new measures of the command and control category in the 2023 NECP, that are not included in the 2019 NECP, this is represented by a 3 in the command and control column for 2023. There is also the categorisation of sectors. Column S, T, U, V, W, X, Y, Z, AA, AB connote to industry, transport, building, energy, and other for both the 2019 and 2023 NECP. There is also the columns AD, AE and AF which are the dimension of the policy. The columns signifies either GHG, RES or EE. In these columns the measures are not counted, instead the policies are counted.

Since one policy can have several measures, these columns are used to conclude the number policies for each dimension.

There is also a column, AC, for overarching theme of the policy. This was intended to help in the analysis if there was policies in the NECP 2023 that did not match the policies in the NECP 2019, but the overarching themes is not included in the report.

To conclude, the data collection and data processing has resulted in two datasets containing target and policies for the member states. Furthermore this has been the basis for the analysis in chapter 6. The target dataset consists of three sheets, one for each dimension, in the same attached excel file. This has all the targets for all member states included in the analysis. The policy dataset is one file with all the included member states' policies. In the policy document there is a separate sheet for each country in addition to a sheet that is a compilation of all the states' policies. The two datasets are the product of the thesis and are attached as separate files.

6
Analysis

The project analysis consists of three primary components: Greenhouse Gas Emissions, Renewable Energy Sources, and Energy Efficiency. These dimensions are examined by targets and policies. The analysis section provides information on past and current targets, as well as how member states are achieving them. This is to identify the primary sectors of focus.

6.1 Greenhouse Gas Emission

For this section a quantitative analysis for GHG emission targets and types of policies will be presented, as well as a qualitative analysis for GHG emission policies. The quantitative analysis is a comprehensive overview of the targets and types of policies of all included member states. While the qualitative analysis aims to achieve a more in-depth analysis including changes of specific policies.

6.1.1 Quantitative Analysis

The quantitative analysis of the GHG dimension consists of the targets of each member state regarding GHG emission reductions for both 2019 and 2023, in addition to a compilation of the number of policies for GHG, and the overall EU scale categorisation trends.

6.1.1.1 Targets

The analysis on GHG emission reductions focuses on the 2030 targets of each member state, both the ones set in the 2019 NECPs and the ones set in the 2023 NECPs. To better understand the changes between reports, both the changes in targets by factor and by difference has been calculated. The mean and median of the targets and changes, along with the countries with the minimum and maximum value in each category, will be presented in Table 6.1.

Due to the different format of the reports and targets, all countries could not be grouped in the same target categories. The analysis has therefore been split into reductions within the sectors of the ESR, 2, and reductions in total emissions. If a country had targets for both categories, the ESR target was chosen, and if they had targets in different categories between NECPs, they were excluded from the analysis.

As mentioned in chapter 4.3.2, countries that used 1990 emission values were converted to a comparison to their 2005 emissions. The converted countries were: Greece, Lithuania, Netherlands, Roumania, and Sweden.

Table 6.1 shows member states' targets for their reduction in GHG emissions.

- The second and third columns, 2019 and 2023 targets respectively, contain the percentage reduction countries plan to achieve compared to 2005 levels.
- The fourth column, factor, shows the increase by factor, calculated by dividing the 2023 target by the 2019 target.
- The fifth column, difference, shows the increase by difference, calculated by subtracting the 2019 target from the 2023 target.
- The sixth column, target category, shows the category the target was set, either reduction of total emissions [%] or reduction in ESR sector emissions [%]. If targets were missing or mismatched, it is stated here.
- If a country's name is marked by a *, it was converted from 1990 to 2005.

Country	2019 Target	2023 Target	Factor	Difference	Target Category
Austria	36.0	48.0	1.33	12.0	ESR emissions [%]
Belgium	35.0	47.0	1.34	12.0	ESR emissions [%]
Bulgaria	0.0	10.0	-	10.0	ESR emissions [%]
Croatia	7.0	16.7	2.39	9.7	ESR emissions [%]
Czech Republic	14.0	26.0	1.86	12.0	ESR emissions [%]
Denmark	39.0	50.0	1.28	11.0	ESR emissions [%]
Finland	39.0	50.0	1.28	11.0	ESR emissions [%]
France	37.0	47.5	1.28	10.5	ESR emissions [%]
Germany	38.0	50.0	1.32	12.0	ESR emissions [%]
Greece*	32.3	42.2	1.31	9.99	Total emissions [%]
Hungary	7.0	18.7	2.67	11.7	ESR emissions [%]
Ireland	30.0	42.0	1.4	12.0	ESR emissions [%]
Italy	-	-	-	-	No matching categories
Lithuania*	78.3	137.1	1.75	58.7	Total emissions [%]
Netherlands*	35.5	45.6	1.29	10.1	Total emissions [%]
Poland	7.0	14.1	2.01	7.1	ESR emissions [%]
Portugal	45.0	55.0	1.22	10.0	Total emissions [%]
Romania*	44.0	138.9	3.16	94.9	Total emissions [%]
Slovakia	20.0	22.7	1.14	2.7	ESR emissions [%]
Slovenia	20.0	37.0	1.85	17	Total emissions [%]
Spain	26.0	37.7	1.45	11.7	ESR emissions [%]
Sweden*	67.6	67.6	1.0	0.0	ESR emissions [%]
Average	26.84	36.5	1.55	9.53	ESR emissions [%]
Median	30.0	42.0	1.34	11.0	ESR emissions [%]
Minimum	Bulgaria	Bulgaria	Sweden	Sweden	ESR emissions [%]
Maximum	Sweden	Sweden	Hungary	Czech Republic	ESR emissions [%]
Average	42.5	76.1	1.76	30.4	Total emissions [%]
Median	39.8	50.3	1.53	12.0	Total emissions [%]
Minimum	Slovenia	Slovenia	Portugal	Greece	Total emissions [%]
Maximum	Lithuania	Romania	Romania	Romania	Total emissions [%]

Table 6.1: Member states' 2030 GHG emission targets in their 2019 and 2023 NECPs, and the change between them.

As can be seen in Table 6.1, all member states except Sweden have raised their targets. It is worth mentioning however, that Sweden had the highest target in the ESR category in both 2019 and 2023.

Roumania and Lithuania both had targets over 100% in 2023. This is due to the conversion of targets using the 1990 comparison value to a comparison to their 2005 value. Both countries emitted roughly half the amount in 2005 compared to 1990 [77]. Despite not having net-zero targets for 2030 compared to 1990 emissions, have targets exceeding 100%.

6.1.1.2 EU Scale Policy Analysis

The EU scale policy analysis section presents the data of all policies in the GHG dimension, to compare countries, as well as a 2019 and 2023 comparison. A categorisation of sectors is included to show what type of sector is primarily addressed through the GHG dimension. Furthermore, this section also includes an analysis of the types of policy instruments, to highlight trends of how member states are to achieve their targets.

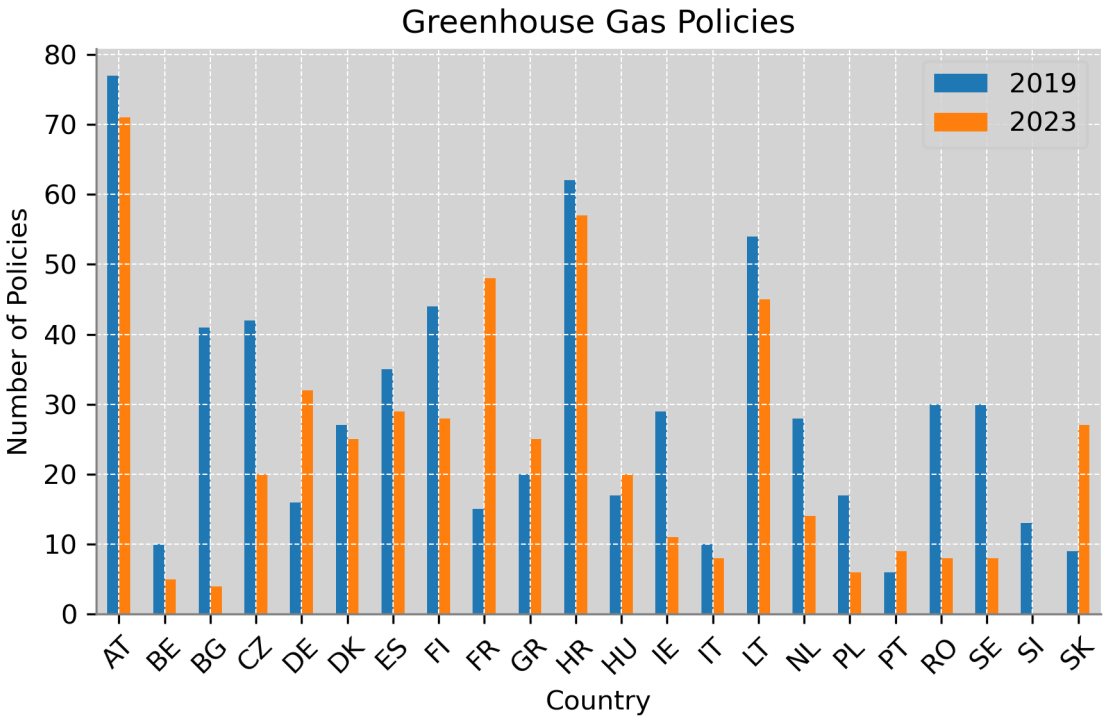

Figure 6.1: Compilation of Policies 2019 vs. 2023 for greenhouse gas. See Table A.1 for country codes.

In Figure 6.1, the number of policies stated by each member state in their 2019 and 2023 NECPs is visualised. For 2019 there was in total 632 policies regarding Greenhouse Gas, and 500 for 2023. Meaning the GHG dimension has a total of 1132 and

thereby the most number of policies. Austria has the most policies overall, followed by Croatia. Austria has almost 80 policies in 2019, in addition to their 71 policies in 2023. Germany, France, Greece, Hungary, Portugal and Slovakia have all increased the number of policies in their 2023 NECPs. For greenhouse gasses no country has zero policies except for Slovenia's 2023 NECP, which contains zero policies overall. France and Slovakia have more than doubled their policies. However Bulgaria, Ireland, Poland, Roumania, Sweden and Netherlands halved or less than halved the amount of new policies in 2023.

Types of Policy Instrument
The types of policy instruments are visualised in Figure 6.2 for the year 2019 and Figure 6.3 for the year 2023. This was done in order to better identify changes in trends.

Addressing the types policy instruments of member states, it is apparent in Figure 6.2 that the economic category is the largest in 2019 with 254 measures. Economic is followed by command and control which has 250 measures and lastly information, with 128 measures. We can thereby see that economic and command and control are almost equal. The ratio of the measures differs for 2023, with command and control having more measures. For 2023, there is 204 command and control, 189 economic and 107 information measures, making information only differ by 21. Command and control differs by 46 and economic by 65. This signifies that economic measures have decreased a lot. From this, it is evident that command and control is the largest category of measures when it comes to greenhouse gasses in 2023 and almost tied with economic in 2019 with slightly fewer measures.

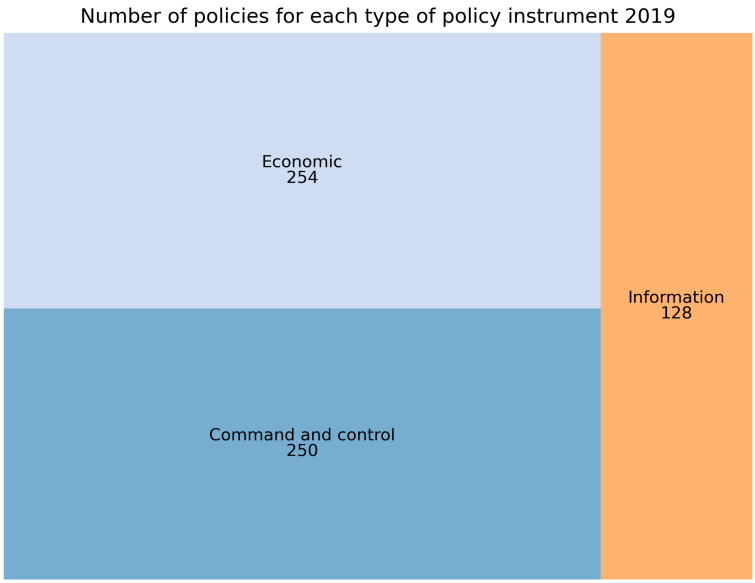

Figure 6.2: Visualisation of the *types of policy instruments* for 2019.

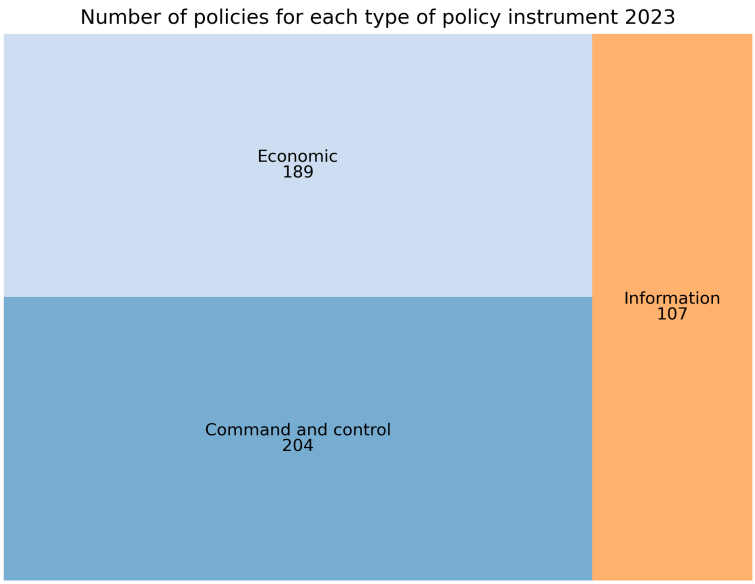

Figure 6.3: Visualisation of the *types of policy instruments* for 2023.

Sector
The sector categorisation consists of energy, transport, industry, buildings and other. By analysing these, a comprehensive perspective of where the measures are being implemented can be achieved.

The transport sector has the most greenhouse gas measures for 2019. In Figure 6.4 it is apparent that there are 343 measures for transport, with energy having the second most with 137 measures, industry 111, buildings 99 and other 56 measures. For 2023, transport is still the largest sector with 256 measures. Industry however has the second most measures with 117 measures, energy 111 measures, buildings 98 measures, and other 48. Industry, building and other have relatively similar numbers for the 2023 classification. The majority of the policies relating to transport could be due to transport accounting for almost a quarter of the greenhouse gas emissions in the EU [86].

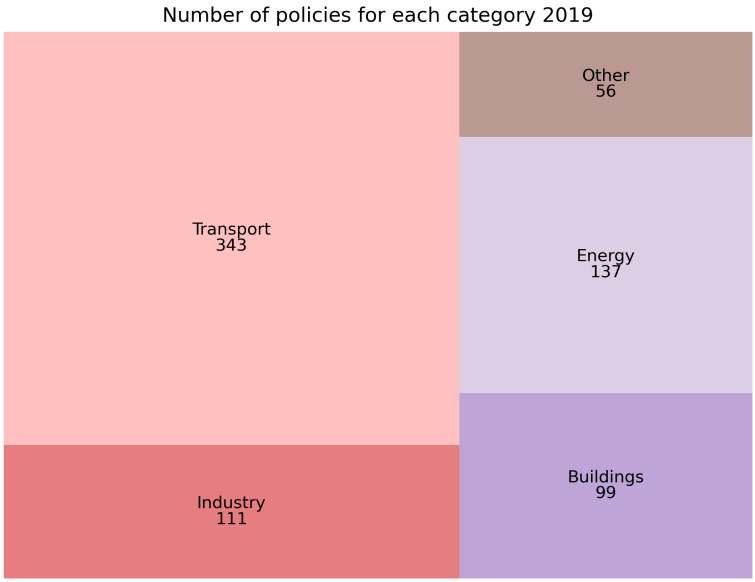

Figure 6.4: Visualisation of the *sector* categorisation for 2019.

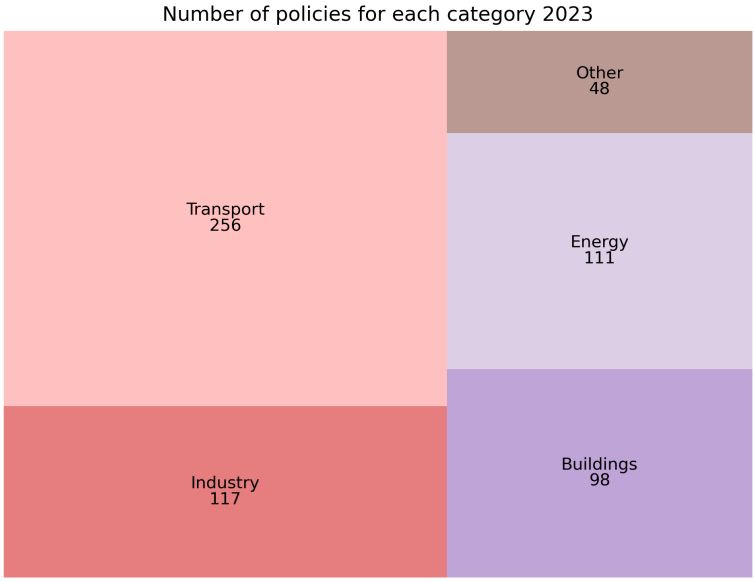

Figure 6.5: Visualisation of the *sector* categorisation for 2023.

6.1.2 Qualitative analysis

The qualitative analysis for GHG emission reductions focuses on the changes in the case countries' GHG policies. Policies that represent broader trends of change and policies of importance to each case country are presented and analysed. The member states included in the qualitative analysis are, as presented in subsection 4.3.4, *Finland, Germany, Greece, Ireland, Italy, Portugal, Spain*, and *Sweden*. For each member state, an introduction of changes in targets is given, and the scope of policies to be covered and main observation relating to changes is presented. The policies included in the qualitative analysis in the GHG dimension is then presented by sector. The sectors are *Building, Energy, Industry, Transport*, and *Other*. A concluding paragraph reflecting on the policy changes are presented at the end of each case country study.

6.1.2.1 Finland

For Finland, the 2030 target reduction of GHG emissions set in the NECP 2019 [21], was 39% in the ESR sectors. In their 2023 NECP [22], this target was increased to 50%. They also presented an ambition to achieve carbon neutrality by 2035, which was one of the reasons as to why Finland was included as a case country. In the GHG dimension, policies in the sectors *Building, Energy, Industry* and *Transport* will be presented. Overall, however, there has not been much change to the policies compared to the updated 2023 targets.

Buildings
In the building sector in the 2019 NECP, they set an obligation to supply light fuel oil used in heating with 10% of bio liquid. In the 2019 NECP it was also mentioned that the Central government would phase out oil heating by 2024 and encouraged public actors to do the same. The NECP 2019 also stated that the EE of the existing building stock would be improved and the use of renewable energy would be promoted, however, it was not clear how this would be done. Clean combustion of pellets and chopped would be promoted in the 2019 NECP, but it was not clear how exactly it would be promoted. In the 2023 report, it was stated that emissions from building-specific heating had been declining recent years, and that the reason was the decrease in oil heating and improvements in the EE of buildings. A new measure in the NECP 2023 was that, since 2020, there were subsidies for the swapping of oil heating systems to other heating systems for detached houses. As of May 2022, the subsidy system also includes phasing out natural gas heating, which means that it had broadened since 2020.

Another new measure regarding the building sector in the 2023 NECP was grants for phasing out oil heating in municipality-owned buildings. The grants have accelerated the phase out since October 2020. If the municipality had acceded to a voluntary EE agreement the grants would be increased.

Overall, in the 2019 NECPthe policies regarding buildings were not very specific or intense. For example, that the phase out of oil heating was to be encouraged, that

the EE of the existing building stock would be improved and the use of RES would be promoted. The measures regarding grants for swapping of heating system for houses and municipalities were quite specific compared to the measures in the 2019 NECP. Thereby the policies are strengthened.

Energy
Policies regarding energy in the GHG dimension only concerned energy taxation. In the 2019 NECP Finland mentioned that in the past few years, the emphasis on the taxation of liquid fuels had shifted towards a carbon dioxide tax. Taxation on biofuels was lower than that on fossil fuels in the 2019 NECP. In the 2023 NECP there was one measure to ensure that lower taxation of electricity, gaseous fuels and diesel mostly applied to commercial vehicles. There was a tax rebate in the NECP 2023 for energy intensive businesses that will be phased out by the end of 2024. The energy tax of electricity for mining, manufacturing, and heat pumps was at the EU minimum level.

Industry
In the 2019 NECP, there were measures on an obligation to supply light fuel oil with 10% bio liquid, promoting the replacement of fuel oil-fired boilers by boilers fired with solid fuel, enhancing energy audit activities and increasing the taxation of heating fuels. These measures were not mentioned in this section in the 2023 NECP. An update in the NECP 2023 was that 13 industrial sectors have prepared sectoral low-carbon road maps. These include GHG emissions, energy consumption and investment needs. In the 2023 NECP there was also a special Energy Aid grant for new energy technologies. There was a new measure in the 2023 NECP which provides payments to compensate for increased electricity costs as result of EU ETS allowance prices. If a organization receives the funds they must allocate a minimum of 50% of the subsidy towards initiatives aimed at lowering emissions, enhancing EE, and promoting the utilization of renewable energy. They also must show that they have conducted an energy audit or provide proof of exemption, along with ensuring that a minimum of 30% of their energy usage comes from carbon-free electricity sources. To provide payments to compensate for high costs because of EU ETS is somewhat counter-intuitive, but may be necessary to keep the industries. It is similar to Germany, who have tax breaks for the manufacturing sector, which can be found in 6.3.2.2.

