Friends or Foes? Political Synergy or Competition between Renewable Energy and Energy Efficiency Policy

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Abstract: Energy efficiency measures and the deployment of renewable energy are commonly presented as two sides of the same coin—as necessary and synergistic measures to decarbonize energy systems and reach the temperature goals of the Paris Agreement. Here, we quantitatively investigate the policies and performances of the EU Member States to see whether renewables and energy efficiency policies are politically synergistic or if they rather compete for political attention and resources. We find that Member States, especially the ones perceived as climate leaders, tend to prioritize renewables over energy efficiency in target setting. Further, almost every country performs well in either renewable energy or energy efficiency, but rarely performs well in both. We find no support for the assertion that the policies are synergistic, but some evidence that they compete. However, multi-linear regression models for performance show that performance, especially in energy efficiency, is also strongly associated with general economic growth cycles, and not only efficiency policy as such. We conclude that renewable energy and energy efficiency are not synergistic policies, and that there is some competition between them.

Keywords: energy efficiency; renewable energy; climate policy; policy cycle; EU climate policy; policy competition

1. Introduction

In 2007, the European Union (EU) Member States for the first time agreed on comprehensive and (in part) legally-binding climate and energy policy targets: by 2020, the EU was to reach a 20% reduction in greenhouse gas (GHG) emissions from 1990, a 20% increase in renewables and a 20% increase in energy efficiency [1,2]. With this 20-20-20 target structure, the 2020 climate and energy package puts equal emphasis on the three policies available for decarbonizing energy. The first strategic option is intended to reduce demand—a kilowatt-hour not consumed has no emissions. The second option is renewable energy, including wind, solar, hydro and biomass power, domestically or in cooperation with other countries. The third option is to switch to lower-carbon technologies (e.g., from coal to gas power) and then to zero-carbon supply (e.g., carbon capture and storage (CCS), nuclear power). As both CCS and nuclear power suffer from currently difficult economics and substantial public and political opposition, they are unlikely to grow strongly in Europe within the next decade [3]. Consequentially, the decarbonization of European energy will very predominantly happen through some combination of the two remaining policies—expanding renewables and improving energy efficiency. These two policies are the focus of our analysis.

From a technological perspective, it may be desirable for countries to use both policies in parallel, as their properties may complement each other: lower energy consumption makes it easier to achieve high shares of renewables [4,5]. As such, countries that are seen as climate policy leaders should be the countries that successfully integrate the two policies and perform equally well in implementing them. However, previous research has shown that policies may compete for political attention and resources, which may effectively lead to trade-offs between implementing them [6–8].

For the climate and energy field, trade-offs between these two policy approaches may be particularly relevant. To reach the temperature goals of the Paris agreement, the energy system must be completely decarbonized around the mid-century (2 °C) or well before (1.5 °C) [9]. This requirement to eliminate, not merely reduce, carbon emissions is also increasingly reflected in long-term policy targets, such as the 2050 climate-neutrality target proposed by the European Commission [10]. This zero-emission requirement implies that energy efficiency and a switch to low-carbon energy alone are insufficient: to meet the Paris targets, all energy consumed—if much or little—must be carbon-free, and most likely largely or entirely renewable. From a climate perspective, decarbonizing the energy supply is necessary, whereas reducing the energy demand is useful to the extent that it makes a transition to renewables easier, faster or cheaper [11]. As such, if there is no political competition between the two policies, making use of both is advisable, so as to speed up the decarbonization of the energy system. If, in contrast, there is political competition, then countries may need to refocus their policies in order to prioritize renewables, as the only both necessary and sufficient strategy for complete decarbonization.

Focusing on energy efficiency and renewable energy, we investigate empirically whether European countries prioritize one policy over the another, or if they manage to push both simultaneously. Upon finding prioritization in performance, we investigate whether it is the result of political competition—following unequal political action—or if the observed prioritization is mainly associated by policy-external factors, such as the wider socio-economic conditions. In this, we address two research gaps. First, the empirical question of whether there is political competition between these two energy and climate policies in Europe. Second, we expand the existing focus from the traditional view on competition in agenda setting and investigate competition also in the formulation and implementation stages.

In the following, we describe the current state of knowledge regarding prioritization in policy mixes, and describe our method and data. Our results are structured in two parts. The first part investigates whether countries prioritize among energy efficiency and renewable energy, or whether the two policies are synergistic. The second part investigates whether any observed prioritization is the result of political competition or rather the effect of policy-external factors. We then discuss our findings, before concluding with a brief discussion of their implications for EU climate and energy policy.

2. Background: Prioritization in Policy Mixes

The literature on policy diffusion shows that countries are often either leaders or laggards in the field of environmental policy. Practically, this means that countries tend to be either ambitious front-runners performing well across the entire environmental policy field, or consistently lag behind in both ambition and performance [12–15]. In environmental policy, Northern European countries—e.g., Denmark, Sweden, the Netherlands—are generally identified as leaders [16], whereas Eastern and Southern European countries are among the laggards [15,17].

For climate policy, a similar divide is found, where Northwestern European countries are often seen as leaders that play an active role in shaping EU climate and energy policy [18,19]. Leadership can, however, manifest itself differently [14]. Intuitively, it is related to countries' political leadership, where individual states push for the adoption of more ambitious targets and actions [14]. In the EU, such leadership is for example shown in the case of the "Green Growth Group", a group of 14 states (Denmark, Finland, Germany, Luxembourg, Portugal, Belgium, Netherlands, Sweden, Slovenia, United Kingdom, Italy, Spain, France, Austria) demanding to limit global warming to 1.5 °C [20]. However, leadership can also mean leadership by example—by rapidly reducing emissions. A concrete

example of such an output-based metric is the "Climate Change performance index", which ranks countries according to their composite performance in GHG emissions, renewable energy, energy use and climate policy [21]. In both perspectives, the "leaders and laggards" view suggests a synergy between different types of climate policy, suggesting that states either push an ambitious climate agenda and its implementation as a whole, or they do not.