Transport
Finland had three main focuses on the area of transport in the GHG dimension. These were *Replacing fossil fuels with renewable and low-emission fuels and power sources, Improving the energy efficiency of vehicles and other means of transport*, and *Improving the EE of the transport system.*

The main measure in the area *Replacing fossil fuels with renewable and low-emission fuels and power sources* was a quota obligation of biofuels. In 2019 NECP, the share of biofuels in road transport were to be increase to 30% by 2030. In the 2023 NECP

the legal binding target was increased to 34%. That was the only new measure in the 2023 report in this area, so one measures was strengthened, but there are no new measures. Other measures in the 2019 NECP are the use of biogas in transportation and investments on infrastructure for electric vehicles. In the 2019 NECP, there was a mention of an obligation that would be set on a number of charging points for petrol station chains. Another measure that they were planning in the 2019 NECP was that the subsidy when buying electric cars would be assessed. Another obligation in the 2019 NECP was that, in the case of a large scale renovation in a housing company, charging points had to be included. These four measures in the 2019 NECP are not mentioned in the NECP 2023, and the only one that was followed up was the raised biogas quota mentioned above. There was one measure in the 2023 NECP that mentioned promoting the infrastructure for electricity and biogas vehicles, but it is unclear how.

In the area *Improving the energy efficiency of vehicles and other means of transport*, the main measure in the 2019 NECP was a binding CO_2 emission performance standard vehicles. These benchmark values were however at a EU level. At a national level, there was a measure giving support for buying electric cars and for conversion to a gas or ethanol car. In 2018, there was a campaign where a buyer of a new car received economic support if they could also scrap an old car. In the 2023 report, there was more focus on regulation on CO2 emission performance standards for heavy-duty vehicles. Subsidy for purchasing gas-powered and electric trucks and vans were introduced. There was also support to the electrification of transport through tax reduction on electric cars. Another new measure in the 2023 NECP was that the car tax on battery electric vehicles had been removed. So there were 4 new measures in the 2023 NECP in this area, and the policy had been broadened in that way that it also focused on on heavy-duty vehicles and vans.

In the 2019 NECP, there were 9 measures in the area *Improving the energy efficiency of the transport system*. One aim mentioned in the 2019 NECP was to ensure that projects promoting walking, cycling and public transport were prioritised in transport planning and project funding. There was funding in the 2019 NECP for promotions related to walking and cycling, public transport, and rail transport services. Taxation of fossil fuels would be increased according to the 2019 NECP. There was also a measure in the 2019 NECP that changes in income taxation and benefits would be made for low-income individuals to take them more into consideration. In the 2023 report, there were investment programs for walking and cycling, and grants for public transport, but it was not stated if any new programs or investments had been made. So, in this area the updated NECP only includes two new measures. The study by Sewerein et al. [68], found that an intense policy could lead to a discontinuation. Considering the many measures in the 2019 NECP this policy can be viewed as quite intense. The measures in the 2023 NECP are unclear and several of the measures in the 2019 NECP are not mentioned in the 2023 NECP, which is a ratcheting down effect. Thereby this coincides with the findings by Sewerin et al. [68].

Overall in the transport sector there were many measures in the 2019 NECP that were not mentioned in the 2023 NECP. In the area *Replacing fossil fuels with renewable and low-emission fuels and power sources* there was one measure that had been followed up in the 2023 NECP and one new measure in the 2023 NECP about promoting infrastructure for electricity and biogas vehicles that was unclear. In the area *Improving the energy efficiency of vehicles and other means of transport* there were 4 new measures, with a larger focus on heavy vehicles in the 2023 NECP, so considering this the policy was broadened. In the area Improving the energy efficiency of the transport system there were 2 new clear measures about investments for cycling, walking and public transport.

To conclude, the changes in the policies in Finland in the GHG dimension differs between different areas. In the area of buildings there has been a shift between the 2019 and 2023 NECP from more promoting and encouraging measures to cost and subsidy measures. The measures are more clear in this area in the 2023 NECP. Regarding energy taxes there was a tax rebate for energy intensive companies that will be phased out by 2024. In the area of industrial fuel use industrial sectors had prepared road maps in the 2023 NECP. A company can receive payments as compensation for high electricity costs due to EU ETS, which was a bit counter intuitive. In the transport sector there was one measure with a raised biogas quota between 2019 and 2023, and in 2023 there was more focus on regulation and subsidies for heavy vehicles, compared to the 2019 NECP. In the 2019 NECP there was funding for promotion cycling, public transport and rail services, and in the 2023 report it was not stated if any new investments or programs have been implemented. Overall in this dimension there was a larger focus on transport. Finland set the target of reaching climate neutrality by 2035, and have raised the target of reduction in GHG emissions from 39% to 50% in the 2023 NECP. Considering this, there is little evidence that the changes in policies is enough to support those targets.

6.1.2.2 Germany

For Germany, the 2030 target of reduction in GHG emissions set in the 2019 NECP, [25], was 38% (for the ESR sectors, comparison year 2005). In Germany's 2023 NECP, [26], this target was increased to 50%. In the GHG dimension for Germany the degree of change of policies varied in different areas. Sectors that are included in this section is *Industry, Transport*, and *Other*, where policies regarding finance is brought up. Important policies that are updated or new in the 2023 NECP were The Coal Phase-out Act, the Finance Strategy, and the national Fuel Emission Trading Act. All of these are described more in detail below. Overall there have been changes in policies in the GHG section to meet the targets, however there were also policies that remained the same or had measures which are not very specific.

Industry
The focus in the industry sector regarded coal phase-out. The policy regarding coal phase-out was strengthened and broadened since, in the 2023 NECP, there were

new legislative measures and an increased consideration to the social aspect compared to the 2019 NECP. One legislative change between 2019 and 2023 in the GHG dimension was the Coal Phase-out Act. A clear decommissioning pathway existed in both the 2019 and 2023 NECPs, but in 2023 there were more legislative control which regulates the gradual reduction of coal fired electricity generation with fixed targets dates. In 2023, there was also more focus on employment, for example the Act included adjustment allowance for older workers in the coal sector. It was also included in the Coal Exit Act that coal fired electricity generation would be reduced first by tendering procedures, then by statutory requirements.

Since coal phase out is included in the EU ETS [65], this is also a part of the policy regarding coal phase out in Germany. In the article by Perino et al. [71] Germany was an example of when policies are overlapping, here in reference to EU ETS and Germany's own policies in reducing GHG emissions from coal. When overlapping policies occur, member states can cancel allowances to support coal phase-outs. However, according to Perino, allowing countries to cancel allowances themselves is not effective. Germany's Coal Phase-out Act includes both provisions and cancels allowances. Their policy is partly shaped by a conflict between EU legislation and its own emission reduction targets.

Despite this, the policy about coal phase out was strengthened between the 2019 and 2023 NECPs. There were more concrete legislative measures in the 2023 report. It was also broadened because the social aspect is more taken into account (security of supply and adjustment allowance for workers).

Transport
In the 2019 NECP, there was only one measure in the transport sector, regarding a national ETS with fuels. In the 2023 NECP, there were new measures in this area, where some were more specific than others, and the policy about the Fuel Emissions Trading Act was strengthened.

One change between 2019 and 2023 NECP was the raised pricing of CO_2 by the Fuel Emissions Trading Act. Based on the The Fuel Emissions Trading Act a national fuel emission trading system had been introduced in Germany. The national emission trading system covers sectors that are not covered by the EU ETS. It had, between 2019 and 2023, gone from a start up phase to being implemented in 2021. In the start up phase only main primary fuels were included in the national ETS. It is not visible in the quantitative analysis that the ETS had gone from the start up stage to being implemented and that all fuels are included from 2021 and forwards. In that way the policy was strengthened. Here the ETS had a gradual implementation and adaption, since not all the fuels were included from the beginning. In the study by Ollier et al. [69] a smaller, gradual adaption in policies regarding renewable energy lead to a more stable policy environment for the stakeholders. This gradual implementation of the ETS could give the stakeholders here a more stable policy environment as well.

In the 2023 NECP, one new measure were tolls for heavy goods vehicles, which would be used to partly cover railway investments. The transport measures were more detailed when it came to rail transport than public transport. One new measure was that incentives for investment in the rail sector in digitalisation, automation and vehicle technology in freight transport would be reinforced. However, there are not any clear new measures regarding public transport. It was mentioned that it became cheaper with a new ticket in 2023, but was not mentioned if this would continue going forward. To increase the attractiveness of local public transport a pact was to be adopted, but no detail was given on which measures were to be taken to implement this. There was no mentioning of carpooling, cycling or anything on private transport except for the national ETS.

So overall in the transport sector in the there were new measures, and one strengthened policy about the national ETS. However measures regarding public transport were not specific, and there were no measures regarding private transport except for the Fuel Emissions Trading Act. Therefore there were changes between the 2019 and 2023 NECPs, but to varying degrees and it also varied between the different types of transport.

Other
In the area of finance there were 3 new policies in the 2023 NECP and a policy about a finance strategy that had moved from the planning stage to being implemented. So overall in the policies relating to financing in the GHG dimension there were changes between 2019 and 2023.

One new policy in the 2023 NECP was a funding program called Light Construction Technology Transfer Programme. It supports projects relating to saving materials on products and energy, increasing circularity, recycling of materials and products, saving resources and reducing CO2 emissions. It was planned to be amended in 2023 and the new program would focus more on material efficiency, circular economy, digitalisation and automation. In the 2023 NECP, there was an additional fund that supports project relating to decarbonisation, expansion of renewable energy, the expansion of refuelling and charging infrastructure. Another change in the 2023 NECP were new projects in Germany's recovery and resilience plan dedicated to the decarbonisation of industry, which receives European funding. The projects also aimed to establish alternative technologies in the transport sector.

In 2019, Germany developed and planned to implement a Sustainable Finance Strategy, with purposes of, amongst other, integrating sustainability into federal investments and examine green federal bonds in Germany. It was implemented 2021. In the 2023 NECP, they mentioned that they have issued green bonds and green federal securities since 2020 to create transparency about federal green spending. They have also decided that a spending review, i.e a review of whether public funds are used in an effective and targeted way, will be conducted on the subject of "linking sustainability goals to the federal budget". They have also established the International Sustainability Standards Board in Frankfurt, which is a key standard setter

for global sustainability reporting. All of these 2023 NECP measures were a part of the Finance Strategy, and considering this, the policy was followed up. The goal and the plan of the policy was specific in the 2019 NECP, and in the 2023 NECP new measures has been implemented. In the study by Sewerin et al. [68], there were no signs found that policy intensity or specificity might affect policy continuation. However, in the policy regarding the Finance Strategy above, a specific policy has had a ratcheting up effect.

In the area of finance in the GHG dimension there were 3 new policies and a ratcheting up effect on the finance strategy, with implemented measures in the 2023 NECP. So overall in this area there have been changes in policies between 2019 and 2023.

In the area of regional cooperation there was no change between 2019 and 2023. Germany and France are working together in the Meseberg Climate Working Group on, amongst others, approaches to the energy transition, sustainable financing instruments and financial incentives and carbon pricing. Between 2019 and 2023 there was no change in the NECPs regarding this.

To conclude, there have been changes in the policies between 2019 and 2023, but the degree and the specificity of the policies and measures varies. Some clear updated policies were the Coal phase-out Act, the Fincance Strategy and the Fuel Emissions Trading Act. Regarding the The coal phase-out the policy was strengthened, however the policy might be affected by a conflict between EU legislation and Germany's own emission reduction targets. In the finance area there were some new measures, and the Finance strategy is implemented. In the transport sector the national ETS have gone from a start up to being implemented and including all fuels. However, measures regarding public transport were a bit unclear, whilst measures regarding rail was more specific. There was an increased focus on digitalisation in the 2023 NECP. The policy's regarding regional cooperation were the same in the 2023 NECP.

6.1.2.3 Greece

Greece set a target of reducing their total GHG emissions by 32.3% by 2030 in 2019 [27], then raised said target to 42.2 % in 2023 [28]. Concerning policies, they have focused on the decarbonisation of electricity production both in the mainland grid and on their non-interconnected islands. In addition, they have implemented measures to update and decarbonise transport.

Energy
Greece faces a unique challenge of decarbonising a set of islands, many of them not connected to the grid. In 2019, they set a target of connecting most of the 28 autonomous systems to the main grid by 2030. They plan to install 240 MW of hybrid plants with a guaranteed capacity by 2026. 120 MW of these will go to non-interconnected islands such as Rhodes, Lesvos, Kos, Megi, Antikythira, Gavda, Heikoussa. The rest will be installed on Crete along with a pumped storage system and 50 MW of wind. They also made a special agreement with the EU to guarantee

free CO_2 allowances for this decarbonisation, which correspond to roughly €2 billion.

In 2022, Chalki became the first of these green islands [87]. With the installation of a 1 MW photovoltaic park, they could cover the entire island's electricity needs. This transition contributed to roughly:

- Electricity bill reduced by roughly 55% for residents, businesses and the municipality of Chalki.
- Annual savings of roughly 180 000 - 250 000 euros per year.
- Reduction of 1800 tons carbon emissions per year.

In the 2023 NECP, there are no updates to the island decarbonisation goal, and no additional measures have been added. The project on Chalki is not referenced.

Greece committed in their 2019 NECP to shut down all lignite fired plants by 2028. They aimed to develop a plan called the Just Development Transition Master Plan by 2020 to aid in this lignite phase-out. The plan will include measures such as: economic investments, developing infrastructure and new technologies, utilising local natural resources, supporting agricultural production and tourism, and retraining workers and securing existing jobs. A total of 14 plants were planned to be shut down by 2023.

By 2023, the Just Development Transition Master Plan had been implemented and 7 of the 14 planned shutdowns had been completed, along with adding an additional plan to shut down the Ptolemaida plant by the end of 2028. In table 6.2 below, the progress on the remaining shutdowns is illustrated [27, 28, 88].

Plant	Capacity [MW]	2019 Plans	Current Plans
Kardia 1	275	2019	Shut down
Kardia 2	275	2019	Shut down
Kardia 3	280	2021	Shut down
Kardia 4	280	2021	Shut down
Agios Dimitrios 1	274	2022	End of 2025
Agios Dimitrios 2	274	2022	End of 2025
Agios Dimitrios 3	283	2022	End of 2025
Agios Dimitrios 4	283	2022	End of 2025
Agios Dimitrios 5	342	2023	End of 2025
Amyntaio 1	273	2020	Shut down
Amyntaio 2	273	2020	Shut down
Florina/Meliti	289	2023	End of 2025
Megalopolis 3	255	2022	Shut down
Megalopolis 4	256	2023	End of 2025
Ptolemaida	615	No plan	End of 2028

Table 6.2: Shutdown plans for Greece's lignite power plants in 2019 compared to their current status

Transport

Transport is under RES in Greece's 2019 NECP and GHG in 2023, but all policies will be featured in this chapter. In 2019, Greece had very few concrete plans regard-

ing public transport. In 2023, however, they presented a number of new measures to strengthen it, such as: Drawing up a Strategic Transport Plan; implementation of a fleet renewal programme for buses with new low-emission buses and exploring a scenario of retrofitting existing buses to use hydrogen; extending Metro Line 2 from Anthoupoli to Ilion, and constructing Metro Line 4. They also included new, concrete plans regarding the implementation of railway transport.

Overall, Greece's GHG policies have not changed much outside of the public transport sector. Their plans regarding lignite phase-out were postponed, and while the decarbonisation of the non-interconnected islands have seen some follow through, the ambition of the plan remains the same. Considering that Greece raised their target from 32.3% to 42.2%, this lack of change may be insufficient to reach the higher target.

6.1.2.4 Ireland

Between their 2019 and 2023 NECP, Ireland raised their 2030 ESR emission reduction targets from 30% [31] to 42% [32]. Their planned measures in the GHG dimension focus mainly on phasing out coal and peat in electricity production, as well as increasing the uptake of electric vehicles along with improving the necessary charging infrastructure. The main change lies in the acceleration of Ireland's peat phase-out and the increase of its carbon tax.

Industry
Plans to phase out all lignite and peat fired electricity production were set in 2019. The original goal from 2019 was to cease firing peat in 2/3 generators by 2023. In the 2023 NECP, however, Ireland reported that all peat fired electricity generation has ceased. Two of the generators West Offaly and Lough Ree, with capacities of 135 MW and 100 MW respectively, were both shut down in 2020 [89], [90]. The third peat power plant, Edenberry, transitioned to burning biomass in December 2023. They also state plans to cease firing coal in the 915 MW Moneypoint power plant by the end of 2025. This plan remains the same in the 2023 NECP.

Ireland have had a carbon tax since 2010, which apply to mineral oils, natural gas, and solid fuels. In 2019 this tax was set to €20/tonne CO_2 with a planned increase of €6/year leading to a tax of €80/tonne CO_2 in 2030. In 2023, the tax had been raised to €48.50/tonne CO_2, with a raised increase of €7.5/year, leading to a tax of €100/tonne CO_2 by 2030.

Transport
In the transport sector, Ireland have not made many significant changes between 2019 and 2023. Their plans for public transport in 2019 involved many large infrastructure projects such as: DART+, a expansion of the electrified rail network in Dublin to cover the entire city; BusConnects, a blend of infrastructure system improvements to improve bus traffic in the Dublin region; MetroLink, a new cross-city rail network in Dublin. In 2023, all of these remain as plans, though they did launch their first all-electric town bus service in Athlone in January 2023.

The remaining transport policies follow a similar pattern, where plans have changed little between reports. Most policies are in the form of grants to support the uptake of electric or low-emission vehicles, which have remained the same in both reports. The most notable addition was, in 2023, the implementation of new supports for the construction of chargers, including Just Transition funds for Just Transition areas. They also doubled the grants for new vehicles for taxi/hackney/limousine drivers if they scrapped old high-emission vehicles.

Overall, Ireland's GHG policies have seen both follow through and increases in ambition. The increased carbon tax and accelerated peat phase-out may contribute to reaching the increased target of 42% reduced emissions in the ESR sectors by 2030, but whether their changes are sufficient is difficult to say.

6.1.2.5 Italy

As can be seen in Table 6.1, Italy has no matching categories in targets for GHG emission reductions and it is therefore difficult to connect the policy analysis to changes in targets. However, Italy mainly continues to operate with the policies described in the 2019 NECP [33], and has not implemented many new policies in the 2023 NECP [34]. A small number of policy measures that were planned in the 2019 NECP have now been implemented and are currently ongoing. The sectors that is included in the GHG dimension for Italy is *Industry, Transport*, and *Other*.

Industry
Italy made plans, even before 2019, to phase out coal in electricity generation by the end of 2025. The objective was, however, more precisely defined in the 2019 NECP, especially when it comes to the conditions necessary to achieve the objective. It is worth noting that they made a significant change in this policy in their 2023 NECP. The change involved an exception from the the 2025 target for the island of Sardinia, where the development of RES and connections to mainland Italy make it difficult to reach that specific target. Instead, Italy deems it more realistic to start the phase out of coal in electricity generation on Sardinia in 2025 with completion of the process set to 2028 [34, p.207]. They also mention that the phase out of a group of coal fired plants totalling a capacity of 5 500 MW faces difficulties as a result of the geopolitical crisis caused by Russia's invasion of Ukraine.

Transport
The Italian government launched a notable funding plan in its Stability Law for the replacement of the fleet of road transport vehicles used for local public transport for the period 2019-2033. The focus will mainly be on replacing existing the existing fleet of buses with buses powered by methane or electricity. In the 2023 NECP they also included hydrogen buses as part of the new fleet. For the aforementioned time period, close to EUR 3.9 billion of state funding is being allocated for the fleet replacement as well as for the development of related infrastructure. In addition, economic incentives are being launched to encourage the procurement of more efficient vehicles with higher climate standards.

Italy is also working to promote soft mobility (non-motorised mobility), carpooling and shared mobility through soft mobility measures as described in their 2023 NECP. By funding the development of soft mobility infrastructure such as bicycle paths Italy feels it can encourage the transition from conventional motorised transport in the private transport sector. In the 2023 NECP, they describe that EUR 372 million is being utilised to finance the national system of bicycle paths for tourism during the 2016-2024 period.

Other
Italy previously participated in a EU funding program called the *Horizon 2020* program, which was for research and innovation spanning from 2014 to 2020. The financial contribution for Italy amounted to EUR 112.4 million, which corresponded to 7.8% of the allocated budget. Italy continues to participate in the successor to Horizon 2020, named *Horizon Europe*.

To conclude, Italy has no matching targets for GHG emission reductions in the NECPs 2019 and 2023. The policy regarding coal phase-out was more precisely defined in the 2019 NECP. There has been some change in the policies regarding transport, and they are continuing to participate in a EU funding program in both the NECP 2019 and 2023.

6.1.2.6 Portugal

A substantial amount of Portugal's policies on decarbonisation are filled with ambiguity, as they have chosen more often than not, to opt for policies involving 'promotion'. In some cases Portugal has even listed it as a measure within the policies, e.g. 'promote the electrification of industry' [41, p.63]. These types of policies seldom contain concrete measures to obtain the desired objective and are therefore more open to interpretation. This can be viewed as counterproductive, given that Portugal increased their target for total GHG emission reductions from 45 % in the 2019 NECP [41] to 55 % in the 2023 NECP [42].

European Union Emission Trading System
One of the most noteworthy policies in Portugal's NECPs were *1.2. APPLY EU ETS* in their 2019 plan and *1.2. CONTINUE THE IMPLEMENTATION OF THE EU ETS SCHEME* in their 2023 draft plan. This is contradictory since Portugal implemented the ETS in 2005 during Phase I and have been using it since, according to the European Commissions documentation on the EU ETS [91]. It is therefore strange that Portugal would set this as one of their key policies in the dimension of decarbonisation.

Energy & Industry
Portugal had a strong focus on promoting decarbonisation. In order to decarbonise the industry sector, Portugal takes action by promoting and encouraging the penetration of RES and the electrification of industry. Portugal doesn't elaborate further on this policy in their 2019 NECP. In the 2023 NECP, however, they added three

new action measures. These measures are listed as:

- Consider the potential contribution of Carbon Capture and Storage (CCS) and Carbon Capture and Utilisation (CCU) activities in the industrial sector.
  - CCS is the process of capturing CO_2, either directly from the atmosphere or from large point sources, and then injecting it into deep geological formations for future storage. CCU differs from CCS in the final stage of the process where, instead of being stored away, the CO_2 can be compressed and utilised e.g. in the fertiliser industry [92, 93].
- Support business investments in decarbonisation.
- Ensure the implementation of the Carbon Border Adjustment Mechanism, as described in subsection 2.2.2.

The latter two measures are planned for the 2023-2030 period, while the former are planned for 2020-2030.

In Portugal's 2019 NECP they introduced a policy regarding dialogue platforms with a focus on sustainable development and measures to promote said platforms. The motivation behind this policy was Portugal's desire to promote an inclusive and transparent dialogue between key actors from all societal sectors at local, as well as, national level.

A key measure in this policy was the promotion of the creation of a National Energy Council which would act as an advisory body independent of the government, acting on local, regional and national levels. It would involve parties from the private sector as well as from the public sector. The Council would act as a platform in order to help develop energy policies aimed at supporting the energy transition. This measure was however eliminated in the 2023 NECP, with the explanation that these types of organs already exists in these areas [42, p.89].

Other
A new policy presented in Portugal's 2023 NECP is the establishment of a new voluntary carbon market. Portugal describes its reason for this policy as the growing interest from society in utilising carbon markets as means to offset carbon emissions. The work to prepare and implement the carbon market is currently ongoing with no certain due date. However, the legislative framework for the carbon markets function should, as of 2023, be established. A publicly available platform for carbon registration and carbon credits is the next measure in line, with development planned for the 2023-2024 period. The platform will, e.g., allow anyone to view transactions carried out as well as allow the registration of projects. A measure deemed necessary to avoid emission reductions being counted twice.

Looking beyond the fact that a large portion of Portugal's policies in this dimension contain ambiguity, they have a few concrete measures in order to reduce GHG emissions. However, given the fact that they have increased their GHG emission reduction target from 45% to 55%, one would expect less ambiguity.

6.1.2.7 Spain

With a target rise of 45%, seen in Table 6.1, changes between the 2019 NECP [49], and the 2023 NECP [50] is needed. With over 20 new measures in the GHG sector it looks like Spain was developing their policies to reach the new targets. Within these new measures the main focus lied in the transport sector with more than half of the new measures belonging to transport.

Buildings
One new policy in the building sector is building life cycle analysis. Here the main objective was to calculate the impact that a building, its material and building process have on the climate, to make it easier to choose the more sustainable option.

Energy
There were a few more new policies like new business models for the energy transition. The main goal of this effort was to assist new business models that tackle the obstacles posed by the transition to renewable energy. This involved encouraging innovation, providing adaptable services to enhance renewable energy incorporation, aiding decarbonisation efforts, and fostering emerging companies that offer inventive solutions for the energy transition.

An improved policy is unique projects and strategy for sustainable energy on the islands. The project is an initiative started in 2017 with 13 other member state. They saw a potential to see the islands as their own energy transition which make them to a place to get a bit more creative. Since the start, multiple aids have been implemented to support the development of new technologies to find the most efficient.

Industry
Spain being under a big change of their energy suppliers, big transition from coal and nuclear energy to almost only renewable energy. The plan presented to phase out both coal and nuclear power plants with the ambition to have zero coal plants in 2025 left of their five still existing plants. To cope with this big change they implemented the policy *just transition strategy*, that is a strategy to support people and the community around the big coal and nuclear industries. The policy gives aid for the affected workers, gender equality, new projects to current factory workers deployment and developing new renewable energy possibilities in the area. The plan for the coal and nuclear phase out remained the same for both 2019 and 2023 NECP, but was worth mentioning due to the big impact it has.

Transport
The transport sector is one of the biggest improved sectors for Spain under GHG. One of the new policies under transport is the decarbonisation of the maritime transport. The two main objectives for the policy is to change the fuels to green fuels as biofuel or renewable hydrogen and the electrification of ports. To do that, new regulations, laws and technology has been implemented. The decarbonisation of air transport that is another, similar, new policy in the 2023 NECP. As for the maritime, the focus is also a change of fuel to more a sustainable fuel source, as

well as the change of energy to renewable. This will affect the infrastructure in the aviator sector, that includes aircraft and airports.

As seen from the changes above, Spain is working towards new targets for GHG. With their focus being mainly on the transport sector as well as the energy and building sector, signifying that Spain covers multiple sectors. With a increased target as high as 45% it is difficult to say if Spain planned and executed enough changes in their policies, or if they need to further develop their strategies. However it is clear that effort has been taken to improve the policies thereby putting Spain on the right path.

6.1.2.8 Sweden

The measures in Sweden's policies where not that clear and therefore the categorisation are made from the policies and not the measures within them.

In general as seen in Figure 6.1 Sweden has implemented 3 new policies and as seen in Table 6.1 Sweden's targets have not changed for GHG. Below are the big changes between the 2019 NECP [51], and the 2023 NECP [52]. The sectors included in the GHG dimension in Sweden are *Energy, Transport* and *Other*.

Energy
A new policy in the energy sector is aid for recharging and hydrogen refuelling infrastructure. Which is a tax reduction for private person that install a recharging station at home, to promote green technology.

Transport
The biggest categorisation for Sweden is economy and finance policies and within them there are many tax regulation. One improved tax for the transport sector is the carbon tax for fuels that was implemented in 1991 and is a tax based on the fossil content of the fuel and it has been increased from 1.18 SEK/kg CO2 in 2019 to 1,33 SEK/kg in 2023. In 2018 a reduction obligation was introduced with the attempt to reduce the GHG emissions. The obligation demands all fuel suppliers to reduce their emissions from petrol and diesel and replace them with bio-fuels. The reduction obligation was 20% for diesel and 2,6% for petrol in 2019 and the reduction level has increased to 30% for diesel and 7,8% for petrol in 2023. Another also improved tax for the transport sector is the air travelling tax. The air travelling tax is divided in to three groups depending on the destination where the tax was 62, 260 or 416 SEK per passenger in 2019 and 69, 288 or 461 SEK in 2023.

To make it easier to travel abroad with low climate impact, the government proposed in 2019 that Trafikverket to investigate to opportunity to purchase night trains. The goal was to find trains to several European countries with daily departments. This plan has now been implemented but as for now just one country and not for several European countries. In 2020 Trafikverket made a deal with SJ for a night train from Stockholm to Hamburg with departments 244 days a year. This deal will be active until 30 July 2025 with a possibility to expand it to 2027. In the 2023 NECP they

do not mention if the plan is still to implement this measure to more countries or if the end goal is Hamburg.

Another policy in the transport sector is the electric bus incentive payment that is a policy for actors within the public transport. Where they can apply for a support in their transition to electric busses. The incentive had a budget on 80 million for this transition in 2019. In 2020 the incentive changed from a electric bus incentive payment to a climate incentive payment where actors could also apply for support in the electrification on trucks and work machines. The budget has also changed to 576 million where the electrification of busses has maximum of 260 million in budget. Both these changes appeared in the 2023 NECP, where the scope change was implemented in 2020 and the budget is for 2023. This means that the policy is strengthened and broadened, since the policy's scope and budget has both been expanded from between the 2019 NECP to the 2023 NECP.

Two new policies in the NECP 23 under GHG are reduction obligation for flights, environmentally responsible take-off and landing fees. The two policies are about lower the emissions from the aviation sector, with the first one about reduction obligation to demand all kerosene suppliers to blend it with bio-fuels. It started in 2021 with a obligation of 0,8% bio-fuel but with the goal that in 2030 have a bio-fuel percentage of 27. The other one was implemented in 2022 and is about take-off och landing fees for planes arriving and departing from Arlanda and Landvetter airport. The fee depends on the climate impact the plane have.

Other
In 2015 Sweden implemented a new support called Klimatklivet for climate investments to all organisations inside the EU ETS. The organisations can apply for this investment for actions like new infrastructure as electric car charging stations or cycling. Other examples are changing of fuels, bio-fuel stations and expansion of smaller district heating networks. The financing from this policy have increased significant from 1,5 billion in 2019 to 2,8 billion in 2022 and will continue to increase in 2023 with another 400 million and 500 million in both 2024 and 2025.

Removed policies
There are also some policies removed from the NECP 23, one is bonus-malus system for new light-duty vehicles. The policy gives the right to a bonus for a purchases of an vehicles with low climate impact. The bonus system was removed in 2022.

Another policy not in the 2023 NECP is electric roads. The plan for electric roads are to be enable to charge a vehicle while driving to extend the reach. In the NECP 19 four different pilot projects are mentioned for different kind of vehicles but the policy is not mentioned in the 2019 NECP. However, electric roads is still an ongoing project. For example, E20 between Hallsberg and Örebro is planned to be the first permanent electric road in Sweden [94].

In general Sweden have improved their GHG policies in the 2023 NECP with a

higher budget for supporting climate investment, larger taxes and strengthening the transport sector. They have also implemented three new policies, but as well removed two. With the fact that the targets have not been improved, and there still improvements on the policies, the policies matches the change in targets from 2019 to 2023.

6.2 Renewable Energy Sources

The RES section includes a quantitative analysis in addition to a qualitative analysis of relevant policies. The RES dimension includes the three main sustainable energy production sources, wind, hydro and solar. The quantitative analysis will thereby include targets and policy measures for all three energy sources and the qualitative analyses specific policies regarding measures taken to implement a renewable energy production.

6.2.1 Quantitative analysis

The quantitative analysis of the RES dimension consists of the compiled comparison of targets of each member states' specific RES ambition, as well as a compilation of the number of policy targets for RES in 2019 and 2023, and the overall EU scale categorisation trends visualised.

6.2.1.1 Targets

The RES targets have been presented similarly to the GHG emission targets. Both targets from the 2019 and the 2023 NECPs have been included, along with changes. As most countries used either capacity or generation in their NECPs, the analysis has been split into two categories. If a country had targets in both categories, capacity was chosen. Furthermore, the tables were split into one for solar, wind and hydro targets each.

As mentioned in chapter 4.3.2, all RES targets were normalised according to total electricity system size [TWh], where each target was divided by the size to allow comparison between countries.

Solar Targets Table 6.3 shows member states' targets for solar energy.

- The second and third columns, 2019 and 2023 targets respectively, contain the target amount either in normalised capacity [GW], or normalised generation [GWh]
- The fourth column, factor, shows the increase by factor, calculated by dividing the 2023 target by the 2019 target.
- The fifth column, difference, shows the increase by difference, calculated by subtracting the 2019 target from the 2023 target.
- The sixth column, target category, shows the category the original target was set, either capacity [GW] or generation [GWh]. If targets were missing or mismatched, it is stated here.

Country	2019 Target	2023 Target	Factor	Difference	Category
Austria	158.92	258.82	1.63	99.90	Generation [GWh]
Belgium	112.77	158.33	1.40	45.56	Generation [GWh]
Bulgaria	-	-	-	-	No 2023 targets
Croatia	0.039	0.049	1.26	0.010	Capacity [GW]
Czech Republic	0.023	0.057	2.48	0.034	Capacity [GW]
Denmark	0.21	0.32	1.52	0.11	Capacity [GW]
Finland	12.99	29.51	2.27	16.52	Generation [GWh]
France	-	-	-	-	No matching categories
Germany	0.18	0.39	2.17	0.21	Capacity [GW]
Greece	0.15	0.25	1.67	0.10	Capacity [GW]
Hungary	0.13	0.25	1.92	0.12	Capacity [GW]
Ireland	0.036	0.13	3.61	0.094	Capacity [GW]
Italy	0.15	0.24	1.60	0.090	Capacity [GW]
Lithuania	67.32	388.51	5.77	321.19	Generation [GWh]
Netherlands	-	-	-	-	No matching categories
Poland	-	-	-	-	No 2023 targets
Portugal	0.16	0.37	2.31	0.21	Capacity [GW]
Roumania	130.51	232.93	1.78	102.42	Generation [GWh]
Slovakia	0.043	0.050	1.16	0.007	Capacity [GW]
Slovenia	138.90	250.53	1.80	111.43	Generation [GWh]
Spain	0.15	0.29	1.93	0.14	Capacity [GW]
Sweden	0.014	0.043	3.07	0.029	Capacity [GW]
Average	0.11	0.20	2.06	0.094	Capacity [GW]
Median	0.14	0.245	1.92	0.097	Capacity [GW]
Minimum	Sweden	Sweden	Slovakia	Slovakia	Capacity [GW]
Maximum	Denmark	Germany	Ireland	Germany	Capacity [GW]
Average	103.57	219.77	2.44	116.17	Generation [GWh]
Median	121.64	241.73	1.79	101.16	Generation [GWh]
Minimum	Finland	Finland	Belgium	Finland	Generation [GWh]
Maximum	Austria	Lithuania	Lithuania	Lithuania	Generation [GWh]

Table 6.3: Changes in normalised solar energy targets between 2019 and 2023.

As can be seen in Table 6.3, Denmark and Germany had the highest normalised solar capacity targets in 2019 and 2023 respectively. Germany also had the highest increase by difference. Ireland had the largest increase by factor, more than tripling their 2019 target. Sweden had the lowest normalised target in both 2019 and 2023. Slovakia, however, had the smallest increase by factor and difference.

Looking at generation, Lithuania had the highest normalised 2023 target, the highest difference between NECPs in the generation category with roughly three times the average, and over a quintuple increase by factor, nearly doubling the average

Overall, all countries have raised their solar targets. The minimum increase in capacity was by a factor of 1.16, and in generation by 1.40. On average, they more than doubled their 2019 targets in 2023.

Wind Targets Table 6.4 shows member states' targets for wind energy.

- The second and third columns, 2019 and 2023 targets respectively, contain the target amount either in normalised capacity [GW], or normalised generation

[GWh]

- The fourth column, factor, shows the increase by factor, calculated by dividing the 2023 target by the 2019 target.
- The fifth column, difference, shows the increase by difference, calculated by subtracting the 2019 target from the 2023 target.
- The sixth column, target category, shows the category the original target was set, either capacity [GW] or generation [GWh]. If targets were missing or mismatched, it is stated here.

Country	2019 Target	2023 Target	Factor	Difference	Category
Austria	226.90	258.68	1.14	31.78	Generation [GWh]
Belgium	283.35	327.74	1.16	44.39	Generation [GWh]
Bulgaria	-	-	-	-	No 2023 targets
Croatia	0.070	0.13	1.86	0.06	Capacity [GW]
Czech Republic	0.014	0.016	1.14	0.002	Capacity [GW]
Denmark	0.28	0.41	1.46	0.13	Capacity [GW]
Finland	212.49	271.51	1.28	58.66	Generation [GWh]
France	-	-	-	-	No matching categories
Germany	0.16	0.26	1.63	0.1	Capacity [GW]
Greece	0.13	0.18	1.38	0.05	Capacity [GW]
Hungary	0.007	0.023	3.29	0.016	Capacity [GW]
Ireland	0.23	0.30	1.30	0.07	Capacity [GW]
Italy	0.056	0.086	1.54	0.03	Capacity [GW]
Lithuania	347.77	1564.11	4.50	1216.34	Generation [GWh]
Netherlands	-	-	-	-	No matching categories
Poland	0.022	0.034	1.55	0.012	Offshore capacity [GW]
Portugal	0.17	0.22	1.29	0.05	Capacity [GW]
Romania	207.38	310.45	1.50	103.07	Generation [GWh]
Slovakia	0.018	0.027	1.5	0.009	Onshore capacity [GW]
Slovenia	16.48	24.02	1.46	7.54	Generation [GWh]
Spain	0.19	0.23	1.21	0.040	Capacity [GW]
Sweden	0.086	0.18	2.09	0.094	Capacity [GW]
Average	0.11	0.16	1.63	0.05	Capacity [GW]
Median	0.086	0.18	1.50	0.05	Capacity [GW]
Minimum	Hungary	Hungary	Czech Republic	Czech Republic	Capacity [GW]
Maximum	Denmark	Denmark	Hungary	Denmark	Capacity [GW]
Average	215.73	459.42	1.84	243.63	Generation [GWh]
Median	219.70	290.98	1.37	51.53	Generation [GWh]
Minimum	Slovenia	Slovenia	Austria	Slovenia	Generation [GWh]
Maximum	Lithuania	Lithuania	Lithuania	Lithuania	Generation [GWh]

Table 6.4: Changes in normalised wind energy targets between 2019 and 2023.

Denmark had the highest normalised wind capacity targets as well as the largest increase by difference. While Hungary had the largest increase by factor, their targets were the lowest. The Czech Republic, meanwhile, had the smallest increase, with a factor of 1.14 and a difference of 0.002.

Lithuania had the highest targets for generation, as well as the largest increase by factor and difference, with more than double the average factor and roughly five times the average difference. Slovenia, meanwhile, had the smallest.

All countries raised their targets in 2023. While the increase by factor was not quite to the same extent as with solar, the wind targets were on average higher. The minimum increase by factor was 1.14 in both capacity and generation, while the average increase was 1.63 and 1.84 respectively

Hydro Targets

Table 6.5 shows member states' targets for hydro energy.

- The second and third columns, 2019 and 2023 targets respectively, contain the target amount either in normalised capacity [GW], or normalised generation [GWh]
- The fourth column, factor, shows the increase by factor, calculated by dividing the 2023 target by the 2019 target.
- The fifth column, difference, shows the increase by difference, calculated by subtracting the 2019 target from the 2023 target.
- The sixth column, target category, shows the category the original target was set, either capacity [GW] or generation [GWh]. If targets were missing or mismatched, it is stated here.

Country	2019 Target	2023 Target	Factor	Difference	Category
Austria	605.42	640.23	1.06	34.81	Generation [GWh]
Belgium	5.20	5.20	1.0	0.0	Generation [GWh]
Bulgaria	-	-	-	-	No 2023 targets
Croatia	0.14	0.12	0.86	-0.02	Capacity [GW]
Czech Republic	-	-	-	-	No 2023 targets
Denmark	0.00019	0.00019	1.0	0.0	Capacity [GW]
Finland	177.07	177.07	1.0	0.0	Generation [GWh]
France	-	-	-	-	No matching categories
Germany	-	-	-	-	No matching categories
Greece	0.074	0.072	0.97	-0.002	Capacity [GW]
Hungary	-	-	-	-	No 2023 targets
Ireland	0.0059	0.0059	1.0	0.0	Capacity [GW]
Italy	0.059	0.058	0.98	-0.001	Capacity [GW]
Lithuania	38.70	29.25	0.76	-9.45	Generation [GWh]
Netherlands	-	-	-	-	No targets
Poland	-	-	-	-	No targets
Portugal	0.047	0.046	0.98	-0.001	Capacity [GW]
Romania	301.22	291.11	0.97	-10.11	Generation [GWh]
Slovakia	0.063	0.063	1.0	0.0	Capacity [GW]
Slovenia	305.54	318.22	1.04	12.68	Generation [GWh]
Spain	0.055	0.054	0.98	0.001	Capacity [GW]
Sweden	0.12	0.12	1.0	0.0	Capacity [GW]
Average	0.063	0.060	0.97	-0.0022	Capacity [GW]
Median	0.059	0.058	0.99	0.0	Capacity [GW]
Minimum	Denmark	Denmark	Croatia	Croatia	Capacity [GW]
Maximum	Croatia	Croatia	Sweden	Sweden	Capacity [GW]
Average	238.86	243.51	0.97	4.66	Generation [GWh]
Median	239.15	234.09	1.0	0.0	Generation [GWh]
Minimum	Belgium	Belgium	Lithuania	Romania	Generation [GWh]
Maximum	Austria	Austria	Austria	Austria	Generation [GWh]

Table 6.5: Changes in normalised hydro energy targets between 2019 and 2023.

As can be seen in Table 6.5, hydro targets have, overall, either remained the same or been decreased. The only exceptions to this pattern are Austria and Slovenia, who have raised their targets by 6% and 4% respectively. Croatia had largest decrease in capacity by factor and difference. Lithuania had the largest decrease in generation

Studying all three energy sources, as can be seen in Table 6.3, Table 6.4, and Table 6.5, solar and wind targets increased significantly in the 2023 NECPs. Lithuania represents the most extreme of these, with increases by factors 5.7 and 4.5 in wind and solar respectively, as well as having the highest normalised 2023 targets in both categories.

6.2.1.2 EU scale policy analysis

The EU scale policy analysis section presents data from policies in the RES dimension. This contains policies sorted into the three main dimensions, as well as sector categorisation and types of policy instruments. Furthermore it is comparing countries and a 2019 and 2023 comparison.

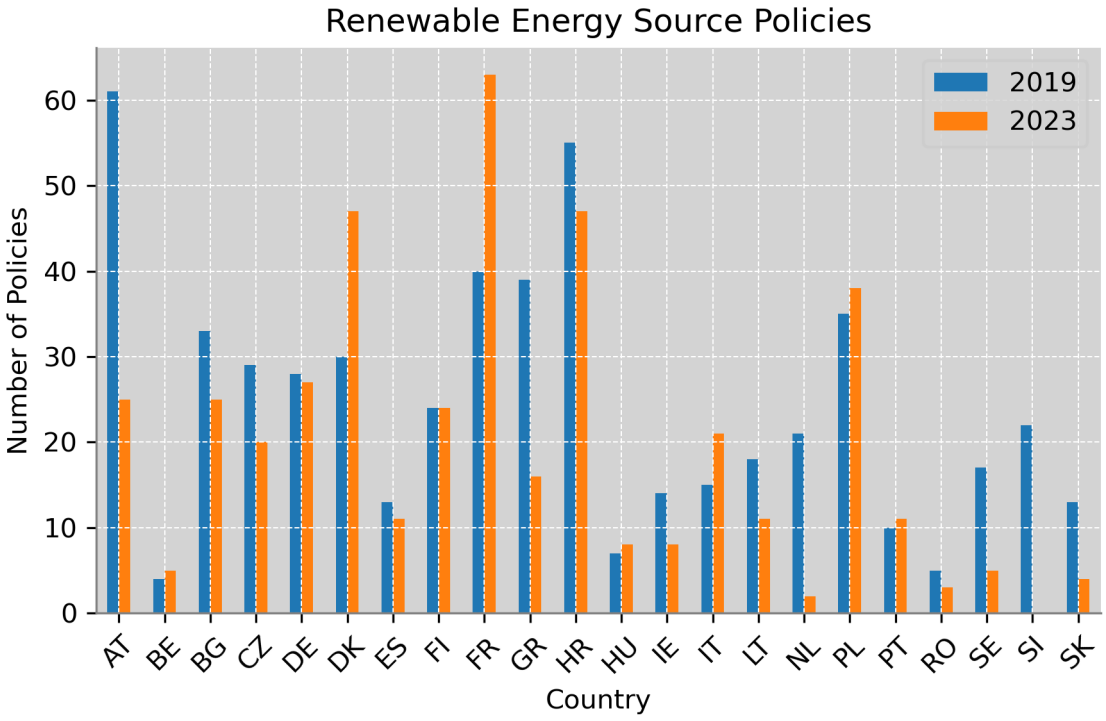

Figure 6.6: Compilation of Policies 2019 vs. 2023 for renewable energy sources. See Table A.1 for country codes.