However, this view may be too simplistic for two reasons. First, policy—just like us all—deals with time and resource constraints: not all issues attract equal attention from the policymakers, and issues that make it onto the agenda are not all seen as equally important [22]. For leaders and laggards alike, there is reason to expect that states prioritize some policies over others in the implementation of an overarching agenda, due to scarce political, organizational and economic resources. Transposing EU into national legislation, for example, is no linear process, but will be affected by governments' views of what is most important and beneficial for their country—they purposefully design and prioritize policies in line with their domestic policy aims. Ćetković and Buzogány [23] show that despite their general opposition to an ambitious climate and energy agenda, Central and Eastern European States, which are commonly considered laggards, do not oppose all policies equally, but rather discriminate against certain policies in line with their domestic agenda. In their analysis of Central and Eastern European states' dissenting voting behavior, they show that Czechia and Slovakia tend to oppose both renewables and energy efficiency policy, while Romania and Bulgaria are supportive of renewables and Poland and Hungary of energy efficiency policy [23]. This supports our expectation that also other Member States may prioritize among different energy and climate policies.

Prioritization in agenda setting is well-researched in political science [22,24–26]. The phenomenon that different issues move up and down on a political agenda—sometimes in a cyclic manner—as a result of limited political resources and attention has received much scholarly attention and has been empirically recorded in different policy areas by the "Comparative Agenda Project" [27]. Although several scholars note that prioritization should increase from the agenda setting to the implementation stage [22,28,29], the question of prioritization in implementation of an agenda has received little systematic attention. Our paper addresses this gap, explicitly picking up the question from Patt et al. [11] and testing if is there political competition between different policies in the energy and climate policy mix, or if states are simply divided into leaders and laggards, either pushing a comprehensive energy and climate agenda or not.

Our analytical focus is here on renewables and energy efficiency policy as two policies within the same climate and energy agenda. An agenda is ultimately a "policy mix", which contains multiple goals, policies and involves multiple levels of government [30]. Our study is distinct from previous research in two ways: we comparatively investigate synergy, prioritization and conflict between two policies of the same agenda, whereas past research has focused either on attention placed on individual agenda issues, or the interaction within the policy mix on an instrumental level [31]. In order to determine prioritization—indicating competition between different policies—or synergy—indicating a simple leaders/laggards divide—we measure different types of policy output for both policies comparatively throughout the policy cycle.

3. Materials and Methods

We address our research question in two steps. First, we analyze a set of policy output and outcome indicators for the three first stages of the policy cycle to identify policy prioritization (Section 3.1). Second, we perform a multi-linear regression analysis to see whether any observed prioritization is connected to political actions, or if it is rather associated with (un)favorable economic context conditions and trends (Section 3.2). Without prioritization, competition is impossible. However, prioritization is a necessary but not sufficient condition for political competition: for that to be met, a substantial part of observed prioritization must be attributable to political action, and not only the social and economic context. As such, our multiple regression analysis allows us to investigate the effect of

various performance parameters, and to what extent observed prioritization is associated with policy and policy competition on the one hand, and other external factors on the other.

3.1. Measuring Policy Prioritization

In determining prioritization or synergy between renewable energy and energy efficiency policy in the climate and energy policy mix, we differentiate between three dimensions, each referring to different stages of the policy cycle: the level of ambition in objectives set, measures formulated and adopted, and implementation efforts (Table 1). In the first two stages, we measure policy output, as the determined targets (agenda setting) and number of measures adopted (formulation/adoption). For the implementation stage, we use performance as a proxy for the combined implementation efforts that cannot be measured directly and quantitatively [32]. We measure the policy outcome both as progress relative to the set target and the degree of change in the energy system.

Table 1. Measurement of policy prioritization: conceptualization and indicators.

Policy Prioritization		
Policy Cycle Stage	**Unit of Analysis**	**Indicator/Measure**
Agenda setting	Target ambition	Ambition of renewables/energy efficiency targets: Targeted share of renewable energy in final energy consumption, as defined in the 'National Renewable Energy Action Plans' (NREAPS) for 2020, minus the share of renewable energy in final energy consumption (FEC) in 2005. Normalized with the size (FEC) of the energy system in 2005. Targeted energy savings, as defined in the 'National Energy Efficiency Action Plan' for 2020. Normalized with the size (FEC) of the energy system in 2005 (negative targets indicate plans for increasing energy demand).
Measure formulation/ adoption	Measure density	Sum of policy measures implemented for renewable energy and energy efficiency: Number of measures implemented to promote energy efficiency and renewable energy, respectively, between 2005 and 2018.
Implementation	Performance	Target performance (renewables/energy efficiency): Mean distance in 2016–2018 to the linear target trajectory between 2005 and 2020, in %-points (positive numbers indicate overachievement). System change performance (renewables/energy efficiency): Addition of energy from renewable sources (% added, relative to FEC in 2005); energy demand reduction (FEC decrease relative to FEC in 2005)

We measure target ambition as the envisioned increase in renewables or demand reduction by 2020 relative to the base year 2005. As such, we do not measure the absolute share of renewables or amount of energy savings, but the relative increase from the base year 2005. So that large and small countries can be analyzed on an equal footing, we normalize the target ambition with the size (final energy consumption, FEC) of each national energy system in 2005. The two metrics are comparable, assuming that a Mtoe renewables and a Mtoe saved both replace roughly the same Mtoe of fossil energy.

For the measure formulation and adoption, we measure the measure density—the number of measures implemented [15,33].

Finally, we measure performance in two ways. First, we investigate whether targets are met, as the distance to the linear target trajectory between the base year 2005 and target year 2020. Second,

we show the extent to which a country deploys new renewables and saves energy, respectively, by measuring both factors directly, normalized with the final energy consumption of each national energy system in 2005.