In Figure 6.6, the number of policies regarding the usage of RES is displayed. For 2019 there was a total of 533 policies, and for 2023 the total was 421. This makes the total number of RES policies add up to 954. Figure 6.6 shows France having the most policies with 63 policies for 2023, and 103 in total. Austria and Croatia are also showing a significant spike compared to the others. Netherlands had very few new policies, along with Austria, Greece, Sweden and Slovakia, introducing far fewer new policies in the 2023 NECPs than in the 2019 NECPs new and existing policies. Similar to Figure 6.1, Figure 6.6 also shows Slovenia having zero new policies. The only member states that have increased the number of new RES policies in 2023 are Belgium, Denmark, France, Hungary, Italy, Poland and Portugal. Concluding that all other member states have introduced or changed less policies than their 2019 NECP introduced.

Type of Policy Instruments
The policy instrument measures for RES are visualised below. They are used to identify trends in this dimension as well as changes in trends.

The economic policy instrument has the most number of measures for 2019, which is visualised in Figure 6.7. It is closely followed by command and control. Economic has 226 measures, command and control 178 and information has 129 measures. This concludes information, as the type of policy instrument with the fewest poli-

cies in 2019. Figure 6.8 shows that economic has the most measures in 2023 as well. Economic has 175 measures in 2023. Command and control has the second most measures with 140 policy instruments, making the ratio between the two categories greater in 2023 than in 2019. This leaves information with 106 measures. Showing the leading measures for renewable energy sources is economic measures.

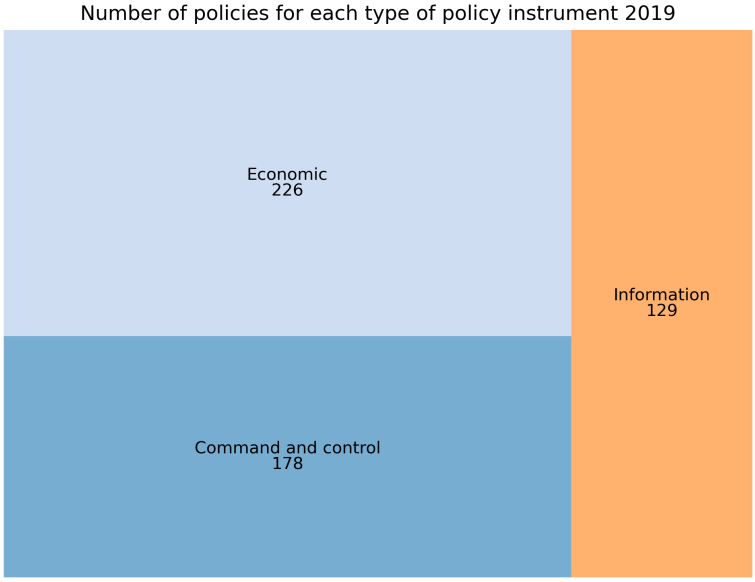

Figure 6.7: Visualisation of the *types of policy instruments* for the RES dimension, 2019.

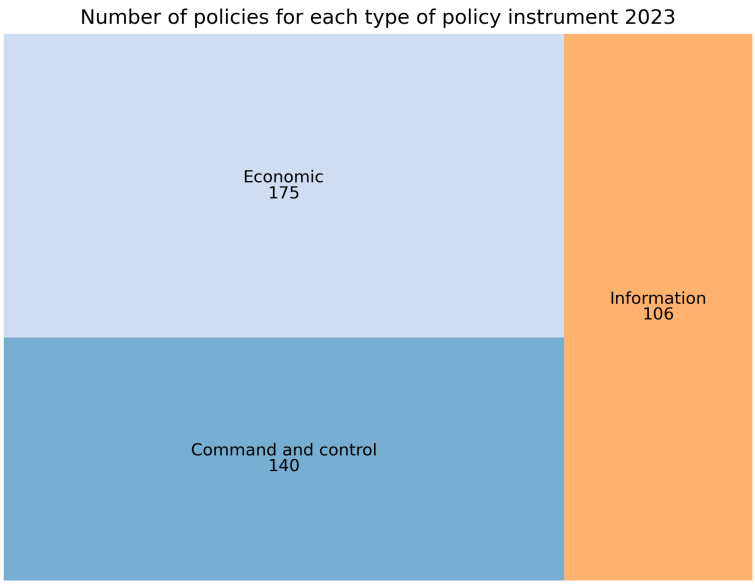

Figure 6.8: Visualisation of the *types of policy instruments* for the RES dimension, 2023.

Sector
The analysis of the sector categorisation below, is made to achieve an overview of what sector the measures are being implemented in. The sectors consists of energy, transport, industry, buildings and other.

In the categorisation for the sectors of renewable energy sources, seen in Figure 6.9, energy is the sector with the most measures. For 2019, energy has 369 thereby having a clear majority of measures, with transport having the second most number of measures with 76. Additionally buildings have 40 measures, other have 15 and industry 12. For the 2023 categorisation of the sectors, energy is still the major sector targeted with 297 measures. Transport is still the second largest with 94, buildings decreased to only having 21 measures and the other two does not differing too much from 2019. Since these are the measures created to improve renewable energy systems it corresponds to heightened targets in energy production, as seen in the targets presented in the section above.

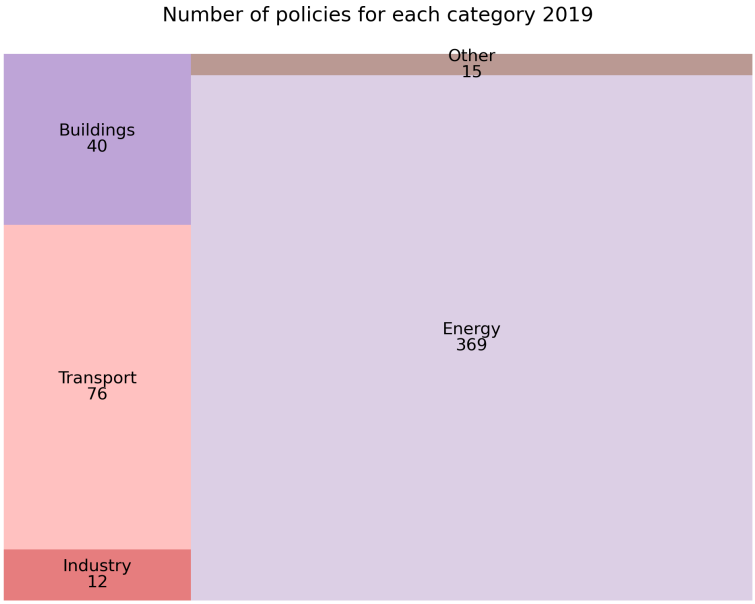

Figure 6.9: Visualisation of the *sector* categorisation for the RES dimension, 2019.

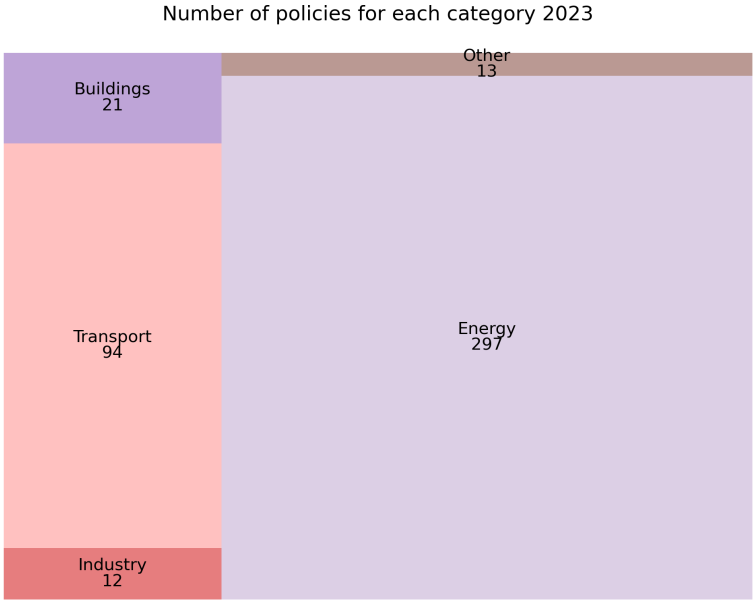

Figure 6.10: Visualisation of the RES *sector* categorisation for the RES dimension, 2023.

6.2.2 Qualitative analysis

The qualitative analysis for RES focuses on the changes in the case countries' policies regarding RES. Policies that represent broader trends of change and policies of importance to each case country are presented and analysed. The member states included in the qualitative analysis are, as presented in subsection 4.3.4, *Finland, Germany, Greece, Ireland, Italy, Portugal, Spain*, and *Sweden*. The policies included in the qualitative analysis in the RES dimension will be presented in a specific order. First an introduction of changes in targets is given, and the scope of policies to be covered and main observation relating to changes is presented. Then general policies that support energy expansion are presented. After that policies that support solar energy deployment, wind energy deployment and other renewable energy sources are presented successively. If there are no policies that belongs to specific section the section is not included. This is followed by a concluding paragraph reflecting on the policy changes.

6.2.2.1 Finland

For Finland, the 2030 target for share of renewable energy in gross final energy consumption in the 2019 NECP, [21], was set to 54%. In the 2023 NECP, [22], this target was set to 60%. In the RES dimension, Finland had no specific policies regarding just solar or wind. Instead there were 6 main focuses in the section *General policies supporting expansion of renewable energy* in this dimension. The focuses were *Tendering, Energy subsidies, Energy taxation, Coal phase out, Transport* and *Measures to facilitate the administrative permit application process of renewable energy.*

General policies supporting expansion of renewable energy
Finland has, since 2011, had a sliding feed-in tariff system for the production of electricity from RES, but it has been phased out. Since 2018 they have a new Act on a new premium system, which is based on tendering processes. An auction was held in 2018 and seven wind projects, with a total of 1.36 TWh/a worth of annual electricity production, was granted the aid. It was mentioned that no new auctions will be held and no aid schemes will be introduced. In the 2023 NECP, it was stated that the 2022 Climate and Energy Strategy did not include any new auctions or aid schemes. This means that this policy has not been followed up. As described in subsection 4.3.4 Finland was selected as a case study country because of the strong goal to reach net-zero by 2035. Considering this, the policy change in this area probably does not meet the 2023 NECP target.

In the 2019 NECP, renewable energy was promoted through the Energy Aid Scheme trough investment subsidies. It firstly applies to the sectors not included in EU ETS and to commercialisation of new technologies, but aid is also paid up for already well-established technologies. As the technology develops the aim is to phase out the aid, since the competitiveness should increase costs should reduce. The only new measure in the 2023 NECP in this policy was that projects focusing on replacing coal use have been given additional funding. So this policy was not strengthened,

since there was only one strengthened measure in the policy.

In the 2019 report Finland stated that RES was promoted through taxation. Fossil fuels were taxed on their energy and CO_2 content, and renewable fuels were not taxed on heat production. The purpose of the taxation was that it should provide incentives for using bioenergy. In 2015, small-scale electricity production got a legal reduction on the taxation and did not have to pay electricity tax. This policy was not mentioned in 2023 NECP.

In the 2019 NECP there were several measures regarding coal phase out. There was an act banning the use of coal in energy production from May 2029. No new power plants will be built nor any replacement investments based on coal be made. Coal will be used as backup fuel in certain situations when the existing plants have been decommissioned. There were plans to give extra support to companies that end use of coal by 2025. In 2020 there was preparation aimed making cuts to environmentally harmful subsidies and redirect the funds to more sustainable uses instead. In the 2023, report the ban on coal was still mentioned at the same date, and it was again mentioned that, in exceptional situations, coal may still be used as a backup fuel. In the 2023 NECP they still have tax expenditures for gas, diesel and peat. The phasing out of fossil fuel subsidies was not further discussed and there is no timeline regarding the phase-out of these tax expenditures.

One new policy in the 2023 NECP regarded transport. Measures included were a roadmap for fossil-free transport was concluded in 2021, with planning measures and measures for sizing the emissions reduction. A working group was supposed to prepare a distribution infrastructure program and study the use of electricity, renewable methane and hydrogen as power sources in road transport. In 2023 there was also a program completed to improve the distribution infrastructure for new fuels in road transport by 2035. It set vehicle related targets targets related to distribution infrastructure. It also defined measures for achieving the targets. So in this area there was some change to meet the new targets between the 2019 and 2023 NECPs.

In the 2019 report, they stated that Member States should facilitate the administrative permit application and granting process of renewable energy through contact points. It was also required to have an efficient administrative process. In the 2019 NECP, Finland had not implemented this into law. In the recent years the power purchase agreements has increased, especially for wind. In the 2023 report, Finland had 6 new measures and thereby strengthened this policy. In the 2023 NECP Finland had designated a contact point, and they had also worked to speed up permit-granting processes for renewable energy production facilities. According to the 2023 NECP this had positive results in permitting especially wind power.

It was also mentioned in the 2023 NECP that permit-granting processes guarantee that environmental impacts have been taken into account thoroughly, and that this was essential for local acceptance of renewable energy production. The 2023 NECP

thereby has a clearer focus on the social aspect. However, this differed from Germany who had an exemption for a period of time in the assessment of environmental impact and species protection legislation. In Germany, this was done to speed up the procurement process. Finland's tactic may however facilitate the permit application. In the 2023 NECP they have accelerated licensing procedures by allocating more resources to permitting authorities. In the 2023 NECP they also said that the number of purchase agreements especially concerning wind have increased recent year.

To conclude, the policy changes varies depending on the area. Overall there was much reliance on existing policies, except for the new policy regarding transport. There were no new auctions for renewable energy in the 2023 NECP, and in the *Energy Aid Scheme* there was only one new measure on additional funding to coal phase out. The policy on Energy taxation is not mentioned in the 2023 NECP. There are new measures regarding facilitating permit application and granting process of renewable energy, which have had positive results especially in wind power. There was also an aspect of social acceptance of renewable energy in this area in the 2023 NECP. This could be in conflict with speeding up permit applications and granting processes, but may facilitate the processes. Regarding phasing out coal subsidies, the policy was not strengthened. Finland has only raised their target in share of renewable energy in the electricity production from 54% by 2030 in the 2019 NECP to 60% by 2030 in the 2023 NECP. Overall there was not much strengthening of policies in Finland in the RES dimension. Despite this, the share of renewable in the total energy consumption has increased from 35% in 2011 to 48% in 2021 [95]. Between 2012 and 2022, the installed wind capacity in Finland increased significantly, and had a growth rate per annum of 36.1%. In 2022 the growth rate was 72.4% [80]. So even though the policy changes in gives little evidence of supporting the new targets, there is a fast deployment of RES happening in Finland.

6.2.2.2 Germany

For Germany, the 2030 target for share of renewable energy in gross final electricity consumption in the 2019 NECP [25], was set to 65%. In the 2023 NECP [26], this target was set to 80%. There was varying degree of change in the policies between 2019 and 2023 in different areas in the RES dimension. The areas that has been included in this section are *General policies supporting expansion of renewable energy, Policies to support offshore wind energy deployment, Policies to support onshore wind energy deployment* and *Policies to support solar energy deployment*. The main observations relating to changes in policies are more legislative control and a bigger focus on planning procedures for deployment of renewable energy in the NECP 2023, and the policy changes regarding solar was lacking.

General Policies Supporting Expansion of Renewable Energy
One new policy in the 2023 NECP was that renewable energy is in the overriding public interest and serve public security purposes. It will therefor precedence over other interests in balancing decisions. This is meant to increase the pace of planning and approval procedures. Another measure that is focused on speeding up the

planning procedure, is that the environmental impact assessment and species protection legislation, is not required for a 18 month period in designated wind areas. These new administrative measures indicate that an acceleration of the expansion of renewable energy could happen in Germany.

In the area of regional cooperation Germany is a part of a cooperation in the Baltic Sea, one in the North Sea and one in Greece. In all three of these cooperation's, there has not been any change. There was mentioning of Luxembourg and France in both 2019 NECP and 2023 NECP, but there was no clear cooperation with them. There is a new cooperation in the 2023 NECP and one planned cooperation with Denmark.

Germany is a part of the Baltic Energy Market Interconnection Plan (BEMIP), which is a platform for the exchange of experience between the participating Member States in the development of renewable energy. It aims to build a common vision of the EU's Baltic Sea states for the development of renewable energy, especially in offshore wind. Germany is also a part of NSEC, which is a Cooperation with other North Sea coastal states in the area of renewable energy. Germany and Greece has a cooperation where Germany funds technical support regarding renewable energy. All of these cooperation were the same 2019 and 2023.

The 2019 NECP mentioned that they are focusing on Luxembourg and France for cooperation. It is quite vague in the NECP 2019, and in the NECP 2023 it is mentioned that they are discussing with them. Therefor there has been no new measures regarding that cooperation.

In the NECP 2023 there were plans to increase the transparency of cross-border tenders for stakeholders in other Member States, and to clarify which tender conditions would apply in the event of cooperation. However, no more details is given on this. One new cooperation in the 2023 NECP regarded technical assistance in Cyprus, where Germany is supporting a project with floating photovoltaic, energy storage and offshore renewable energy. Another new project in the NECP 2023 stated plans for Germany and Denmark to develop a joint offshore project on Bornholm, and connect it to the German and Danish electricity grids.

In general there are many cooperations that were not changed or followed up, such as the North Sea cooperation and the discussions with France and Luxembourg. However there were plans to increase transparency for cross-border tenders, but no specifics were given. In the 2023 NECP there was a new cooperation with Cyprus and a planned cooperation project on Bornholm. There were no updates in the existing cooperations, but varying detail and specificity in plans on new projects.

Policies to Support Offshore Wind Energy Deployment
In the area of offshore wind there were some changes between 2019 and 2023. In the 2023 NECP there was an amendment of an act which include new measures to expand offshore wind. There was also a new 2023 policy regarding planning procedures, and one to secure the land to reach the 2030 target for offshore wind.

Since 2017 the conditions for tendering for offshore wind power have been regulated in the *Offshore Wind Energy Act*. In the NECP 2023 it is amended, with measures to increase tender volumes and expansion paths, speed up authorisation procedures, procurement and planning and that offshore expansion will be in the overriding public interest in the future. In that way the policy has been strengthened, with a gradual implementation of measures. This should according to the article by Ollier et al. [69] lead to a more stable policy environment, compared to if the Act have had the larger tendering volumes and the increased expansion paths from the start.

A new policy in 2023 NECP is the Offshore pre-deployment, which includes timetables for defined milestones with regard to the start and end of relevant authorisation and planning procedures. This measure could be a way of putting renewable energy as a priority into practise. Another new policy is the Maritime Wind Development Plan, which is a plan to secure the land needed to reach the 2030 target.

To conclude, there were some changes in policies between 2019 and 2023 to meet the raised target for offshore wind. The amendment of the *Offshore Wind Energy Act* included measures such as expanding tender volumes and put offshore expansion in the overriding public interest. In the NECP 23 there was a plan including milestones for authorisation and planning measures, and there was also a plan to secure the land needed to reach the 2030 target.

Policies to Support Onshore Wind Energy Deployment
In the area of offshore wind, some changes has been done between 2019 and 2023. In the 2023 NECP there was more legislative control to secure land for onshore wind and consequences if the surface area targets were not met. In the 2023 NECP there was focus on accelerating and simplifying planning procedures.

In 2019 there were measures that focused on tendering, and expansion of RES in power generation will be regulated by the Renewable Energy Sources Act. In 2019 it was mentioned that further measures are planned in relation to the expansion of renewable energy and it will be put into practical form in legislative proposals. In the 2023 NECP a new Onshore Wind Act was introduced which included the The Wind Energy Demand Act (WindBG). It ensured that, by the end of 2027 a total share of 1.4% of the federal area is available to use for onshore wind energy and 2% by the end of 2032. It also simplified planning requirements for wind energy sites. The onshore wind act also comprised amendments to the Building Code (BauGB), which has legal consequences regulation if the surface area targets are not met. In that case, plants will be permitted in areas outside the designated wind energy sites, to accelerate and simplify planning procedures. So there has been change in the policy between 2019 and 2023.

The 2023 NECP measures regarding onshore wind has thereby strengthened since they are more specific and there was legislative control. There was also a broadening in the measures, from just tendering to legislative control and focusing on simplify-

ing and accelerating planning procedures. So there has been changes between the 2019 and 2023 NECP regarding onshore wind.

Policies to Support Solar Energy Deployment In 2019 the only policies regarding photovoltaic, had to do with tendering. They also had a pilot project between 2018 and 2020 with cross-technology calls for tender. It included joint calls for tender for photovoltaic systems and onshore wind farms. This project is not mentioned in the 2023 NECP. In the 2023 NECP it is mentioned in the Renewable Energy Sources Act 2023 that expansion paths for solar were increased. Further measures are planned, and that these measures are specified in legislative proposals. The proposals are not specified. Germany has more than doubled their targets for solar capacity between 2019 and 2023. Since there is focus on tendering in the NECP 2019 and NECP 23 there has not been much change regarding photovoltaic, and the focus on the specific measures are just economic (tendering). Therefore there is little evidence that the changes in policies regarding solar is enough to meet the increased target.

To conclude, there are varying degree of change in the policies between 2019 and 2023 in different areas of the RES dimension. One change is that renewable energy will be in the overriding public interest, and there is much focus on speeding up planning procedures in the 2023 NECP. In the area of regional cooperation there are cooperations that remain the same in the 2019 NECP and 2023 NECP, and there is a new cooperation in Cyprus and a planned project on Bornholm. In the areas on offshore and onshore wind the measures are quite similar, with more legislative control to secure the land in 2023 NECP and focus on accelerating and simplifying planning procedures. In the area of photovoltaic the policies in both 2019 and 2023 NECP are lacking and it is not clear how they will meet the target for 2030.

6.2.2.3 Greece

In the RES dimension, Greece have focused on updating and simplifying their RES licensing framework, allowing more mature RES to participate in the energy market without additional support, and developing storage. They raised their solar target from 6.3 GW to 13.4 GW, their wind target from 7 GW to 9.5, but lowered their hydro target from 3.9 GW to 3.8 GW[27, 28].

General policies supporting expansion of renewable energy
Greece set licensing simplification as one of their key policy priorities in the 2019 NECP. They made a 2-phase plan to achieve this, with phase 1 focusing on simplifying the procedure for generation authorisation and drawing up necessary legislation by the end of 2019. Phase 2 focuses on the licensing process after authorisation with plans to draw up the necessary legislation by end of April 2020. They also plan to create a basic architecture for an information system supporting the licensing procedure.

In 2023, they committed to further simplifying the licensing process by digitising procedures, creating a single point of contact for all licensing issue, and improving

communication regarding spacing.

Greece featured very few plans regarding storage in their 2019 report. Mainly, said plans focused on the decarbonisation of the islands, the creation of a pumped storage facility in Amfilochia, and acknowledging the need for storage in the larger electricity system. In 2023, however, integrating storage with RES was a high priority. They implemented plans and economic tools, as well as launching a public consultation for storage in the electricity market. Here, storage systems are envisaged to participate as Balancing Service Entities.

In 2019, Greece set out plans to create an environmental market using guarantees of origin for renewable energy. The regulatory framework for this was completed in July 2022 and the first tenders for Guarantees of Origin were planned for the end of 2023. These plans have been postponed, however, and the auctions have not yet been performed.

As can be seen in the examples above, Greece's changes and additions in policy have largely focused on more general measures to support the expansion of renewable energy. They have measures supporting specific energy sources, but these have seen little to no change between reports.

6.2.2.4 Ireland

In the RES dimension, Ireland have completed a number of planning frameworks both for on- and offshore RES, and have implemented support schemes for both. [31, 32].

General policies supporting expansion of renewable energy
Three support schemes have been planned for onshore RES. The Renewable Energy Support Scheme and the Micro-generation Support Scheme were both planned in the 2019 report and implemented by the 2023 report. The Small-scale Renewable Support Scheme was planned between reports and implemented by the 2023 report. The Renewable Energy Support Scheme scheme is in the form of competitive auctioning for RES. Six auctions have been planned to take place before 2030, with three planned by 2023. The scheme is planned to support 4.5 GW of renewable energy.

In 2023, three of the six auctions have been auctions have been performed. The first auction was reported to have led to a planned increase of RES of over 15%. The second led to a planned increase of nearly 20%, and the third to roughly 12%.

The Micro-generation Support Scheme was planned in 2019 and implemented in 2023. This scheme is planned to support up to 380 MW of micro-generation by 2030.

The 2023 report describes the Small-Scale Renewable Electricity Support Scheme was implemented in 2023 as a support for renewable electricity installations that do

not fit into the Renewable Energy Support Scheme or the Micro-generation Support Scheme. It will be implemented in two phases. The first, featuring grants, has already been implemented. The second phase including tariff rates is due to launch in 2024. It is planned to support up to 500 MW of community-based renewable projects by 2030.

Policies to support offshore wind energy deployment
Ireland committed to a 3-phase plan for offshore wind in 2019. In the first half the decade, they will focus on laying foundations by implementing a number of frameworks and starting early projects. The frameworks include:

- Development and implementation of the National Marine Planning Framework, which will set out the Irish Government's long-term planning objectives and priorities for their seas over a 20-year timeframe.
- Development and implementation of the Marine Planning and Development Management, which aims to establish new marine planning system.
- A revision of the Offshore Renewable Energy Development Plan.

Another key policy implemented in 2022 is the creation of the the Offshore Renewable Energy Support Scheme auctions. These are modelled after the abovementioned Renewable Support Scheme.

In the 2023 report, both planning frameworks have been implemented and the Offshore Renewable Energy Development Plan has been revised. The auction for offshore wind has been completed, procuring a total capacity of 3.5 GW. The second auction is planned to procure an additional 5 GW.

Overall, Ireland have implemented a number of support schemes for both on- and offshore RES. Much of their progress centred on developing frameworks for offshore RES, and all plans were implemented by 2023, allowing Ireland to begin auctioning offshore wind.

6.2.2.5 Italy

In general, Italy is mostly continuing work on the policies regarding RES set in the 2019 NECP [33]. Most of the policies in the 2019 NECP had not yet been implemented or was in the process of being implemented. Some new policies have been drawn up and new measures either planned or implemented in the 2023 NECP [34]. A majority of the policies and measures revolve around both economic and non-economic support for renewable energy plants and technologies, as well as streamlining authorisations and procedures regarding RES. All of the policies belongs to the category *General Policies Supporting Expansion of Renewable Energy.*

General Policies Supporting Expansion of Renewable Energ
In 2019, a ministerial decree was announced that would contribute to the development of Power Purchase Agreements. Power Purchase Agreements are contracts, often medium to long term, between a costumer and a supplier of electricity. The decree stated that Italy's energy market operator (*Gestore Mercati Energetici - GME*) must set up a regulatory framework for the creation of a long-term renewable energy

trading platform. Since then, the Power Purchase Agreement's notice board was set up in 2022 and the measure is now ongoing.

Italy has been working on streamlining authorisations and procedures to revamp existing renewable energy plants. It's main focus is to provide support through measures by clarifying and simplifying the legislative framework regarding construction of new plants and maintenance of or increase in production of existing plants. Continuing on this work, Italy introduced a decree in 2021 which provided guidelines for works carried out on hydroelectric and photovoltaic installations, as well as for measures to be carried out on wind projects, installations and related work.
The following measures will also be carried out, according to the 2023 NECP;

- "promote the development of a chain associated with the restoration of production performance and the extraordinary maintenance of decayed plants;
- identify, within homogeneous categories of installations, possible interventions to improve performance and extend the useful life;
- raise awareness among operators of actions that make it possible to optimise the performance of the installations;
- encourage the deployment of innovative technologies for monitoring performance" [34].

In 2019, the Italian government published a legislation which provided an incentive for technologically mature renewable energy plants with a capacity totalling around 8 GW. Through competitive procedures such as tenders and registers, the quotas were allocated in six rounds during the period 2019-2021. After the six rounds of auctions, around 4.2 GW was allocated, with the majority of the capacity being allocated for wind and PV installations. Italy is continuing with this measure and suggests it provides for competitive procedures for the allocation of around 4.5 GW, according to the 2023 NECP.

To conclude, Italy continues to work toward injecting more RES into their electricity system with concrete measures and a focus on building new capacity through tender procedures.

6.2.2.6 Portugal

Portugal has a strong focus on developing and evolving solar and wind energy, particularly solar. This can clearly be seen by the increased targets in Table 6.3 and Table 6.4, where the increase in capacity corresponds to 131% and 29% for solar and wind respectively. This increase is reflected in the country's policies, as Portugal has significantly increased the number of measures in the dimension of RES and have therefore evolved and strengthened the policies introduced in their 2019 NECP. Policies where they have introduced the majority of new measures are connected to the transport sector, as well as energy communities. Their policies are not clearly connected to a specific renewable energy source, except for one, which is why almost all the policies are under the section *General Policies Supporting Expansion of Renewable Energy* below.

General Policies Supporting Expansion of Renewable Energy
In their 2019 NECP, Portugal presented a policy regarding streamlining the licensing process for renewable energy plants. With this policy, they announced a revision of the current legislative framework in order to identify potential obstacles such as unnecessary laws and finding areas in need of improvements. Due to the complex nature of the framework, they deemed it necessary to achieve clarification in order to increase the efficiency of project implementations. The time horizon for this measure was expected to be 2019-2021.

In their 2023 NECP, Portugal announced that this measure has partially been implemented, but still states the complexity of the legislative framework as a reason to continue the revision in order to further simplify the framework. The intended time period for this measure has therefore been moved to the period 2023-2024.

Another measure described within the policy of streamlining licensing processes is the *One-Stop Shop*. This measure was introduced in the 2019 NECP and was meant to further simplify the licensing procedures by acting a centralised service provider in regards to RES projects. Additionally, as support for the *One-Stop Shop*, Portugal wanted to develop an electronic platform in order to provide relevant information regarding licensing procedures as well as expedite said procedures. In the 2019 NECP, the expected time frame for the implementation of this measure was 2020-2021. The measure is still present in Portugal's 2023 NECP, however the time period was amended and now reads 2020-2024.

The development and implementation of a program for "Renewable Energy Go-To Areas" was a new measure within the policy that Portugal introduced in their 2023 NECP. The program is planned for the 2022-2030 period and is aimed at identifying both onshore and offshore areas less sensitive to environmental changes, that would be suitable for the construction of renewable energy units.

As mentioned above, Portugal focuses heavily on energy from RES and building new capacity for renewable energy. The country's main approach in this area are RES auctions, or 'tendering'. Through tender offers, Portugal can ensure the injection of more renewable energy into the energy market and therefore meet their set targets in the RES dimension. Portugal describes these auctions as financially efficient and low risk because of the generated competition between market investors. This measure to ensure an increase in capacity is still preferred in Portugal, as described in their 2023 NECP. In the 2023 updated policy they present concluded auction procedures for PV systems in 2019 and 2020, as well as a concluded auction for floating PV systems in 2021. Portugal also mentions in the 2023 NECP that they are planning on holding auctions for offshore wind projects by 2030, further increasing renewable energy capacity.

Being a coastal country, Portugal sees potential in utilising ocean based renewable energy technologies. In the 2019 NECP, they launched a measure aimed at

exploring the feasibility and potential to develop a new chain of export for oceanic renewable energy technologies. This measure was updated and elaborated in the 2023 NECP. In the update, Portugal mentions that areas in the Atlantic Ocean are being investigated as potential sites for renewable energy exploitation. Auctions will be launched to develop the necessary technologies and a technologically neutral zone will be drawn up outside the coast of Viana do Castelo in northern Portugal in order to develop demonstration projects. In addition, a working group tasked with assessing the potential of oceanic renewable energy technologies was created in 2022.

Policies to support wind energy deployment
In order to increase the capacity of wind energy, Portugal presented a measure in their 2019 NECP regarding the maintenance and upgrading of existing wind power plants. The measure encourages retrofitting and upgrades to the existing stock of wind power plants, with the aim of ensuring optimal efficiency and competitiveness of the national wind power stock. The measure was first planned for the 2019-2021 period, but was extended to 2030 in the 2023 NECP.

In conclusion, Portugal are working intensely to integrate more renewable energy in their energy system with the main focus being on solar energy and wind energy. The increased targets for renewable energy capacity are strongly supported by policies and measures described in the NECPs.

6.2.2.7 Spain

With the phase out of both coal and nuclear power plants Spain is looking for a big upgrade of renewable energy to replace it. With the changes from the 2019 NECP [49], to the 2023 NECP [50] wind and solar energy are planned to be expanded with 93% for solar energy seen in Table 6.3 and 21% in wind enrgy seen in Table 6.4. With that, Spain has implemented new policies for both solar and wind energy.

General Policies that Support Renewable Energy Expansion
With a big development of the renewable energy three new policies has been constructed in the 2023 NECP. The first one is development of innovative renewable energy installations. The policy has implemented a new framework for the developing of renewable energy through offshore wind, energy storage, biogas, floating photovoltaic and other renewable technologies like solar thermometric with large scale storage. The framework for off shore wind has implemented a road map that will make it easier to develop offshore wind as well as new technology within it with less administrative obstacles. It has also approved five new offshore plans.

Another new policy is renewable energy development compatible with territory and rural development. This policy supports rural areas to promote the energy transition. This can be done by lowering the cost of energy for individuals and companies. Another measure will be taken to deepen the knowledge about the climate.

The third new policy is development of renewable energy compatible with biodiversity and protection of ecosystems. This policy is mostly information based, with

measures such as finding areas with the high potential to exploit energy while also having a very low impact on the ecosystem and the surroundings. It also included that knowledge will be shared through information channels in rural areas. This is to ensure learning regarding the energy transition being done alongside rural development and biodiversity.

Policies to support solar energy deployment
Solar photovoltaic is the target that has been improved the most between the 2019 and 2023 NECP. With that said there are not much expectation regarding the development of photovoltaic policies. However one new policy is strategic autonomy and value chain, that have for an example implemented new requirements for the internal market that would affect solar photovoltaic modules, investors and systems. The policy also include a support for implemented solar panel factories, as well as wind and battery support.

Improvements have been made for both solar and wind energy with new framework support systems. However with a target rise of 95% of solar energy and 23% of wind energy, a bit more practical changes would have been expected.

6.2.2.8 Sweden

RES is the only part of the three dimensions that Sweden have increased their targets between the 2019 NECP, [51], and the 2023 NECP [52]. The target has increased with 207% for solar seen in Table 6.3, 109% for wind seen in Table 6.4 and no change for hydro. With that new policies for both on- and offshore has been implemented as well as tax reductions for installations of solar panels.

General policies that support renewable energy expansion
A new tax reduction policy was implemented in 2021 with the meaning to make it cheaper for Private persons to install green technology. The policy has two different tax reduction within it, one for the installation of photovoltaic systems with 20% reduction and a second for also been able store the self generated electricity with 50 percent. The 50% reduction also apply to installing charging points.

Policies to support offshore wind energy deployment
Sweden wants to expand their offshore wind energy production and to do that they firstly need to find new areas to implement the wind energy. The new policy Offshore wind energy has set out a goal to find new areas that are suitable for adding an additional 90 TWh annual production to the Swedish wind energy.

One big policy that has been implemented is the plans for maritime. The policy started in 2015 but wasn't implemented until 2022. The plan involves detailed plans for different areas of Sweden's seawater. The plan has been implemented to assures that the resources in these areas are being used sustainably and also to make new plans to support the transition for an example renewable energy while the ecosystems are not being harmed. One examples of plans being implemented by the maritime spatial plans is offshore wind energy beyond the offshore expansion mentioned in

the policy above.

Policies to support onshore wind energy deployment
For the onshore wind power the need for expansion is high if Sweden wants to reach the 2040 target with 100% renewable energy. With that a policy for finding the strategy and places for the expansion was implemented 2021. Where the main goal was to find a possible solution while at the same time make it sustainable for the environment around the expansion, nearby ecosystem and the people living nearby. To conclude Sweden has implemented new policies especially in the wind sector with both onshore and offshore plans that make it reasonably that they have increased their wind targets with 108 percent. On the other hand does they not mention as much changes in the solar wind and with a improved target of 200% it seems odd to not have more new or improved policies to back that up. The maritime spatial plans is also a little vague in the NECP, they say that they have implemented it but they don't give concrete examples of what the plans are.

6.3 Energy Efficiency

Under this section a quantitative analysis, as well as a qualitative analysis will be presented for EE. The quantitative analysis aims to be more numerical and more hands on point of view. While the qualitative part aims to have a more step back perspective and with that get a more in depth analysis of the policies.

6.3.1 Quantitative analysis

The quantitative analysis of the EE dimension consists of the compiled targets of each member states' specific EE ambition. As well as a compilation of the number of policy targets for energy efficiency, and the overall EU scale categorisation trends visualised.

6.3.1.1 Targets

The target analysis for EE was performed similarly to those of GHG and RES. As mentioned in subsection 4.3.2, due to the greater variation in target categories found in the NECPs, targets set in the categories, reduction in energy consumption by amount [GWh] and final energy consumption [GWh], have been normalised by final energy consumption in 2015. The countries that have been normalised are: Austria, Croatia, Czech Republic, Hungary, Ireland, Italy, and Lithuania.

Table 6.6 shows member states' targets for reduction in energy consumption.

- The second and third columns, 2019 and 2023 targets respectively, contain the percentage reduction in final energy consumption countries plan to achieve.
- The fourth column, factor, shows the increase by factor, calculated by dividing the 2023 target by the 2019 target.
- The fifth column, difference, shows the increase by difference, calculated by subtracting the 2019 target from the 2023 target.

- The sixth column, target category, shows the category the target, in this case, reduction in energy consumption [%]. If targets were missing or mismatched, it is stated here.
- If a country's name is marked by a *, it was normalised from an original target in the reduction in final energy consumption by amount category. If it is marked by **, it was normalised from an original target in the final energy consumption category.

Country	*2019 Target*	*2023 Target*	*Factor*	*Difference*	*Category*
Austria**	-3.33	12.67	-3.80	16	Reduction in energy consumption [%]
Belgium	12.0	13.0	1.08	1.0	Reduction in energy consumption [%]
Bulgaria	-	-	-	-	No 2023 targets
Croatia*	45.71	46.35	1.01	0.64	Reduction in energy consumption [%]
Czech Republic*	8.72	15.06	1.73	6.34	Reduction in energy consumption [%]
Denmark	-	-	-	-	No 2023 targets
Finland	-	-	-	-	No 2023 targets
France	20.0	30.0	1.5	10.0	Reduction in energy consumption [%]
Germany	30.0	39.3	1.31	9.3	Reduction in energy consumption [%]
Greece	38.0	38.0	1.0	0.0	Reduction in energy consumption [%]
Hungary**	-10.96	-6.01	0.55	4.95	Reduction in energy consumption [%]
Ireland**	-34.95	-25.74	0.73	9.47	Reduction in energy consumption [%]
Italy*	8.23	13.69	1.66	5.46	Reduction in energy consumption [%]
Lithuania*	48.65	70.82	1.46	22.7	Reduction in energy consumption [%]
Netherlands	11.7	8.65	0.74	-3.05	Reduction in energy consumption [%]
Portugal	35.0	35.0	1.0	0.0	Reduction in energy consumption [%]
Poland	-	-	-	-	No matching categories
Roumania	40.4	45.0	1.11	4.6	Reduction in energy consumption [%]
Slovakia	30.3	30.3	1.0	0.0	Reduction in energy consumption [%]
Slovenia	-	-	-	-	No matching categories
Spain	39.5	44.0	1.11	4.5	Reduction in energy consumption [%]
Sweden	50	50	1.0	0.0	Reduction in energy consumption [%]
Average	21.70	27.06	0.83	5.41	Reduction in energy consumption [%]
Median	30.0	30.3	1.01	4.6	Reduction in energy consumption [%]
Minimum	Ireland	Ireland	Austria	Netherlands	Reduction in energy consumption [%]
Maximum	Sweden	Lithuania	Czech Republic	Lithuania	Reduction in energy consumption [%]

Table 6.6: Changes in normalised energy efficiency targets between 2019 and 2023.

Due to the negative percentage values, the increase by factor turned out misleading and was therefore not included in the analysis.

As can be seen in Table 6.6, Sweden had the highest 2019 target with a 50% reduction, while Lithuania had the highest 2023 target and the largest increase by difference, aiming to achieve a reduction of roughly 70%. The Netherlands are the only country who have reduced their EE target. Outside of the minor decreases seen in hydro targets, this is the only decrease in targets among all the member states in all three dimensions.

This dimension proved the most unclear and difficult to analyse. Many countries submitted mismatched data between 2023 and 2019, simply did not include any targets in 2023 at all, as well as the normalisation resulting in negative targets for some countries.

6.3.1.2 EU scale policy analysis

The following analysis contains visualised data based on the policy data file compiled from the policies. This contains policies sorted into the three main dimensions, as well as sector categorisation and types of policy instruments.

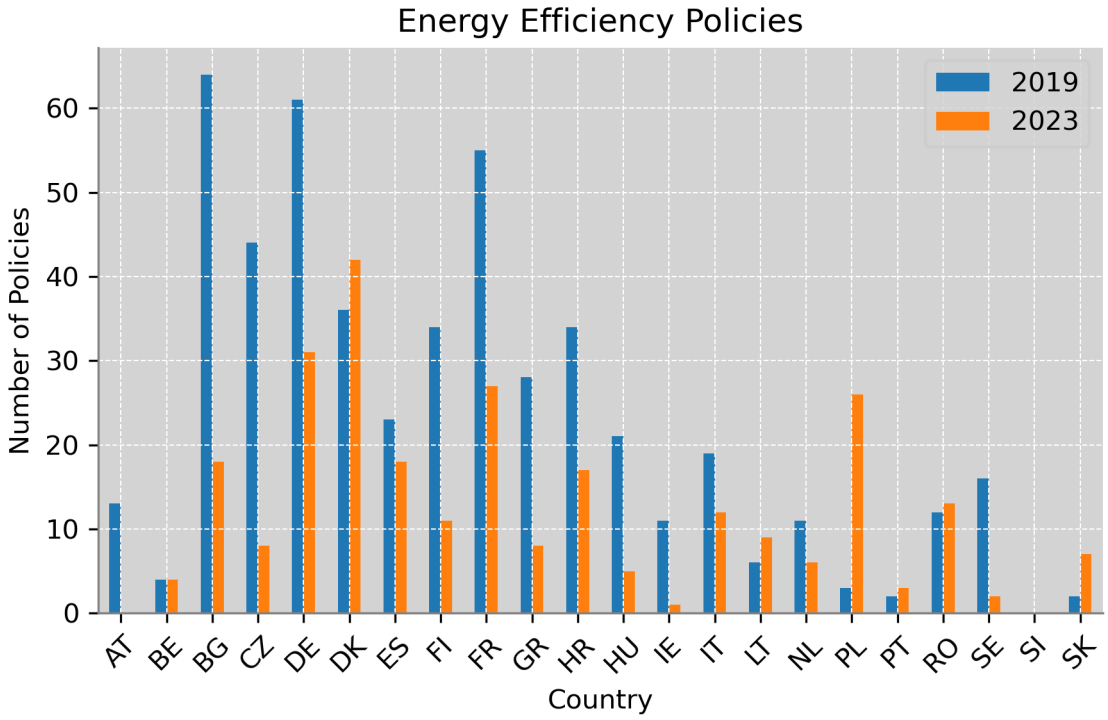

Figure 6.11: Compilation of Policies 2019 vs. 2023 for energy efficiency. See Table A.1 for country codes.