Because we measure prioritization, we are less interested in the absolute measure of our indicators, for example whether countries implement more or less measures, but rather in how energy efficiency and renewable energy indicators perform relative to each other. We focus on systematic patterns of prioritization—of whether countries have similar ambition, activity and performance in energy efficiency and renewable energy policy, or not. We interpret strongly different measures, as a sign that countries prioritize one policy above the other. If both indicators are similar, we view them as non-conflicting, meaning either synergistic or independent.

Finally, we also group Member States according to their leadership in reducing GHG emissions, using the "Climate Change Performance Index" [21]. This way, we examine the "leaders and laggards" hypothesis, and show whether countries either over- or underperform for both policies, or if countries tend to prioritize one policy. We define climate leadership as "leadership by performance" in reducing GHG emissions, and divide countries into leaders, intermediates, and laggards according to the rank they take in the Climate Performance Index (see Appendix A for a list of country classifications according to this index).

3.2. Measuring Policy Competition

An unequal performance in renewable energy and energy efficiency policy may indicate political competition. Yet performance is not only explained by policy action, but also by the socio-economic context. A necessary condition for political competition is thus that performance depends on political action, and not (only) on the system-external context. To test whether this condition is met and whether observed prioritization is the result of political competition, we complement the first analytical step with a multi-linear regression analysis (MLR). In the MLR, we test the plausibility of political action variables alongside socio-economic context variables in explaining target and system change performance (Table 1).

Concretely, we analyze whether and to what extent renewables and energy efficiency performance are associated with policy output, system-internal context variables or system-external socio-economic and technical preconditions (system-external context). The system-internal context holds factors within the energy sector, such as market concentration or historical performance, that are or have been directly shaped by (energy and climate) political action. The system-external context, in contrast, holds factors that are relevant for the energy sector but are not influenced by energy and climate political action, such as general economic growth and state affluence. If we find that performance is mainly predicted by system-external context, we can assume that renewable energy and energy efficiency policy do not actually compete for political resources. In that case, a favorable socio-economic context drives performance—and therefore also the prioritization we have determined in the previous section. If, in contrast, performance is predominantly linked to policy or system-internal variables, prioritization is affected by political action, and we attribute differences in performance to policy competition.

We select policy output, system-internal context and system-external context variables based on an extensive literature review. The results of this literature review are summarized in Table 2. Next to describing the variables, we also formulate concrete expectations for the direction of the relationship between each independent variable (IV) and target and system change performance as dependent variables (DV). We expect the direction of this relationship to remain the same for both target and system change performance.

We collected data (see Section 3.3) for the entire population (28 countries) for 4 dependent DVs, and 10 potentially IVs (see Table 2). Due to missing data on several independent variables, we constructed an MLR model for the final sample of 18 countries (see Appendix B for a list of countries in our sample). We are confident that this country sample does not systematically distort our findings, as the excluded countries vary in (1) when they joined the EU, (2) country size,

and (3) performance in reducing GHG emissions (leaders/laggards). However, our sample now has a slight underrepresentation of eastern European countries. To avoid collinearity resulting in unstable regression coefficients, we calculated variance inflation factors as a measure of the amount of multicollinearity for all independent variables (IVs) in all final models. We did not find critical collinearity between IVs (>0.8) and did not need to exclude any of the IVs. We decided against using panel data, as the data for several countries are incomplete for the entire implementation period, which would have reduced our sample size—instead we are using a mean of the existing data.

We use variable selection to reduce overfitting to our sample and better reflect the overall population. To assist in variable selection and find regression models with the best overall significance (according to an F-test), we first applied backward stepwise selection. Second, we evaluated and adjusted these models using knowledge from literature and theory. To check the validity of the model, we analyzed MLR assumptions using residual plots (Tukey–Anscombe, normal, scale-location and leverage plots). As is common in social science studies, we applied a high significance level of 10% [34,35]. We consistently report the adjusted coefficient of determination (adjusted R^2) to consider the effect of non-explanatory variables in models, and evaluate the relevance of regression estimates using standardized predictors and domain knowledge.

Table 2. Overview of policy output and socio-economic variables used in the MLR, their units and types in the model (DV = dependent variable, IV = independent variable). Expectations describe the expected relationship between IV and DV for both energy efficiency and renewable energy.

Predictor	Description	Unit	Type	Group	Expectations	Literature Sources Expectations
Target performance energy efficiency	Distance to the linear target trajectory between 2005 and 2020 (mean 2016–2018).	%-points	DV			
Target performance renewable energy	Distance to the linear target trajectory between 2005 and 2020 (mean 2016–2018).	%-points	DV			
System change performance	Energy demand reduction between 2005 and 2018 (FEC decrease relative to FEC in 2005).	%	DV			
System change performance renewable energy	Addition of new renewables between 2005 and 2018 (% added, relative to FEC in 2005).	%	DV			
Target ambition (renewables, efficiency)	Percentage reduction of final energy consumption from FEC 2005.	%	IV	Policy	Establishing a direction for change, higher ambition increases performance.	[32]
Measure density	Number of measures implemented to promote energy efficiency/renewable energy between 2005 and 2018.	No. measures	IV	Policy	More implemented measures increase performance.	[32,34]
Support for renewable energy	Renewables electricity support per unit of gross electricity produced (including bioenergy, geothermal energy, hydropower, solar, wind energy onshore, wind energy offshore) in EUR/MWh (mean 2014/2016).	EUR/MWh	IV	Policy	Reducing the risk of investment, more financial support increases performance.	[36,37]
Historical efforts	Share of renewable energy in FEC 2005. Energy intensity reduction between 2000 and 2007, normalized by FEC in 2000.	%	IV	System-internal context	Due to positive feedback from technical, economic and social systems, better performance in the past increases performance in the present.	[38–40]
Size of energy efficiency/renewables sector	Gross added value (GAV) of goods and services for heat/energy savings or production of renewable energy to GDP (mean 2010–2017).	%	IV	System-internal context	By realizing economic and industrial co-benefits and creating vested interests for both renewables and energy efficiency, performance increases.	[41,42]

Table 2. *Cont.*

Predictor	Description	Unit	Type	Group	Expectations	Literature Sources Expectations
Electricity share in final energy consumption	Share of electricity in final consumption (mean 2010–2018).	%	IV	System-internal context	A larger electricity share increases performance for renewables, while it decreases performance for energy efficiency. Countries with a higher share of electricity profit from electricity being a relatively easy and cheap option to decarbonize. The opposite is true for energy efficiency, where heat efficiency is cheaper; and fewer electricity efficiency measures exist.	[43,44]
Centralization of the electricity market	Market share of the largest generator in the electricity market (share of domestic generation, mean 2010–2018)	%	IV	System-internal context	For renewables, performance decreases with higher centralization, while for energy efficiency performance increases. Incumbents resist deploying renewables but are supportive of energy efficiency measures as a means of costs reduction and achieving a competitive advantage.	[45–50]
Technical potential (to expand renewables; to reduce energy intensity)	Technical–social potential (based on Tröndle et al.'s definition that defines an upper boundary to the electricity that can be generated in each administrative unit, reduced to the areas that are not socially and ecologically in use [51]) of solar PV and wind onshore and offshore (biomass and hydropower were exempt due to their comparatively small potential), as percentage of current generation (mean of annual generation 2005–2010). Energy intensity (mean 2005–2010).	energy per unit of GDP (mean intensity) und % of FEC 2005	IV	System-external context	Larger technical potential for both policies increases performance. Larger potential for renewables reduces land-use competition and local opposition to new infrastructure. Higher energy intensity suggests that countries can still profit from "low hanging fruits" of energy efficiency.	[35,52–54]
State affluence	Gross disposable income of households per capita (PPS) in 2015.	Index (European Union average = 100)	IV	System-external context	As states can spend more funds on energy/climate policies, higher state affluence increases performance.	[55–58]
Economic growth	Annual GDP change from previous year in percent (mean annual growth 2010–2018).	%	IV	System-external context	Because an increase in FEC outweighs deployment of RE and EE measures, economic growth decreases performance.	[59,60]

3.3. Data

All data used in this study are publicly available. We use 2005 as the base year, as determined by the EU for its climate and energy policy processes; for the energy efficiency effort before defining the 2020 targets, we use the pre-crisis period 2000–2007 so as to exclude the effects of the 2008 economic crisis on energy demand and energy intensity. For both renewable energy and energy efficiency, our analysis focuses on the implementation period 2010–2018; no comprehensive, official data were available for after 2018 at the time of writing in fall 2020.

Target data were collected from the most recent National Energy Efficiency Actions Plans (NEEAP) and National Renewable Energy Action Plans (NREAP). Targets in the Renewable Energy (RE) Directive are legally binding and have a fixed part for each country (pro-rata part), as well as a country-specific part. The pro-rata part is a 5.5% increase from 2005. The country-specific part is added to the pro-rata part, and is based on the following: a) efforts already made between 2002 and 2005 (if more than 2% increase, then the country-specific part is reduced by one-third) and b) a GDP per capita index, so that more affluent countries have a higher target [61]. In their NREAPs, Member States can adopt more ambitious targets than those agreed on in the RE Directive and 13 of 28 countries have done so, those are: Czechia, Denmark, Germany, Spain, Croatia, Lithuania, Hungary, Netherlands, Austria, Portugal, Sweden, Slovenia and Poland. Because the Energy Efficiency (EE) Directive is only indicative, Member States set their own Energy Efficiency targets, although the EU recommends the costs-effectiveness of measures and each Member State's ability to stem the necessary investments be considered [2].

To make them comparable components under the climate target, we convert both targets to energy-based metrics (Mtoe energy savings; Mtoe renewables deployment). As a first approximation, a saved Mtoe has the same effect on CO_2 emissions as a Mtoe replaced by renewables. We calculate the targets from the targeted FEC and targeted share of renewables in FEC, and calculate their difference made to the FEC in the base year 2005. In order to account for different system sizes, we normalize all targets with the FEC 2005.

We collect policy measure data from the IEA Policies and Measures Database on Energy Efficiency [62] and the IEA/IRENA Global Renewable Energy Policies and Measures Database [63]. These databases hold data that were actively gathered by analysts at IEA and IRENA, and stretch back to 1999. Other studies use data from the European Environmental Agency database on climate change mitigation policies and measures [64], which should be the most comprehensive data available, as they collect data directly from governments. However, Member State reporting only became mandatory in 2015, and the database is incomplete for before this date, as well as having no entries for Austria and Romania after 2015. As such, we use the IEA Databases for our analysis.

We compile performance data from the official Eurostat data, for all Member States. To measure performance, we use FEC data (for energy efficiency performance) and share of renewables in FEC (renewable energy performance). For both, we calculate the distance to the linear target trajectory (between base year 2005 and target year 2020) on average in the three years 2016–2018. This way, we measure not whether countries have met their targets, but whether they are on track for doing so; at the time of writing, the 2019 and 2020 data had not yet been published by Eurostat.

With the exception of 'spending on renewable support schemes' and 'technical potential', all data on 'system-internal and -external context' come from Eurostat [65–70]. Data for 'spending on renewable support schemes' was collected from the Council of European Energy Regulators in 2014 and 2016 [71,72]. For the renewable energy potential, we use the technical-social potential per country from Tröndle et al. [73], which estimates the highest possible amount of electricity that can be generated on land not currently in use or under environmental or military protection. We focus on the potential for PV, offshore and onshore wind power; as other solar energy applications (e.g., heat) compete with PV, and the potentials for biomass and hydro power are comparatively limited, this is a reasonable proxy for the renewable energy potential [73].