As seen in Figure 6.11, the number of policies per country for 2019 and 2023 are displayed. The EE dimension is the one with the fewest policies, with only 767. Where 2019 has 499 and 2023 268. The figure illustrates a decrease of energy efficiency policies for the majority of the countries. Austria, Bulgaria, Czech Republic, Finland, France, Sweden, Hungary, Greece and Ireland 2023 policies is less than half of the 2019 ones. Although Belgium, who started out low, maintains the same level. Slovenia had a total of zero measures regarding energy efficiency. For all countries except Denmark, Lithuania, Belgium, Portugal, Poland, Roumania and Slovakia, the policies have reduced which could be due to the fact that 2019 includes the already implemented policies as well as new ones, while 2023 only includes new policies. This could conclude that there is not a lot of new measures taken regarding energy efficiency. However Germany's, Bulgaria's and France's 2019 policies are the highest columns in the figure, which contributes to them being the countries with the highest number of energy efficiency policies overall.

Types of policy instruments
The number of types of policies regarding EE are visualised in Figure 6.12 and Fig-

ure 6.13. One for 2019 and one for 2023, this is to be able to identify changes in trends.

For the categorisation of the type of policy instruments in energy efficiency, it is apparent that the major category is economic for 2019 with 187 measures, followed by command and control and lastly information. Information is thereby the minor one of the three instruments with 142 measures in total. Lastly command and control has 170 measures.

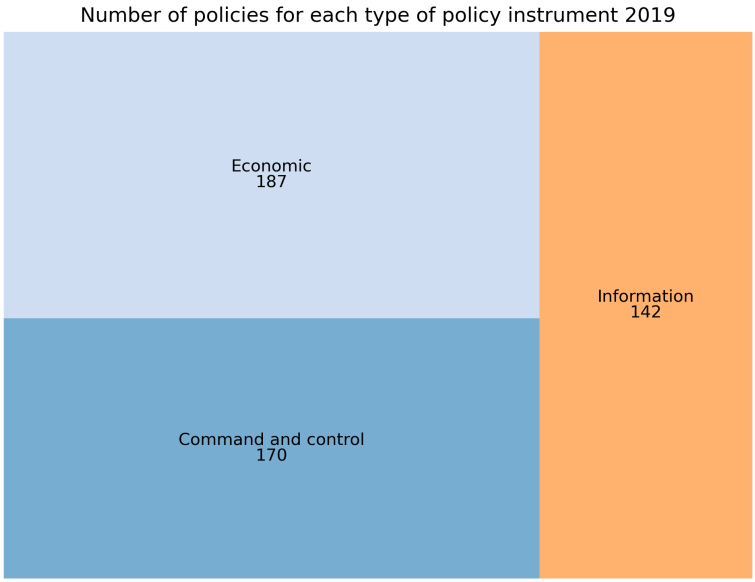

Figure 6.12: Visualisation of the *types of policy instruments* categorisation for energy efficiency, 2019.

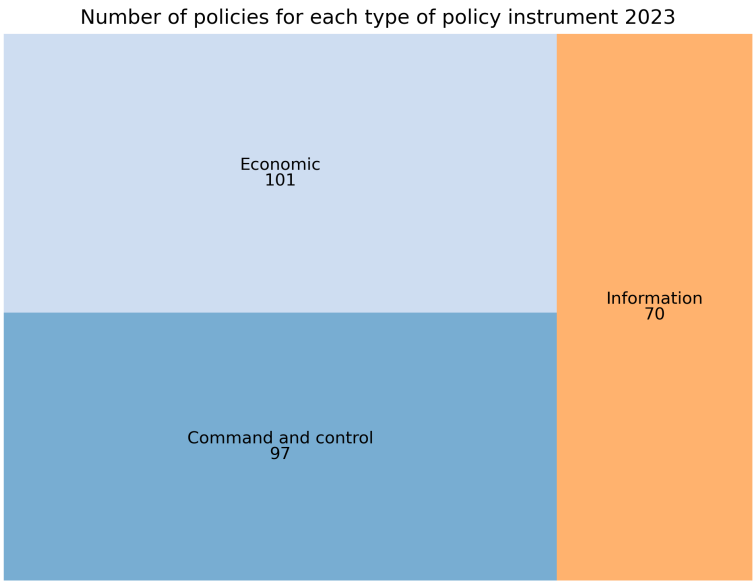

Figure 6.13: Visualisation of the *types of policy instruments* categorisation for energy efficiency, 2023.

The 2023 policy instrument type is shown in Figure 6.13, where economic is still the major policy instrument with 101 measures. It is less than the number of economic measures in 2019, by 86 measures. The command and control category for 2023 has 97 measures and differs from 2019 by 73. Lastly, information has 70 measures for 2023 which is 72 less and thereby less than half of the number of 2019 measures. Upon examining the two plots, it becomes clear that the trends observed between the years 2019 and 2023 have many similarities. Further, there is a notable consistency in the ratios among the categories. Showing that energy efficiency is being addressed by mainly economic and command and control types of instruments.

Sector
The sector categorisation consists of energy, transport, industry, buildings and other. By analysing these, it is evident where the measures are being implemented.

Buildings and energy constitutes for the majority of the measures for 2019, as seen in Figure 6.14. There are 179 buildings measures and 223 energy measures. This makes energy the sector with the most measures for energy efficiency. Industry amounts to 66 measures, transport 45 and other 72 measures. This indicates that a significant proportion of energy efficiency initiatives has been taken through the energy and building sectors.

Furthermore when it comes to the 2023 sector categorisation, the energy and buildings trend is continuing. While other has gone down in ratio size, as seen in Figure 6.14 and Figure 6.15. The number of measures regarding buildings in 2023 is 98,

21 transport measures, 30 industry measures and 25 other measures. Energy had 103 energy measures, making energy the sector with the most measures of 2023 as well. The ratio of the sectors are not that different other than industry overtaking other with more measures in 2023. This shows that energy efficiency policies are following similar trends in both 2019 and 2023.

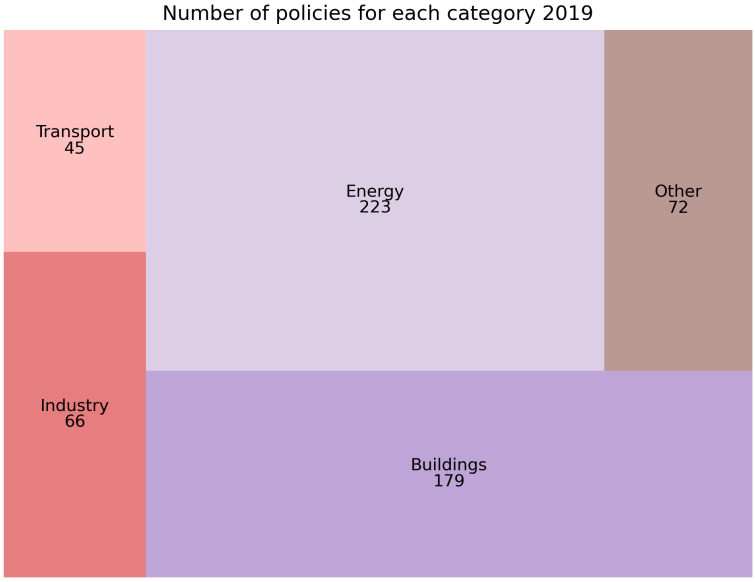

Figure 6.14: Visualisation of the *sector* categorisation for energy efficiency, 2019.

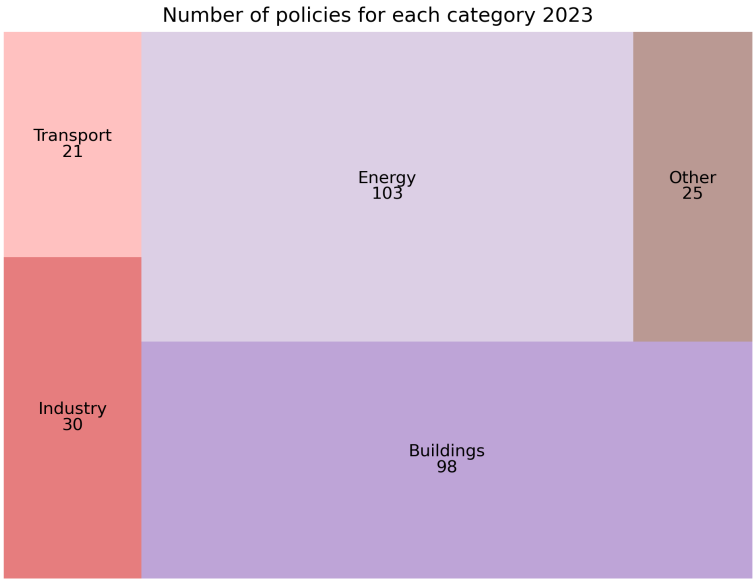

Figure 6.15: Visualisation of the *sector* categorisation for energy efficiency 2023.

6.3.2 Qualitative analysis

The qualitative analysis for EE emission reductions focuses on the changes in the case countries' EE policies. Policies that represent broader trends of change and policies of importance to each case country are presented and analysed. The member states included in the qualitative analysis are, as presented in subsection 4.3.4, *Finland, Germany, Greece, Ireland, Italy, Portugal, Spain*, and *Sweden*. For each member state, an introduction of changes in targets is given, and the scope of policies to be covered and main observation relating to changes is presented. The policies included in the qualitative analysis in the EE dimension is then presented by sector. The sectors are *Building, Energy, Industry, Transport*, and *Other*. A concluding paragraph reflecting on the policy changes are presented at the end of each case country study.

6.3.2.1 Finland

In the EE dimension, Finland's 2030 target in final energy consumption in the 2019 NECP [21], were 290 TWh. Finland's 2023 NECP [22] did not contain revised EE targets. In the EE dimension there were not many policies that had been followed up in the 2023 NECP. Sectors that will be discussed in this dimension is *Buildings, Energy* and *Other*, where circular economy is the focus. There were also measures regarding EE in the transport sector, but these were included in the GHG dimension for Finland, 6.1.2.1, since this was how it was classified in Finland's NECPs. Since the 2023 NECP did not contain revised EE targets it is difficult to analyse if the new policies meet the targets in the EE dimension. However, overall in this area

there was not much change in policies between 2019 and 2023.

Buildings
Finland had a policy regarding energy performance of buildings that is not changed between the 2019 and 2023 NECPs. In the 2019 report, it was stated that Finland would adopt an energy subsidy scheme for housing companies with the goal of supporting improvements in EE. In proportion to the EE improvements achieved, they would be given financial support. Finland would also phase out fossil fuel oil in heating by 2030 and adopt a plan to encourage properties switching from using oil heating to other forms of heating. They also had minimum requirements for new building and existing buildings regarding EE and energy consumption. As mentioned above, no updates were given in the 2023 NECP in this policy. It was not mentioned if the energy subsidy scheme has been adopted.

One of the few new policies in the 2023 NECP was the *Long-term renovation strategy*. It covers the period 2020-2050 and aims to reduce the emissions and energy consumption of the building stock by 90% by 2050 compared to 2020. It was mentioned in the 2023 NECP that the EE improvements were more achievable in densely populated urban regions, particularly when coupled with the demolition of older buildings in rural areas. According to the 2023 NECP this was supported through demolition subsidies and spatial planning. To improve buildings towards nearly zero energy level, it was encouraged that property owners prepare a plan on repair actions for the next 15-20 years, or a plan for demolition. Since 2020 family houses have been able to receive subsidies for phasing out oil heating, and it would be phased out in state-owned buildings by 2024. So this policy is new in the 2023 NECP.

Energy
According to the 2019 NECP, EE has been improved through Voluntary EE Agreements since 1990 between the industries or municipalities and the Government. This policy had not changed between 2019 and 2023 NECP. The participants in the EE agreement set a target to improve their EE, and receive subsidies as support for implementing actions to reach their targets. Participants in the EE agreement were op carry out energy audits to see if they could save energy and inform and train their personnel about promoting EE. Companies were also to report their energy consumption and energy savings every year. As mentioned above, this policy had not been followed up and no new information was provided in the 2023 NECP.

Other
Finland focused on circular economy to improve EE. There were 6 measures regarding circular economy in the 2019 NECP, and 7 new measures in the 2023 NECP. In the 2019 report, there was an ongoing research project to better understand the GHG emission effects of the circular economy and what policy measures would be the most cost-efficient to transition to a more circular economy. In the 2019 NECP, it was mentioned that a state owned company, Motiva Ltd, promotes the efficient use of materials and energy, and supports businesses to make efficiency improvements. There was also a program for strategic circular economy with additional

funding to support innovation in circular economy. In the 2019 NECP, they also planned to implement the Plastics Roadmap to improve the efficiency of plastics recovery and recycling. The new measures in the 2023 report included targets on consumption of raw materials, resource productivity and circular material use rate. In the 2023 NECP, they were working on a *Circular Economy Strategic Green Deal*. There was also a competence centre which aims to connect actors and a circular design education program with 50 companies involved. So in the area of circular economy the policy was strengthened with new measures in the 2023 NECP.

To conclude, there were not many policies that were followed up in the 2023 NECP. In the building sector the policy about energy performance of buildings was not followed up, whilst the *The Long-term renovation strategy* was one of the few new policies in the NECP 2023. The voluntary EE agreements was not followed up, but was the same in the 2019 and 2023 NECPs. In the area of circular economy Finland had 6 measures in the 2019 NECP and 7 new measures in the 2023 NECP. Finland's 2023 NECP did not contain revised EE targets. Therefore it is difficult to analyse if the new policies meet the targets in the EE dimension. However, overall in this area there was not much change in policies between 2019 and 2023.

6.3.2.2 Germany

Germany's target regarding EE in the 2019 NECP [25], was a reduction in primary energy consumption of 30%, compared to 2008 levels. In the 2023 NECP, [26], this target was raised to 39,3%. Germany had overall a change in policies in the EE dimension between 2019 and 2023, but it varies depending on the area. The sectors included in this section is *Buildings, Energy, Industry*, and *Other*.

Buildings
In the area of buildings there were three strengthened policies included in this report. There was one policy regarding the *Long-Term Renovation Strategy* for buildings, which had gone from a planning stage to being submitted in the 2023 NECP. One policy included a building energy act with legislation for energy requirements buildings, and for the use of renewable energy for heating and cooling in buildings. Another policy was regarding the role of Government buildings, where their buildings must set an example in EE and sustainable construction.

In the 2019 NECP Germany had plans to submit a Long-Term Renovation Strategy, which is a renovation strategy focusing on EE and decarbonisation of the building stock. In the 2019 NECP it was mentioned that the demand for energy for heating and cooling must be reduced and the share of renewable energy increase. They also mentioned that measures such as installation of efficient windows and insulation and the use of high-efficiency technique for heating, cooling, and lighting could improve the EE. The 2023 report stated that the Long-Term Renovation Strategy was submitted. So there was policy sequencing in that way that the strategy was submitted, but there is no more details in the NECP 23 regarding this.

One policy regarding buildings that was somewhat strengthened was regarding the

Building Energy Act. The Act includes legislation for energy requirements for new and existing buildings, and for the use of renewable energy for in heating and cooling in buildings. In the 2019 report, the Act states that the current level of performance for new buildings and renovation remained unchanged. In the 2023 report it was stated that from 2024, any newly built-in heating must be operated with at least 65 % renewable energy. Heating system would meet the increasing renewable energy quotas from 2029, so advice will be provided if new oil or gas heating systems are installed during the transitional period. So the Act had somewhat strengthened with the legal requirement of new built-in heating and the increasing renewable quotas from 2029 onwards. It however did not include any follow up or any more detailed change in the 2023 report, for example if the rules regarding existing buildings has changed.

Germany has tax support for energy renovation of buildings, which provides benefits for homeowners by covering 20% of the investment costs such as new windows, insulation or heating replacement. This policy was the same in 2019 and 2023, so the amount of tax support was not changed.

The government are providing funds to people who want to make their homes more energy-efficient, called *Federal Funding for Efficient Buildings*. In the 2019 report it was mentioned that there is additional funding for projects that promote the use of renewable energy. In the 2023 NECP this funding program it had expanded and was explained in more detail. One new measure was that it also supports the replacement of old fossil heating systems with heating based on renewable energy. In the 2023 NECP there was also special support for the renovation of energy poor buildings and heat pumps that are particularly efficient or use natural refrigerants. So they have strengthened this policy somewhat, since it was more specific and additional funds for certain renovations.

The 2019 NECP stated that Government buildings will be given a standard and were expected to have an exemplary role in EE and sustainable construction practices. It was also mentioned that government buildings will meet higher energy standards from 2022. In the 2023 NECP the efficiency building standards for renovations and new federal buildings were raised. The EE requirements for the buildings of the government are set as a minimum requirement for new federal buildings. Annual renovation rates are also set by 2045 for federal buildings. Since the EE requirements were raised, there were new minimum requirements and there were new annual renovation rates the policy is strengthened between 2019 and 2023.

The submission of the *Long-Term Renovation Strategy*, the *Building Energy Act*, *Federal Funding for Efficient Buildings*, and the *Exemplary role of federal buildings* were policies that has been strengthened in between the 2019 NECP and 2023 NECP. Since there were three strengthened policies in the area of buildings there has been changes made to the policies to meet the targets, but the change varies between the policies.

Energy
In the 2019 NECP Germany had laws ensuring that central governments purchase only products, services and buildings with high EE performance. It states that highest EE class must be required and that EE must be used as a criterion when evaluating the economically most advantageous tender. In the 2019 NECP it was stated that they also published lists of EE criteria for various product categories as supplementary guidance for contracting authorities. The 2023 NECP has 3 added measures in this policy. A carbon price must be calculated for procurement operations, so that CO_2 emissions over the whole life cycle is taken into account as a cost factor when purchasing. There is also a 'negative list' of services which are in principle not to be procured. Certain products are no longer allowed, such as drinks in disposable packaging or disposable tableware. The measures in 2019 was specific and the ambition was raised in the 2023 NECP with additional measures. In the study by Sewerin et al. [68] the hypothesis was that a more specific policy, should lead to a ratcheting up effect. Signs of this was not found in the study, but in the policy mentioned above, the policy is rather specific and has had a ratcheting up effect.

In the 2019 NECP there was focus on that energy demand must be reduced and renewable energy must be used instead. The main priority mentioned in the NECP 2019 was to use technologies that use little electricity to replace as many fossil fuels as possible. It was also mentioned in the 2019 NECP that, to ensure that EE are implemented as a matter of priority, implementation of energy saving measures must happen in all sectors through a range of funding programmers and standards. In 2023 this has shifted to that *Efficiency first* is the highest principle. It was mentioned that they are currently analysing the measures by which the principle can be implemented for further energy demand reduction.

In the 2019 NECP they had a Energy's communications and activation campaign called *Germany Does It Efficiently.* They say that it will be shifted from general public awareness activities to technical communication and targeted consumer information, with the goal of a greater degree of activation of energy consumers. In the 2023 report there was a new campaign. It aimed to inform, raise awareness and encourage consumers, as well as municipalities and businesses, about saving energy, increasing EE and developing renewable energy.

One policy that has gone from a planning stage to being implemented is that in 2019 Germany planned to create a new fund to group together funding programs for heating networks, cross-building investments and heat storage. It has been implemented in the 2023 report, which is not visible in the quantitative analysis.

Industry
The measures regarding industry are the same in the 2019 and 2023 NECP. The measures includes funding provided to companies reduce their energy consumption and to improve resource efficiency. As a result of statuary energy audits, a voluntary commitment to speed up the implementation of recommendations from it was

introduced. There was no other details on how the implementation of these recommendations should happen. In the NECPs there are two measures focusing on training and information for companies about EE. Germany will also examine the extent to which the existing energy tax benefits for fossil fuel can be aligned more closely with climate policy.

Germany has tax incentives for the manufacturing sector. This policy was the same in the 2019 and 2023 NECP. The purpose of the tax breaks is to ensure that companies that has competition on the international market do not have a disadvantage because of high energy costs. For certain energy- and electricity-intensive processes full tax exemptions are granted, in addition to a general tax break for energy intensive companies. This is a bit counter intuitive, but at the same time it may be necessary to keep the industries in the country.

So the measures in the industry sector were both informational and economical. No additional measures or changes regarding industry is done between 2019 and 2023. There is no update on to what extent the energy tax benefits for fossil fuel sources can be aligned with climate policy goals.

To conclude, in the EE dimension Germany has a range of measures that are quite detailed and are focusing on different areas. In the area of buildings the *Long-Term Renovation Strategy*, the *Building Energy Act*, and the exemplary role of federal buildings are policies that has been strengthened or followed up in between the 2019 NECP and 2023 NECP. There has been a shift in measures between 2019 to 2023 from energy savings and use technology that use little electricity to a larger focus on effiency in the 2023 NECP. The measures to implement *Effiency first* however are not yet planned or implemented. There is a fund that has a broadened focus in the 2023 report compared to the 2019 NECP, and an implemented fund 2019 that bundled together other funds regarding EE. The policy regarding Energy-efficient procurement by public authorities is strengthened with new measures in the 2023 report. The measuers regarding industry is the same in the 2019 and 2023 NECP. So the change in policies varies depending on the area in the EE dimension, where there is more change in the area of buildings than in the area of industry, for example.