We measure state affluence as adjusted gross disposable income of households per capita in 2015, in purchase power standard (PPS), and economic growth as annual GDP growth. The size of the
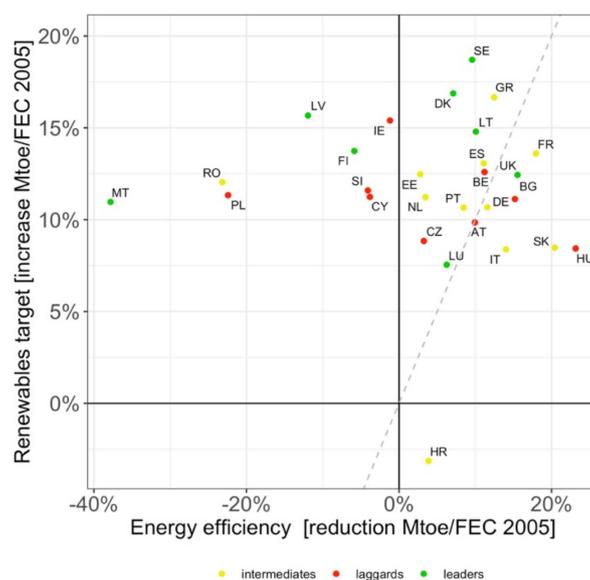
energy efficiency and renewable energy sectors, respectively, is measured as the percentage of gross added value (GAV) to the gross domestic product (GDP), provided by Eurostat [67]. We combine data for 'Heat/energy saving and management' and 'Management of energy resources' to measure the size of each national energy efficiency sector and GAV from the 'Production of energy from renewable sources', to measure the size of each national renewables sector. For the electricity market centralization metric, we use data on the market share of the largest generator in the electricity market [66].

4. Results

4.1. Policy Mix Prioritization

4.1.1. Agenda Setting

Figure 1 shows that countries tend to prioritize renewables over energy efficiency in the agenda setting phase. Of 28 countries, 13 have clearly higher ambitions for renewables than for energy efficiency, 9 countries show a roughly equal level of ambition, and 6 show a slight prioritization of energy efficiency. Only two countries (Hungary, Slovakia) clearly prioritize energy efficiency. We see that in particular 'climate leaders', prioritize renewables in their target ambition, while intermediates display similarly high ambitions for both targets.

Figure 1. Ambition of 2020 renewables targets and ambition of 2020 energy efficiency targets of all European Union Member States. Negative NEEAP numbers indicate a targeted absolute energy demand reduction. The dotted line indicates equal ambition for both policies; Member States to the right of the line have higher ambitions in energy efficiency. Negative efficiency targets indicate that countries plan to increase their FEC compared to 2005; negative renewables targets mean that countries plan to increase their energy supply faster than their renewable energy supply, based on expectation of economic growth.

Three observations are particularly important. First, the countries classified as climate leaders almost exclusively prioritize renewable energy over energy efficiency; the UK is the only exception with its roughly equal ambition. This suggests that "climate leaders" are, at least in Europe, in particular renewable energy leaders. The climate laggards, in contrast, also tend to have higher renewables than efficiency targets, but their ambition levels vary widely.

Second, we observe that the spread in ambition is much higher for efficiency (from 23% lower demand (Hungary) to 37% higher demand (Malta)) than for renewables (+7% (Luxembourg) to +18% (Sweden)). Very likely, the lower variance in renewables targets is in part tied to the stronger

formalization of the target setting process for renewables as a legally binding target, whilst there is no formal target setting procedure for the indicative energy efficiency targets. Nevertheless, we also note that the countries that increased their renewables target beyond the RE Directive requirements are not all in the upper part of Figure 1. Contrary to the intuitive expectation, increasing targets beyond the mandatory RE Directive requirement therefore does not appear to be the decisive factor behind higher ambition.

Third, although displaying average renewables ambitions, many Central and Eastern European states have low energy efficiency ambitions, aiming at increasing energy demand. On the one hand, this reflects an intention for rapid economic growth, such that their aim is to reduce energy intensity but not absolute energy demand. On the other hand, it also suggests that some EU10 Member States make use of the flexibility in energy efficiency target-setting to adopt less ambitious targets. Hungary and Slovakia are exceptions in that they set comparatively ambitious energy efficiency targets (while adopting minimum renewables targets, as does Czechia). This finding is in line with Ćetković and Buzogány's analysis, which shows that politically, Hungary and Romania are generally supportive of energy efficiency policy [23].

4.1.2. Formulation and Adoption

Figure 2 shows that EU Member States do not prioritize regarding their activity in formulating concrete measures. Most Member States implement more energy efficiency than renewable energy measures, but even so, countries that implement more measures for one policy tend to also implement more measures for the other. Overall, we find that the two policies are synergistic in terms of measure formulation and adoption.
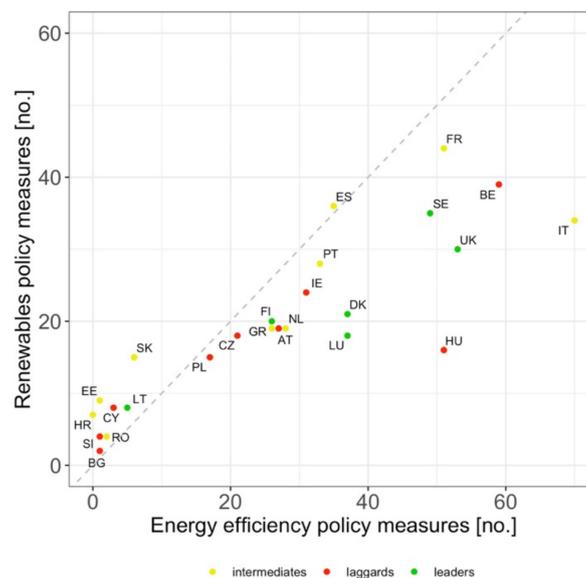
Figure 2. Number of new measures implemented for energy efficiency and renewable energy policies of European Union Member States, 2010–2018. If measures support both energy efficiency and renewable energy, we count them in both categories; transport policies are excluded in both categories. The grey dotted line indicates an equal distribution between energy efficiency and renewable energy measures. Due to missing data for energy efficiency, we exclude Latvia and Malta. Germany is outside the chart (34 renewable energy and 135 energy efficiency measures implemented).

In most Member States, the numbers for energy efficiency and renewable energy measures are approximately equal (Figure 2). Contrary to the agenda-setting stage, where there is prioritization in favor of renewables, countries, if anything, tend to prioritize the formulation/adoption of energy efficiency measures.

Newer Member States (EU10), especially in Central and Eastern Europe, are the least active in adopting measures, which is in line with the generally low-ambition targets found in the agenda setting. However, we find no clear pattern of "climate leaders" adopting more measures. Similarly, we find no indication of a correlation between higher target ambition and more measures—whereas countries with lower targets tend to also implement fewer measures, the opposite is not true; there appears to be no systematic relationship between higher targets and more measures.

4.1.3. Implementation

For implementation, we observe a slight prioritization in terms of target achievement—Member States reach their renewables targets more often than their efficiency targets—and find strong evidence that countries perform better on renewable energy deployment than energy demand reductions (Figure 3). Importantly, most (18) countries are on track to meet only one of the targets, whereas 10 are on track for both. In terms of system change, all countries perform at or below average in at least one policy; many laggard countries, mainly in Eastern Europe, perform below average on both. As such, we see weak prioritization in terms of target achievement and strong prioritization regarding system change.

In Figure 3a, we see that countries are somewhat more on track to reach their renewables (20 are on or above the linear trajectory) than their energy efficiency targets (15 countries are on or above track), indicating a slight prioritization of renewables in implementation. Many countries (11) are on track to meet both targets, among them the 4 intermediate countries Croatia, Italy, Greece and Romania, whereas 4 are not on track to meet any target. Again, we see that the leaders, except Malta, are all on track to meet the renewables target, but show substantial divergence in their energy efficiency progress. Intermediates, in contrast, tend to be on track to meet their energy efficiency targets (or are not far from it), whereas the laggards' target performances vary widely.

(**a**) (**b**)
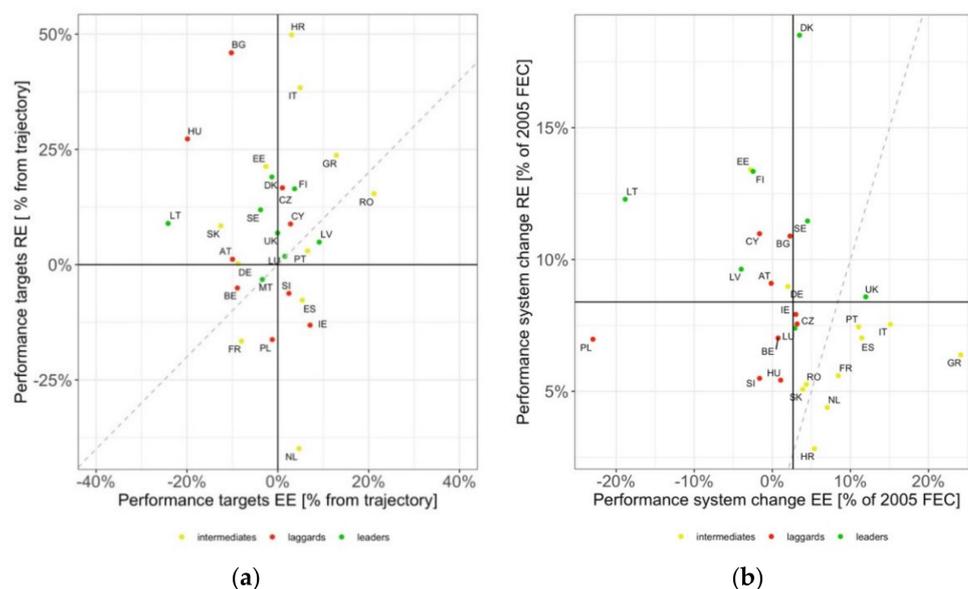
Figure 3. Performance towards 2020 targets as expressed in the 2017 NREAPs and 2017 NEEAPs, measured as the mean distance between 2016–2018 to a linear trajectory between 2005 and 2020 (**a**). Positive numbers indicate that countries are on or above track to meet the 2020 target. Performance as total deployed renewables (% of 2005 FEC) and total energy saved (% of FEC 2005) 2005–2020 (system change). The solid lines indicate average system change performance. Due to missing data we excluded Malta (**b**). In both panels, the dotted line indicates equal performance for energy efficiency and renewable energy.

When assessing performance not against targets but against system change, this division among leaders, intermediates and laggards is more pronounced (Figure 3b). In this sense, countries perform well either on energy efficiency (especially intermediate countries) or on renewables (especially climate leader countries). No country performs clearly above average for both policies; the upper-right quadrant of the average performance axis in Figure 3b is empty, but Denmark, Sweden and the UK are all just barely in this quadrant. This indicates that many Member States meet their renewables targets because they have low targets, not because they deploy many renewables. This applies particularly to the intermediate countries—most of them are in the top-right quadrant of Figure 3a, but all except one is in the bottom-right quadrant of Figure 3b. Most of the intermediate countries are Southern European countries, strongly affected by the Euro crisis; very likely, their energy demand decrease is caused also by the economic downturn. A decreasing FEC also "artificially" increases their renewables share, even without much deployment. On the other hand, this may be the result of political choice, which may for example originate from energy efficiency measures being cheaper than renewables [71]. We investigate both possibilities further in the next section.

The results of Figure 3b reject the climate leaders/laggards hypothesis: leaders do not perform well on both policies, but mainly or only in the renewables policy. Nevertheless, Member States in different categories show different performances—intermediates prioritize energy efficiency, leaders mostly prioritize renewables, and the laggards tend to perform below average, especially on renewables. Firstly, this indicates that countries which prioritize one policy, regardless of which one, tend to reduce their emissions more (most laggards do not prioritize). Secondly, this indicates that countries that prioritize renewables perform best in reducing their emissions.