6.3.2.3 Greece

As can be seen in table 6.6, Greece have not changed their 2030 EE target [27, 28]. This is reflected in their policies, with no new polices and only 8 new measures added to existing policies in 2023. They have, however, followed through on measures presented in the 2019 report. Some examples include the National Energy Efficiency Fund and the Electra programme. A focus of their planned measures in both 2019 and 2023 was to improve EE in industry, with 7 out of the 8 new measures focusing on this sector. The 2019 report also set EE in public buildings as a high priority, though there were no changes to the reported policies in the 2023 report.

Buildings
Both the National Energy Efficiency Fund and the Electra programme were planned

in the 2019 NECP and have been implemented by the submission of the 2023. The National Energy Efficiency Fund was aimed at providing funding for future programmes to aid in EE measures. The Electra programme focuses on providing support for the EE upgrade of buildings, was implemented in 2020, and began operating in 2022 [96]. Its goal is that all buildings included in the programme will achieve an energy rating of B. The programme has an allocated budget of €640m between 2020 and 2026, and has mobilised additional private funds, bringing the total to over €1bn.

Industry
In the industrial sector, measures aimed at extending existing support schemes for large enterprises to small and medium ones were introduced in 2019. They planned on using an existing framework for mandatory energy audits in larger enterprises to allow audits on small and medium enterprises and households. A support scheme was also planned to aid in implementing the measures suggest in the audit. Neither of the two plans included concrete plans or budgets, and while Greece stated plans to further expand them in 2023, they plans remained vague. For larger enterprises, the plans were clearer. In 2019, they planned actions to centralise heating and distribution networks in industrial-business zones. They also aimed to design further financing measures to aid in implementing EE solutions, such as subsidising borrowing costs and aiding with access for energy service companies to financing. In 2023, they planned to: implement programmes to conclude problematic agreements with industries and manufacturing companies; strengthen mandatory energy audits according to the new Energy Efficiency Directive; creating an open database with energy efficiency measures to further improve energy audits; granting aid to prevent carbon leakage in vulnerable industries.

The lack of new policies in 2023 is, as mentioned previously, likely due to Greece not raising their targets. However, the policies with clear follow-through, such as the implementation of the National Energy Efficiency Fund and the Electra programme, as well the addition of new measures regarding larger industrial enterprises, followed a pattern of specificity. This lines up with the results stated by Sewerin et al. [68], that more specific polices are more likely to be continued or ratcheted-up in ambition.

6.3.2.4 Ireland

There have been few changes in Ireland's EE dimension between 2019 and 2023 [31, 32]. Measures planned in 2019 remain as plans in most cases. Both their 2019 and 2023 targets feature final energy consumptions that are higher than their current values. It is worth mentioning that Ireland's EE targets in their 2023 NECP were unclear regarding their planned reductions. In 2019, 5 of the 8 planned policies focused on buildings. Two outliers, where measures have been followed through, are the smart metering programme and the Support Scheme for Energy Audits.

Buildings
In their 2019 report, Ireland presented plans to develop a new delivery model for

grouping building retrofits. The aim of the new model was to achieve EE measures at a larger scale at more optimal prices. This development is an example of a more vague policy where little progress has been made between reports. The only addition was the establishment of a task force in order to drive the development. A working group set up by the task force, focused on the public sector, was finalising guidance for public sector bodies by the submission of the 2023 report.

The smart metering programme, introduced in 2019, aimed to deliver smart meters to every house in Ireland by 2024. This programme saw significant follow-through in the time between the reports, with 1.5 million meters delivered. The deadline was pushed back a year, however, with the remaining 2.4 million meters to be delivered by 2025.

Other
In their 2023 report, Ireland presented the Support Scheme for Energy Audits, offering up to €2000 towards the cost of an energy audit for small and medium sized enterprises.

Unlike their presented measures in the GHG and RES dimensions, their 2019 EE measures were both fewer in number, smaller in scale, and often lacked road maps as to how they were to reach their stated targets. Using the results of Sewerin et al. [68], the lack specificity in many of the 2019 policies, outside the smart metering programme, may have led to Ireland's lack of ambition in 2023.

6.3.2.5 Italy

As can be seen in Table 6.6, Italy has increased their target regarding reduction in energy consumption from 8.23% in 2019 to 13.69% in 2023 [33, 34].

Buildings
Tax deductions for restoration of buildings and energy efficient retrofitting are in place and have been since 1997. A set of incentive measures, applying tax deduction mechanisms, are currently in place to expedite residential building renovations. The majority of these measures (bonuses) have an expiration date in 2024 and Italy therefore plans to implement a new general reform of deductions.

Energy
Italy presented a programme in their 2019 NECP regarding energy renovations which was estimated to produce cumulative energy savings amounting to 0.1 Mtoe in final energy consumption by 2030. The prediction of cumulative energy savings by 2030 was increased to 0.54 Mtoe in the 2023 NECP, although few changes were made to the actual policy. Keeping in mind that the programme is planned to end in 2030, Italy declared it necessary to revise the programme for the period after 2030.

For the 2015-2017 period Italy allocated EUR 210 million for the support of research carried out by a variety of national energy agencies with a focus on industry

and energy systems. In their 2019 NECP Italy presented a new allocation of funds for industrial research and energy research, for the 2019-2021 period. The size of funding is equal to that of the 2015-2017 period, i.e. EUR 210 million. There is no mention of continued funding in the 2023 NECP.

In general Italy mainly focuses on the energy sector in the dimension of EE, with little focus being given to transport and buildings. As in the dimension of GHG, Italy presents few new policies in the dimension of EE.

6.3.2.6 Portugal

Portugal's target regarding reductions in energy consumption has not changed between the 2019 NECP and the 2023 NECP as can be seen in Table 6.6, nor have they introduced a large number of new measures as can be seen in Figure 6.11.
Portugal's main focus in the dimension of EE is on the long-term renovation of buildings and the transition of the building sector toward nearly zero-energy/zero-energy buildings in the public sector as well as in the private sector. Focus is also given to the decarbonisation of the government at local, regional and national level.

Buildings
In the 2019 NECP Portugal presented their policy on promotion of nearly zero-energy buildings and energy renovation of buildings, were some of the main measures included:

- the development and implementation of national strategy for the renovation of buildings, which would increase the energy efficiency in the building sector;
- a revision of the regulations regarding energy efficiency for both private and public buildings, and;
- the promotion of nearly zero-energy building standards in new buildings.

The former two measures are still present in the 2023 NECP, however Portugal did update the measure aimed at promoting nearly zero-energy building standards to move beyond nearly zero-energy buildings and also include zero-energy building standards, as well as introduce new measures within the policy. One of the new measures introduced in the 2023 NECP is aimed at providing technical support for building rehabilitation, e.g. through the implementation of *One-Stop Shops*, as well as ensuring sufficient financial support, especially for households that are financially vulnerable.

Energy
Another policy that has been updated in the 2023 NECP is the promotion of energy efficiency in public lighting. In the 2019 NECP, two measures were presented;

- defining a legal framework for the upgrade and installation of infrastructure regarding public lighting, and;
- the introduction of a management system for public lighting consumption.

The aim of the first measure was to develop and publish a technical manual covering the criteria for public lighting projects as well as the main technological concepts in public lighting. The planned time horizon for this measure was presented as 2020-

2021 in the 2019 NECP. This time period was however pushed back to 2024-2026 in the 2023 NECP.

Besides introducing a new management system for the consumption of public lighting, an additional aim was presented in the second measure to promote and install smart metering systems to measure energy consumption in the public lighting sector. In their 2023 NECP, Portugal introduced one new measure in this policy regarding the upgrade of the existing public lighting system with new, low energy LED technology. The planned time period for this new measure extends from 2020 to 2028.

Portugal, like many other EU member states, has chosen to focus less on the dimension of EE and more on GHG emission reductions and RES. This will be further elaborated upon in chapter 7.

6.3.2.7 Spain

Spain have increased their targets for EE between the 2019 NECP [49], and the 2023 NECP [50], by 11%, see table 6.6. They have also implemented new policies where the main focus has been on the transport and building sector.

Buildings
The building sector was the biggest sector for Spain in EE and had some new policies and measures in the 2023 NECP. The main new measures were about heating and cooling. The goal was to change the system to more sustainable and implement more renewable energy. New legislative measures have also been implemented which require labelling to make it easier to see the energy efficiency of a product. Another taxation law that has been implemented grants aid to support the renovations of buildings to support the transition.

A new law in 2014 gave responsibility to Spain's government to regulate an energy saving certificate scheme to make savings and implement more energy efficient solutions. The scheme was implemented in 2023 and was an important measure to achieve the targets for EE. The scheme gives information about a building's energy efficiency to facilitate the processes of selling, buying or rental with information about the measures needed to make the building more efficient.

Transport
One new policy for Spain was the aim to reduce the transport on roads and make the transport on railroad more dominant. They also included a plan to electrify the rails and implement longer trains to get a larger capacity of goods that can be transported by train. Another improvement in the NECP was that the vehicle fleet would be more efficient in 2025 which will lead to a 15% reduction of CO_2 emission compared to the target set in 2020 and 100% in 2035 compared to 2021 targets.

Overall, Spain have implemented new policies and the main focus for the new policies lie in the transport and building sector. The new policies and measures include, for example, changing of heating and cooling system, taxation law, reducing trans-

port on roads and an energy saving certificate scheme. With all these new policies and a target rise of 11 percent, it seems reasonable that the target and the policy changes match each other.

6.3.2.8 Sweden

Sweden's targets for energy efficiency is the same for the 2019 NECP, [51], and 2023 NECP [52]. They only have one new policy in the NECP 2023, see Figure 6.1, but considering the targets are not raised, this is more reasonable.

Buildings
The new policy for EE is an aid for EE in single-family houses. The policy aims to renovate and change the heating system for singe-family houses to make them more energy efficient. In particulate the houses with gas or direct acting electricity. The budget for this policy is 1,2 billion SEK.

With no change in the target for EE it is expected to not be any big changes for the policies. With the fact that it has been one new policy means that they still looking to improve the EE category but with a low pace.

7
Discussion

The projects discussion consist of four parts: Changes in targets, quantitative changes in policies, qualitative changes in policies and limitations. These topics discuss the changes we have found in the analysis as well as the limitations of the project.

7.1 Changes in Targets

In the GHG dimension, all countries except Sweden increased their targets between 2019 and 2023. In the ESR sectors the average of the 2019 target was 26.84%, and 36.5% in 2023. Targets to reduce total emissions were, overall, higher, with an average of 42.5% in 2019 and 76.1% in 2023. Targets increased by a factor 1.55 in the ESR category, and 1.76 in the total category.

In the RES dimension, solar and wind targets increased significantly between reports while hydro targets either remained the same or were decreased. Solar targets increased, on average, by a factor of 2.06 in capacity and 2.44 in generation. While wind targets saw a lesser increase, an average factor of 1.63 in capacity and 1.84 in generation, the targets were, on average, roughly twice as high in generation, and about the same in capacity. Hydro targets, meanwhile, either remained the same or were decreased between NECPs, with a decrease by a factor 0.97.

EE was the most difficult dimension to analyse, with many targets becoming negative after the normalisation. With 4 countries, Greece, Portugal, Slovakia and Sweden, having the same target for EE in the 2023 NECP as they had in the 2019 NECP and the Netherlands lowering their target the average still increased by difference of 5.41% But many targets still included a higher final energy consumption in 2030 compared to 2015. This might be due to factors such as populations growing and increased electrification.

Among the member states, Lithuania stood out with the highest normalised 2023 targets in solar, wind, and EE, and the second highest in GHG. They also had the highest increases by both factor and difference in solar and wind, and the highest by difference in EE. There are no clear stand-outs when it comes to the lowest targets, with different countries in nearly all categories and dimensions.

To answer research question 1: To what extent have member states changed their

targets regarding renewable energy sources, energy efficiency, and greenhouse gas emissions between 2019 and 2023? Targets have, overall, been increased. The largest increases were seen in the RES dimension, specifically solar and wind energy, followed by the GHG dimension. In the EE dimension, targets were more unclear, but were on average increased. The only category that saw little to no increase was hydro.

As to research question 2: How do the member states' targets differ regarding renewable energy sources, energy efficiency, and greenhouse gas emissions? As mentioned above, RES targets, more specifically solar and wind, saw the largest increases by factor. The EE targets were difficult to compare to other dimensions as the increase by factor was excluded from the analysis. GHG targets were raised across the board, though not quite to the same extent as solar and wind.

Research questions 3: *What policy measures do member states plan to implement in order to support them in achieving their targets?* will be discussed further below. This research is not to clear since it is difficult to grasp what the effects of the planned measures will have.

7.2 Quantitative Changes in policies

GHG
The most common category for types of policy instrument for GHG was *Command and control* and *Economic* for both the 2019 and the 2023 NECPs. For the sectors *transport* was dominating in both 2019 and 2023. This can be connected to The European Green Deal where there is a goal that there will be a 55% reduction of emissions from cars and 50% reduction of emissions from vans in 2030, and 0 emissions from new cars in 2035 [57]. These are specific targets with a set date when it should be fulfilled which would require almost imitate action to meet the target.

RES
In the RES dimension the type of policy instruments that was the most common was *Economic* and *Command and control* being the second for both 2019 and 2023. The sector dominating RES was *Energy* which is in line with the Renewable Energy Directive[60].

The study done by Pavlenko et al. [70], discusses that policy objectives prior to 2018 was strongly affected by costs and technological uncertainties, and did not have a strong connection to long-term climate targets. In the quantitative analysis however, it is not visible that policies regarding economic has decreased between 2019 and 2023.

Energy Efficiency
For the EE dimension the categories in types of policy instruments were more equally spread between all three, compared to GHG and RES. But *Economic* had the most measures and *Command and control* second for both 2019 and 2023. *Buildings* and

energy were the two most common sectors, with *energy* the most common for 2019 and *buildings* for 2023. This is reasonable since the *Energy Performance of Buildings Directive* were revised in 2018[63]. This would result in new guidelines in the *building* sector and the new legislative framework could act as a guide that results in a heavy focus on buildings measures in 2023. With the deadline of submitting a report in 2019 there would be understandable if the new framework would not have made it in the 2018 or 2019 report.

Comparison
Information is the least used type of policy instrument throughout all dimensions. This could suggest that more action is being taken or planned in the policies. Furthermore, this can indicate a plan for change.

Sector-wise, the focus is more divided where all three dimension have a different major sector in 2023. This is interesting since it could signify that the other sectors could partake in improvements made in one particular sector. For example, if RES is being addressed through the transport sector, this might innovate technology that has the capacity of being implemented in a similar way for other sectors. By dividing the priority and measures taken over different sectors, tools can be developed that might make future measures easier to accomplish. This could be shown in solar panels, which have been developed and price reduced enabling small-scale solar installations. This can further incite people who own solar panels to relieve the power grid, heat their house with solar energy, or buy an electric vehicle, thus helping the dimension of energy efficiency and decreasing greenhouse gas emissions.

7.3 Qualitative Changes in Policies

This section is mainly related to answering Research questions 3: *What policy measures do member states plan to implement in order to support them in achieving their targets?* This research question is difficult to give a short answer to, as the whole qualitative analysis is trying to answer this question. Below follows a discussion on the qualitative changes in policies.

In the GHG dimension, Sweden is the only member state that did not raised the target between the 2019 and 2023 NECP, as mentioned above. However, the level of change in policies in the GHG dimension varies between the different case study countries. Finland, who has a target of reaching carbon neutrality 2035, has overall not much change in the policies between 2019 and 2023. Germany on the other hand has a less ambitious target, but overall more change in policies to support the targets, compared to Finland. Greece has a lack of change in policies, and has a raised target of 10 percentage points, while Ireland has an increased ambition in policies. Italy mainly continues to operate in the 2019 policies, and Portugal has many vague policies regarding *promotion*. Spain has quite a lot of change in policies, especially focusing on transport, and Sweden has somewhat changed their GHG policies, but not raised the targets.

The level of change in policies differs more between the member states in the GHG dimension than what it does in the RES and EE dimension. One reason for this could be that for RES and EE, there are the *Renewable Energy Directive* and the *Energy Effiency Directive*, which gives states obligations to for example have a smooth permit process of wind, and submit a *Long-term Renovation Plan*. Another reason for this could be in the article by Perino et al., [71] that discusses the implementation gap in section 3.2. In the article Perino et al. discusses that the EU ETS in combination with other policies regarding for example coal phase-out and renewable energy support, sometimes can become counterproductive. It could be that member states are more affected by this in the GHG dimension than in RES and EE dimension. To what degree member states combine the EU ETS might differ between different member states. Finland for example compensate some companies for increased electricity costs as result by EU ETS allowance prices, 6.1.2.1, whilst Germany are trying to combine both in the policy regarding coal phase out, 6.1.2.2. These could be reasons why the level of ambition differs a lot between the states in the GHG dimension, compared to in the RES and EE dimension.

In the RES dimension, there is a clearer trend of the change in policies amongst the case study countries. At least when compared to the GHG dimension. One trend amongst the case study countries is that the policies regarding wind has increased between the 2019 and 2023 NECPs. This can be connected to the article by Pavlenko et al., [70]. The article reads that after 2018 countries have higher ambition through policies especially in wind, and that the policies are more inline with the 2030 targets. In our study we have found that there are more legislative control, more economic measures, and a bigger focus on speeding up and simplifying incensing framework and permit granting processes in the NECPs 2023, compared to the NECPs 2019. This is however not as apparent in the quantitative analysis.

Regarding solar, all member states have raised their targets, as can be seen in Table 6.3. The policy changes for the case study countries regarding solar is overall lacking. For example, Germany and Ireland has increased their solar targets notably, but in this report there is little evidence that the policy changes will meet that new 2023 NECP targets. For Portugal, the photovoltaic targets has increased the most, but with just one concrete new 2023 policy regarding solar. There are however policies that apply to both wind and solar.

There are not many policies regarding hydro in neither the 2019 and 2023 NECPs. However, the only member states that has raised the targets regarding hydro are Austria and Slovenia. This trend indicate that hydro is not a RES in focus for the EU countries to improve and therefore not any point to include new or improve policies.

The EE dimension has, compared to the GHG dimension and the RES dimension, had the least change in targets and policies. There are multiple member states without any change in their EE targets and some has even lowered their targets. With this in mind it is not so strange that this is the dimension with the least new

2023 policies. There are however member states, such that Greece, Portugal and Sweden, that has not raised their EE targets between 2019 and 2023, but still has implemented new measures in the NECP 2023. One reason for this can be that the member states does not put effort in strengthening specific EE targets, but the measures included in EE may also be necessary for a reduction in GHG and help in a transition to renewable energy. Many of the policies in the EE dimenson are also required from the *Energy Efficiency Directive*, such as the *Long-term Renovation Plan*, and implementing an energy support scheme.

Comparing the three dimensions for the qualitative analysis we can see that the policies and measures in the NECPs 2023 to support the new targets differ between the three dimensions GHG, RES, and EE. In the GHG dimension, the level of change in policies between the 2019 NECP and the 2023 NECP varies between the different member states. Considering that all member states has raised their target, the policy change should happen in all states and in all dimensions to have clear evidence that the targets will be met in EU. In the RES dimension there is a clearer trend compared to in the GHG dimension. Wind has a big focus of the policy change in the qualitative analysis, whilst the policies regarding solar is lacking. There are almost no policies regarding hydro. In the EE dimension there is evidence from the quantitative and qualitative analysis that the ambition level is the lowest. This is when comparing the three dimensions. The targets are not raised for all member states, and there is not much policy change overall.

7.4 Limitations

The main layout in every NECP is the same for 2019 and 2023, and between the member states. However, even if the layout is mostly the same, the way of presenting the information differs widely between member states and even between the same states NECPs 2019 and 2023. These differences makes it difficult to compare policies between countries. For example, Portugal has the same layout in both 2019 and 2023, and have colour-coordinated which policies have been added, achieved or eliminated. In these instances it is easy to compare the change between 2019 and 2023. Other member states like Roumania's 2019 NECP had all policies in a mix of running text and bullet points without any names on the policies. In their 2023 NECP the layout had been completely redone and everything was structured with tables and sorted into different categories. Even if they had improved the 2023 NECP greatly compared to the 2019 NECP the ability to compare the two reports decreases. The same applies for France, where the structure of the NECP 2019 and NECP 2023 differs significantly. Therefore it is difficult to analyse if one specific policy has been strengthened between 2019 and 2023 in these cases.

When reading two similar policies it is difficult to know if there has been added information for clarity reasons on a policy, or if there has been any real strengthening of the policy. This can impact the analysis in that way that there sometimes may not have been a strengthening, but just added clarity on the policy.

One attempt of finding a way around the problem of different structure in different NECPs were to sort the policies in *"Overarching themes"*. The idea of this were to find common themes in policies, for example carbon budget or Nearly Zero Energy Buildings, and group those together. In that way it would be easier to detect if there has been an increase or decrease in those kinds of policies, since it does not have to be the same policy that has strengthened or weakened between 2019 and 2023, but rather a set of similar policies.

Another issue with the different layout is that every member state do not put the same sort of policies in the same dimension. This is a problem since the scope of this study the dimensions GHG, RES and EE. There has been instances where policies which could be considered to belong to the GHG dimension, such as coal phase out, have been put under the chapter *Internal energy market* in the NECP. Since this study does not include all chapters, some policies that would be considered to be important for a member state might have been missed. That makes it a possibility that some countries might have been wrongly portrayed in this study.