4.2. Policy Mix Competition

The prioritization we observe in Section 4.1 may be caused by political competition between renewables and energy efficiency, or by other factors unrelated to direct political action. In this section, we test this with several multivariate linear regression models (MLR). Our final MLR models explain (adjusted R^2) 83% of the observed variation in system change for renewables and 68% of variation for energy efficiency (Tables 3 and 4). Regarding target performance (NREAP/NEEAP), our models account for 61% of the variation in renewables and 76% of the variation in energy efficiency (Tables 3 and 4). The remainders making up to 100% cannot be attributed to any systematic effects or predictors, but instead are attributed to other (in our models, unexplainable) factors. We excluded some of the potential predictors from the final models using variable selection (based on both stepwise selection and knowledge from the literature, see Table 2). By reducing the number of predictors, we increase the overall significance (F-test) of the models, avoid potential overfits to the current sample and increase generalizability. Predictors that do not increase the significance of our models, and hence do not explain performance, are not included in our models; these are omitted from Tables 3 and 4 below. All models are unbiased, i.e., residuals are 0 on average, normally distributed, homoscedastic, and there are no influential outliers. We use standardized estimates to interpret individual effects, but they are reported in different units, which makes direct comparison challenging. As such, we use std. Beta as a means of comparing between different effect sizes.

4.2.1. Renewables

We find that renewables performance, from both the system change and target achievement perspectives, is shaped by both political factors and system-external context variables (Table 3). Even though system external variables explain a big part of the performance variation in our model, policy variables also have a non-negligible explanatory value. Consequentially, the prioritization we observe above is in part attributable to competition, especially from the system change perspective, but also to a favorable economic context. Among all predictors, the system-external context variables technical potential and state affluence have the largest effect on system change; top performers are

generally more affluent and have a higher technological potential to build renewables, which allows them to progress faster.

Table 3. Predictors for renewable energy performance (system change and target performance) estimates including 95% confidence intervals.

Variables Group	Predictors	Unit	Renewable Energy System Change Performance			Renewable Energy Target Performance		
			Estimates	Std. Beta	CI	Estimates	Std. Beta	CI
	(Intercept)		−0.050 **	−0.000	−0.086−−0.013	0.166 *	−0.000	−0.017–0.349
Policy output	Measure density	total	−0.001 **	−0.359	−0.002−−0.000			
	Target Ambition (NREAP)	%	0.228 **	0.282	0.013–0.443	−2.676 ***	−0.697	−3.982−−1.370
	Spending on renewables support schemes	EUR/MWh	0.001 **	0.341	0.000–0.002	0.006 **	0.374	0.000–0.011
System-external context	Technical potential	%	0.018 ***	0.624	0.010–0.025	0.094 ***	0.699	0.045–0.143
	State affluence	total	0.001 ***	0.668	0.001–0.001			
	Observations		18			18		
	R^2/adjusted R^2		0.882/0.832			0.679/0.610		

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

System Change: Deployment of Renewables

Our model for system change performance for renewables supports several of our expectations in Table 2. Even though system-external factors are the stronger predictors, we find that policy variables nevertheless explain substantial parts of the variation, indicating that prioritization is partially attributable to competition.

In policy output, we find that the three potential predictors have a significant correlation with performance, although this is smaller than that of system-external predictors. Measure density has the highest effect compared to the other two variables, but with a negative sign. This suggests that the budgetary or administrative resources committed to a policy are more relevant for performance than mere numbers. Possibly, with an increasing number, policies draw financial and administrative resources from each other. Target ambition and spending on renewables both have smaller, but positive, effects: higher ambition and spending are both associated with a stronger deployment of renewables. Among the system-internal variables, we find no significant variable.

The system-external socio-economic context variables have, on their own and together, the strongest influence on system change. In line with our expectation, both their technical potential as well as their affluence positively influence countries' performances. That states with more financial capacity do support renewables, the deployment of which in the 2010s was still very subsidy-intensive, perform better makes intuitive sense. The fact that countries with a higher potential are generally more successful in deploying renewables is also unsurprising, but the size of the effect is, however, unexpected.

Target Achievement: Deployment of Renewables

Target performance is explained by only three of our potential predictors: target ambition, spending on support schemes and technical potential. Contrary to system change, state affluence and historical efforts are not significant predictors—as expected, because the minimum target ambition, as prescribed by the RE Directive, is determined based on these two factors (see Section 3.3). Our different findings for explaining system change performance and target performance are thus the result of the target-setting procedure itself.

In policy output, we find that target ambition has a comparably strong negative effect on performance. This indicates that countries with higher targets reach their target less often. This is a key

difference in the deployment of renewables ("system change")—higher targets are associated with more deployment, but it is harder to reach a higher target. Countries with low targets, in contrast, meet and overshoot their low-ambition targets more easily, although they deploy less renewables. Finally, spending on renewables support schemes, while significant, has about half of the effect on performance compared to ambition, indicating that paying more increases deployment, but not very strongly.

Among the system-external variables, we find that technical potential has an effect which is of equal magnitude to target ambition—countries with higher technical renewables potential reach their targets better.

4.2.2. Energy Efficiency

Our models explain energy efficiency performance based on three main variables—historical efforts, market centralization and economic growth—each to roughly the same degree. Target ambition is the only significant policy output variable, and only in the system change model. Similarly to renewables, the prioritization we find in Section 4.1 is likely the result of a combination of both political competition and favorable economic context; in this case, economic decline had a particularly strong impact on energy demand. Nevertheless, political action, directly through policy and indirectly through shaping the system-internal context, plays a substantial role in explaining performance variations. As such, the observed prioritization is partially attributable to competition.

Table 4. Predictors for energy efficiency performance (system change and target performance) estimates including 95% confidence intervals.