Some countries describe the policy in great detail with background and the current state of the implementation of the policy. It can be a good thing and make it clear what the intended measure is, but it also have the ability to mislead what is the actual action and what is a description of the same measure or the same policy. Another example is that sometimes information in policies are described very vaguely, and there is little evidence that implementation of the policy is possible or really intended. When adding a layer of poor translation it is difficult to pick up the nuances that might have been clear in the original language.
Overall in the 2023 NECP only new measures were categorised, as mentioned in chapter 4. However, sometimes the change in a specific measure between the NECP 2019 and 2023 was categorised as a new measure, even though the measure is mentioned in the 2019 NECP as well. This was done when the change was considered to be significant. This means that there is some inconsistency in the quantitative part in the analysis.

8

Conclusion

To conclude, this study aimed to investigate how the EU member states are progressing toward their targets concerning reductions of greenhouse gas emissions, renewable energy sources and energy efficiency. This was done by studying how the member states' targets and policies changed between the 2019 NECPs and 2023 NECPs. These plans outline how member states intend to meet the agreed upon EU 2030 climate and energy targets. Each state follows a framework that is set by the European Commission. To answer the research questions, the analysis was divided in a quantitative and qualitative analysis. Research questions 1 and 2 was answered in the quantitative and qualitative analysis, and research question 3 was mostly answered in the qualitative analysis and in the discussion. The main findings included that the member states' targets have increased overall. The increase differed between the GHG, RES and EE dimensions, and the largest increase was identified in the RES dimension. The smallest increase in targets was identified in the EE dimension, but overall they had also increased.

For the GHG dimension, most of the measures were found in transport sector in both the 2019 and 2023 NECPs. The most common policy instrument in the GHG dimension is command and control in the 2019 NECPs and economic in the 2023 NECPs. For RES, a clear majority of the measures are being implemented in the energy sector for both the 2019 and the 2023 NECPs, while most of the policy instruments are economic measures. Energy efficiency was the least prioritised dimension when it comes to number of policies. Once again, the majority of measures were found in the energy sector, and similar to GHG, economic was the most common policy instrument. From the quantitative section it is apparent that informational policies are the least common.

The policy changes also differed between the dimensions. Overall, there are some member states that have made policy changes to meet the new targets, and some member states where there is little evidence that the changes in policies are meeting the raised targets. When comparing dimensions, policy changes between states differ regarding GHG emissions. In the RES dimension, the policy changes regarding wind is more significant than the policy changes regarding solar. The policy changes in the EE dimension are however lacking. Since the targets in all three dimensions have been raised, the policy changes should, in all states and in all dimensions, have clear evidence of support for the targets.

This project has made a contribution by uncovering insights into the EU member

states progression towards meeting their climate related targets, and how these differ between the dimensions of greenhouse gas emissions, renewable energy, and energy efficiency. The study has also contributed by compiling two datasets containing EU member states' targets and policies from the 2019 and 2023 NECPs. Further research is needed to deeper investigate and understand changes in EU member states' energy and climate policies.

Bibliography

[1] H.-O. Pörtner et al. "Summary for Policymakers". In: *Climate Change 2022 – Impacts, Adaptation and Vulnerability*. Cambridge University Press, June 2023, pp. 3–34. DOI: 10.1017/9781009325844.001. URL: https://www.ipcc.ch/report/ar6/wg2/chapter/summary-for-policymakers/.

[2] A. Patt et al. "International Cooperation". In: *Climate Change 2022 - Mitigation of Climate Change*. Cambridge University Press, Aug. 2023, pp. 1451–1546. DOI: 10.1017/9781009157926.016. URL: https://www.ipcc.ch/report/ar6/wg3/chapter/chapter-14/.

[3] European Commission. *Cooperation on climate action with non-EU countries*. URL: https://climate.ec.europa.eu/eu-action/international-action-climate-change/eu-engagement-climate-action-non-eu-countries/cooperation-climate-action-non-eu-countries_en#:~:text=Climate%20action%20is%20an%20integral,efforts%20to%20tackle%20climate%20change..

[4] European Commission. *National energy and climate plans*. URL: https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en.

[5] European Commission. *RePowerEU*. May 2022. URL: https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131.

[6] Vadim Vinichenko et al. "Historical diffusion of nuclear, wind and solar power in different national contexts: implications for climate mitigation pathways". In: *Environmental Research Letters* 18.9 (Sept. 2023), p. 094066. ISSN: 1748-9326. DOI: 10.1088/1748-9326/acf47a.

[7] Aleh Cherp et al. "National growth dynamics of wind and solar power compared to the growth required for global climate targets". In: *Nature Energy* 6.7 (July 2021), pp. 742–754. ISSN: 2058-7546. DOI: 10.1038/s41560-021-00863-0.

[8] Sustainability Federal Ministry Republic of Austria and Tourism. *Integrated National Energy and Climate Plan for Austria*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-03/at_final_necp_main_en_0.pdf.

[9] Federal Ministry for Climate Action Environment, Mobility Energy, and Innovation and Technology. *Integrierter nationaler Energie- und Klimaplan für Österreich*. Tech. rep. 2023.

[10] *National Energy and Climate Plan*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-09/be_final_necp_partb_en_0.pdf.

[11] *National Energy and Climate Plan*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-09/be_final_necp_parta_en_0.pdf.

[12] *Draft update of the Belgian National Energy and Climate Plan*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/592ce466-d54d-4633-a908-ea936aa5269c_en?filename=Belgium%20-%20Draft%20updated%20NECP%202021-2030%20EN.pdf.

[13] REPUBLIC OF BULGARIA Ministry of Energy Ministry of the Environment and Water. *INTEGRATED ENERGY AND CLIMATE PLAN OF THE REPUBLIC OF BULGARIA 2021–2030*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-06/bg_final_necp_main_en_0.pdf.

[14] Directorate-General for Communication. *Bulgaria - Draft updated NECP 2021-2030*. Tech. rep. 2024. URL: https://commission.europa.eu/document/download/58f949db-7df0-4a6d-abf9-befdac47485a_en?filename=Bulgaria%20-%20Draft%20updated%20NECP%202021-2030%20EN.pdf.

[15] MINISTRY OF ENVIRONMENT AND ENERGY. *Integrated National Energy and Climate Plan for the Republic of Croatia*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-01/hr_final_necp_main_en_0.pdf.

[16] Directorate-General for Energy and Directorate-General for Climate Action. *Croatia - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/c4a12c32-7c7c-475a-80b9-366a7309bdc8_en?filename=CROATIA_%20DRAFT%20UPDATED%20NECP%202021%202030%20%282%29_0.pdf.

[17] *National Energy and Climate Plan of the Czech Republic*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-03/cs_final_necp_main_en_0.pdf.

[18] Directorate-General for Communication, Directorate-General for Energy, and Directorate-General for Climate Action. *Czech - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/caa18b5a-3c07-46b5-8089-2c2753ff68e5_en?filename=Czech%20Draft%20Updated%20NECP%202021%202030_en.pdf.

[19] Energy Danish Ministry of Climate and Utilities. *Denmark's Integrated National Energy and Climate Plan*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-01/dk_final_necp_main_en_0.pdf.

[20] Directorate-General for Energy and Directorate-General for Climate Action. *Denmark - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/31895e48-37c3-46fe-8a8f-8f61fbff6724_en?filename=EN_DENMARK%20DRAFT%20UPDATED%20NECP.pdf.

[21] Ministry of Economic Affairs and Employment. *Finland's Integrated Energy and Climate Plan*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-01/fi_final_necp_main_en_0.pdf.

[22] Ministry of Economic Affairs and Employment. *FINLAND'S INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/78c7f4bd-a3ca-4e83-8732-65f1e0d0baaa_en?filename=DRAFT%20NECP%20update_Finland.pdf.

[23] *INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN for FRANCE*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2022-08/fr_final_necp_main_en.pdf.

[24] Directorate-General for Communication. *France - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/e160e0b8-2ac9-4731-bcad-5024ce97bcc9_en?filename=FRANCE%20-%20DRAFT%20UPDATED%20NECP%202021-2030_EN.pdf.

[25] *Integrated National Energy and Climate Plan*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2022-08/de_final_necp_main_en.pdf.

[26] Directorate-General for Communication. *Germany - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/c589deb5-9494-4984-9ef5-8e2ee711aaf2_en?filename=GERMANY-%20DRAFT%20UPDATED%20NECP%202021-2030%20EN.pdf.

[27] HELLENIC REPUBLIC Ministry of the Environment and Energy. *National Energy and Climate Plan*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-03/el_final_necp_main_en_0.pdf.

[28] Directorate-General for Communication. *Greece - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/83ffdc95-2d22-4c67-8d4c-a3e59f752921_en?filename=GREECE%20-%20DRAFT%20UPDATED%20NECP%202021-2030%20EN.pdf.

[29] Ministry of Innovation and Technology. *National Energy and Climate Plan*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2022-08/hu_final_necp_main_en.pdf.

[30] Directorate-General for Energy and Directorate-General for Climate Action. *HUNGARY - DRAFT UPDATED NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/f51a47de-30f0-4176-bab0-89fca0244233_en?filename=HUNGARY%20-%20DRAFT%20UPDATED%20NECP%202021-2030%20_EN.pdf.

[31] Climate Department of the Environment and Communications. *National Energy & Climate Plan*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-08/ie_final_necp_main_en_0.pdf.

[32] Climate Department of the Environment and Communications. *Draft Updated National Energy & Climate Plan*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/4b741649-7249-47d6-b62a-b123edd49ae5_en?filename=Ireland%20-%20Draft%20updated%20NECP%202021-2030%20EN.pdf.

[33] Ministry of Economic Development, Ministry of the Environment and Protection of Natural Resources and the Sea, and Ministry of Infrastructure and Transport. *INTEGRATED NATIONAL ENERGY AND CLIMATE PLANvv*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-02/it_final_necp_main_en_0.pdf.

[34] Directorate-General for Communication and Directorate-General for Energy. *Italy - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/75b8162c-3d62-4627-8706-

c62997b324da_en?filename=ITALY%20-%20DRAFT%20UPDATED%20NECP%202021%202030%20%281%29.pdf.

[35] *NATIONAL ENERGY AND CLIMATE ACTION PLAN OF THE REPUBLIC OF LITHUANIA FOR 2021-2030*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2022-08/lt_final_necp_main_en.pdf.

[36] Directorate-General for Communication. *Lithuania - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/cd246df6-377e-4db3-bb48-8475c80aa43c_en?filename=LITHUANIA%20DRAFT%20UPDATED%20NECP%20EN.pdf.

[37] Ministry of Economic Affairs and Climate Policy. *Integrated National Energy and Climate Plan*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-03/nl_final_necp_main_en_0.pdf.

[38] Directorate-General for Energy and Directorate-General for Climate Action. *Netherlands - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/0fe725be-1783-4c33-a9b1-d42b428ea903_en?filename=EN_NETHERLANDS%20DRAFT%20UPDATED%20NECP.pdf.

[39] MINISTRY OF NATIONAL ASSETS. *The National Energy and Climate Plan for 2021-2030*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-08/pl_final_necp_part_1_3_en_0.pdf.

[40] Directorate-General for Communication. *Poland - Draft updated NECP 2021-2030*. Tech. rep. 2024. URL: https://commission.europa.eu/document/download/5118b15e-d380-49ae-b8bb-41cc81a28e15_en?filename=PL_NECPupdate_Projekt_EN.pdf.

[41] *NATIONAL ENERGY AND CLIMATE PLAN 2021-2030 (NECP 2030)*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-06/pt_final_necp_main_en_0.pdf.

[42] Directorate-General for Communication. *Portugal - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/bbcdfa78-5d50-474d-bd7f-16bd804a8388_en?filename=EN_PORTUGAL%20DRAFT%20UPDATED%20NECP.pdf.

[43] "The 2021-2030 Integrated National Energy and Climate Plan". In: (2020). URL: https://energy.ec.europa.eu/system/files/2020-06/ro_final_necp_main_en_0.pdf.

[44] Directorate-General for Communication. *Romania - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/c42fd541-c493-4479-8bdf-b2ba6aad85b8_en?filename=ROMANIA%20-%20DRAFT%20UPDATED%20NECP%202021-2030.pdf.

[45] SLOVAK MINISTRY OF ECONOMY. *Energy and Climate Plan for 2021 to 2030*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-03/sk_final_necp_main_en_0.pdf.

[46] Directorate-General for Communication. *Slovakia - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/4f373d12-ce73-403a-a2d5-0107bf3e0c24_en?filename=SLOVAKIA%20-%20DRAFT%20UPDATED%20NECP%202021-2030_EN.pdf.

[47] *INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN OF THE REPUBLIC OF SLOVENIA*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-06/si_final_necp_main_en_0.pdf.

[48] Directorate-General for Communication. *Slovenia - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/88f140fc-424f-4740-8b6f-6d4d89b2a701_en?filename=EN_SLOVENIA%20DRAFT%20UPDATED%20NECP.pdf.

[49] *INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN 2021-2030*. Tech. rep. 2019. URL: https://energy.ec.europa.eu/system/files/2020-06/es_final_necp_main_en_0.pdf.

[50] Directorate-General for Communication. *Spain - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/9ea170ec-fdce-49cb-9424-4ee95db33a4a_en?filename=EN_SPAIN%20DRAFT%20UPDATED%20NECP.pdf.

[51] The Ministry of Infrastructure. "Sweden's Integrated National Energy and Climate Plan". In: (2019). URL: https://energy.ec.europa.eu/system/files/2020-03/se_final_necp_main_en_0.pdf.

[52] Directorate-General for Energy and Directorate-General for Climate Action. *Sweden - Draft Updated NECP 2021-2030*. Tech. rep. 2023. URL: https://commission.europa.eu/document/download/bdd2bbe5-eefd-4d22-a729-2a74cbb30e1f_en?filename=EN_SWEDEN%20DRAFT%20UPDATED%20NECP.pdf.

[53] European Commission. *National energy and climate plans*. URL: https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en.

[54] European Commission. *Questions and answers: National energy and climate plans explained*. June 2019. URL: https://ec.europa.eu/commission/presscorner/detail/en/MEMO_19_2997.

[55] European Commission. *Energy union*. URL: https://energy.ec.europa.eu/topics/energy-strategy/energy-union_en.

[56] European Commission. "Governance of the Energy Union and Climate Action". In: (). URL: https://climate.ec.europa.eu/eu-action/climate-strategies-targets/governance-energy-union-and-climate-action_en.

[57] European Commission. *European Green Deal*. Oct. 2023. URL: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en.

[58] European Council. *Fit for 55*. Apr. 2024. URL: https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55/.

[59] European Commission. *Carbon Border Adjustment Mechanism*. URL: https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en.

[60] European Commission. *Renewable Energy Directive*. URL: https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en.

[61] Markus Pieper and Nils Torvalds. *Revision of the Renewable Energy Directive*. URL: https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-the-renewable-energy-directive.

[62] European Commission. *Energy efficiency directive*. URL: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en#the-revised-directive.

[63] European Commission. *Energy Performance of Buildings Directive*. URL: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en.

[64] European Commission. *Effort sharing 2021-2030: targets and flexibilities*. URL: https://climate.ec.europa.eu/eu-action/effort-sharing-member-states-emission-targets/effort-sharing-2021-2030-targets-and-flexibilities_en.

[65] European Commission. *What is the EU ETS?* URL: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en.

[66] European Commission. *Scope of the EU Emissions Trading System*. URL: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/scope-eu-emissions-trading-system_en.

[67] European Commission. *Emissions cap and allowances*. URL: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/emissions-cap-and-allowances_en#:~:text=In%20phase%204%20of%20the,is%20fixed%20at%201%2C571%2C583%2C007%20allowances%20..

[68] Sebastian Sewerin, Lukas P Fesenfeld, and Tobias S Schmidt. "The role of policy design in policy continuation and ratcheting-up of policy ambition". In: *Policy and Society* 42.4 (Dec. 2023), pp. 478–492. ISSN: 1449-4035. DOI: 10.1093/polsoc/puad027.

[69] Lana Ollier, Marc Melliger, and Florence Metz. "How Do Governments' Policy Priorities Change as the Energy Transition Progresses? A Cross-Country Comparison". In: *Journal of Comparative Policy Analysis: Research and Practice* (Nov. 2023), pp. 1–15. ISSN: 1387-6988. DOI: 10.1080/13876988.2023.2280270.

[70] Anastasia Pavlenko. *When is it feasible for policies to accelerate energy transitions? The case of REPowerEU*. Tech. rep.

[71] Grischa Perino et al. "Closing the Implementation Gap: Obstacles in Reaching Net-Zero Pledges in the EU and Germany". In: *Politics and Governance* 10.3 (June 2022). ISSN: 2183-2463. DOI: 10.17645/pag.v10i3.5326.

[72] Taryn Fransen et al. "Taking stock of the implementation gap in climate policy". In: *Nature Climate Change* 13.8 (Aug. 2023), pp. 752–755. ISSN: 1758-678X. DOI: 10.1038/s41558-023-01755-9.

[73] I.M. Bouwma et al. *Policy instruments and modes of governance in environmental policies of the European Union*. Tech. rep. 2012.

[74] *Classification of Instruments*. URL: http://www.claimknowledgeplatform.eu/claim.1.0.php.

[75] "Emissions Trends and Drivers". In: *Climate Change 2022 - Mitigation of Climate Change*. Cambridge University Press, Aug. 2023, pp. 215–294. DOI: 10.1017/9781009157926.004.

[76] John Gerring. "What Is a Case Study and What Is It Good for?" In: *The American Political Science Review* 98.2 (Apr. 2004), pp. 341–354.

[77] Climate Watch. "Historical GHG Emissions". In: (). URL: https://www.climatewatchdata.org/ghg-emissions?end_year=2005&regions=EUU&sectors=total-excluding-lucf&start_year=2005.

[78] World Bank. *Sustainable Energy for All*. URL: https://databank.worldbank.org/source/sustainable-energy-for-all/preview/on#.

[79] Johannes Hyvönen, Tero Koivunen, and Sanna Syri. "Possible bottlenecks in clean energy transitions: Overview and modelled effects – Case Finland". In: *Journal of Cleaner Production* 410 (July 2023), p. 137317. ISSN: 09596526. DOI: 10.1016/j.jclepro.2023.137317.

[80] Energy Institute. *Statistical Review of World Energy 2023 | 72 nd edition*. Tech. rep.

[81] European Commission. *GHG emissions of all world countries*. URL: https://edgar.jrc.ec.europa.eu/report_2023.

[82] European Union. *Facts and figures on life in the European Union*. URL: https://european-union.europa.eu/principles-countries-history/key-facts-and-figures/life-eu_en#:~:text=By%20surface%20area%2C%20France%20is,country%20and%20Malta%20the%20smallest..

[83] iea. *Italy Natural Gas Security Policy*. Oct. 2022. URL: https://www.iea.org/articles/italy-natural-gas-security-policy.

[84] Directorate-General for Energy and European Commission. *EU energy in figures : statistical pocketbook 2023*. Publications Office of the European Union, 2023, p. 127. URL: https://data.europa.eu/doi/10.2833/502436.

[85] Dimitrios Theofanidis and Antigoni Fountouki. "LIMITATIONS AND DELIMITATIONS IN THE RESEARCH PROCESS". In: *Perioperative nursing (GORNA)* 7.3 (2019), pp. 155–162. URL: https://www.spnj.gr/articlefiles/volume7_issue3/pn_sep_73_155_162b.pdf.

[86] European Commission. *The EU transport sector and its contribution to reaching climate neutrality*. URL: https://climate.ec.europa.eu/eu-action/transport/overview_en.

[87] European Comission. *GR-eco Islands: Turning Greek Islands into models of green & sustainable development*. June 2022. URL: https://clean-energy-islands.ec.europa.eu/news/gr-eco-islands-turning-greek-islands-models-green-sustainable-development.

[88] Chryssa Liaggou. *PPC extends operation of seven lignite units to ensure supply*. Dec. 2021. URL: https://www.ekathimerini.com/economy/1174648/ppc-extends-operation-of-seven-lignite-units-to-ensure-supply/.

[89] Electricity Supply Board. *West Offaly Power*. URL: https://esbarchives.ie/portfolio/west-offaly-power/.

[90] Electricity Supply Board. *Lough Ree Power*. URL: https://esbarchives.ie/portfolio/lough-ree-power-co-longford/.

[91] European Commission. *Union Registry*. URL: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/union-registry_en#documentation.

[92] Sara Budinis, Mathilde Fajardy, and Carl Greenfield. *Carbon Capture, Utilisation and Storage*. Apr. 2024. URL: https://www.iea.org/energy-system/carbon-capture-utilisation-and-storage.

[93] Mathilde Fajardy and Carl Greenfield. *CO2 Capture and Utilisation*. Apr. 2024. URL: https://www.iea.org/energy-system/carbon-capture-utilisation-and-storage/co2-capture-and-utilisation.

[94] Trafikerket. *Sveriges första permanenta elväg*. 2024. URL: https://www.trafikverket.se/vara-projekt/projekt-i-orebro-lan/sveriges-forsta-permanenta-elvag/?fbclid=IwAR2HwbGbthlkeb4uBZcs7LzVmR__HYZvHpxdONfdUh5s0dmdBMa-ryg0aQY.

[95] International Energy Agency. *Finland 2023 - Energy Policy Review*. Tech. rep. 2023. URL: www.iea.org/t&c/.

[96] International Energy Agency. *Building Sector ELECTRA: Subsidies for Energy Efficiency of Public Buildings*. URL: https://prod.iea.org/policies/12747-building-sector-electra-subsidies-for-energy-efficiency-of-public-buildings.

[97] Destatis. *Country codes*. URL: https://www.destatis.de/Europa/EN/Country/Country-Codes.html.

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Appendix: Additional Tables

Country name	Country code
Austria	AT
Belgium	BE
Bulgaria	BG
Croatia	HR
Czech Republic	CZ
Denmark	DK
Finland	FI
France	FR
Germany	DE
Greece	GR
Hungary	HU
Ireland	IE
Italy	IT
Lithuania	LT
Netherlands	NL
Poland	PL
Portugal	PT
Romania	RO
Slovakia	SK
Slovenia	SI
Spain	ES
Sweden	SE

Table A.1: Two letter country codes used in this report. These are called ISO-3166 Alpha-2 [97]

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