Group	Predictors	Unit	Energy Efficiency System Change Performance			Energy Efficiency Target Performance		
			Estimates	Std. Beta	CI	Estimates	Std. Beta	CI
	(Intercept)		0.087 **	0.000	0.008–0.165	0.292 **	−0.000	0.056–0.528
Policy output	Measure density	total				−0.001	−0.279	−0.002–0.000
	Target Ambition (NEEAP)	%	0.556 ***	0.798	0.257–0.854			
System-internal context	Historical efforts	%	−0.776 ***	−0.798	−1.306–−0.246	−0.642 **	−0.734	−1.131–−0.153
	Market centralization	%	−0.098	−0.261	−0.228–0.032	−0.182 ***	−0.534	−0.275–−0.088
System-external context	Economic growth	%	−7.186 ***	−0.794	−11.454–−2.919	−5.132 **	−0.630	−9.169–−1.095
	State affluence	total				−0.001	−0.330	−0.002–0.000
	Observations			18			18	
	R2/R2 adjusted			0.761/0.687			0.834/0.765	

$** p < 0.05, *** p < 0.01.$

System Change: Reduction of Consumption

The three predictors target ambition, historical efforts and economic growth have similar effect sizes, but with varying direction. The substantial effects of target ambition and historical efforts on performance suggest that prioritization is in part attributable to competition.

For policy output, we see a similar effect as for renewables: higher target ambition drives stronger reduction of energy demand. This indicates that performance is shaped in part by political action, and that observed prioritization is partially attributable to competition.

In the system-internal context, only historical efforts are significant; countries that have previously performed better continue to perform better (here negative, because we are measuring reduction in energy intensity, therefore the larger the reduction in energy intensity the better states perform). As such, energy efficiency improvements are path-dependent. Here, the largest reduction in energy intensity between 2000 and 2007 can be found among Central and Eastern European countries; the continued

above-average performances of these countries may be explained by the countries' lower marginal costs in achieving energy efficiency gains, and a relative decoupling of energy demand and economic growth.

Finally, for system-external context, we see a strong, negative correlation between demand reduction and economic growth—a 1% mean annual decrease in GDP leads to a 7% increase in performance. This effect is clearly visible also in Figure 3b—the countries hardest hit by the Euro and financial crises are among those that perform best, suggesting that not only do polices trigger energy savings, but so too do regional economic and industrial downturn.

Target Achievement: Reduction of Consumption

In our model, only the context predictors significantly explain target performance. Again, the relatively large effect of system-internal context suggests that target performance is dependent upon political action and prioritization in part attributable to competition. One policy output predictor—measure density—is included due to its contribution to larger model significance (F-value), but it has no significant effect on target performance. Other than in the renewables models, including target ambition did not improve model significance, implying that there is no correlation between target level and energy efficiency target achievement. It is likely, this is related to certain randomness in the energy efficiency ambition, as targets are non-binding, and there is no formal target-setting procedure. Some governments additionally changed their targets within the implementation period, likely also to avoid failing to achieve or strongly overshooting them, and our analysis uses not the initial but the most recent targets.

The system-internal context explains much of the effects on target achievement. Just like for system change, more historical efforts in reducing energy intensity, i.e., a more negative predictor, have a positive effect on target performance. However, in this model, market centralization does too, but with a negative effect. Possibly, higher market power leads to stronger opposition against energy savings measures in more centralized markets.

Finally, economic growth has an effect, as part of countries' system-external contexts—a decrease in GDP leads to a very strong increase in performance. This again highlights that performance in energy efficiency is to a large extent the result of economic decline.

5. Discussion

In this paper, we find clear evidence for prioritization in target-setting and policy implementation, and some evidence of policy competition between renewable energy and energy efficiency policy in European Union Member States.

Our analysis provides clear evidence for policy prioritization. First, and most importantly, we show that countries generally perform well in one of the two policies, but rarely in both. Second, countries tend to set more ambitious renewables targets, indicating that this is the key area in which they seek to advance their climate protection progress. As higher targets are linked to stronger system change—more renewables deployment, more energy savings—countries tend to progress more in the renewables policy than in efficiency. Interestingly, we find that higher targets lead to stronger system change, but worse target performance: a higher target is associated with more activity, but it is also harder to reach it.

Further, we find no clear evidence of a division into climate leaders and laggards, where leaders successfully integrate the two policies and laggards fail to successfully implement either one. Our results instead show that countries classified as leaders tend to perform well in renewables, but not in energy efficiency. The Member States classified as intermediates perform better in energy efficiency and, although the variation is large, the laggards tend to perform less well on both parameters. In addition to a more nuanced view on leader/laggard classifications, this suggests that countries strategically prioritize either renewables or energy efficiency as the centerpiece of their decarbonization policy.

We find some evidence for policy competition. For both energy efficiency and renewable energy, performance is explained by a combination of policy output and system-external variables, as well as

system-internal variables in the case of energy efficiency. In all areas, performance depends strongly on system-external context variables, such as state affluence (renewables) or economic growth/decline (efficiency). This shows that performance is not only driven by political action but rather by factors outside of governments' political influence. Nevertheless, a substantial part of the prioritization is attributable to political action, suggesting a political choice—and hence policy competition—between the two policies.

In addition, we find clear evidence that countries prioritize, mainly in favor of renewables, when setting their targets, also going beyond what is required of them by the European Commission, suggesting that energy efficiency and renewable energy compete for political attention in the agenda-setting stage.

Further, for both policies, we find that the policy cycle stages are not directly connected. Whereas targets and performance correlate for both renewables and energy efficiency (higher targets are associated with stronger system change performance), there is little or no connection between target ambition and measure density, or between measure density and policy outcome—countries with more measures do not perform better, or worse, suggesting that the stages of the policy cycle are not directly connected. Possibly, this is an artefact of the material difference of the two fields—"energy efficiency policy" refers to a very large range of products and sectors, from buildings to loudspeakers, whereas "renewables" include mainly electricity and heat. Nevertheless, this finding casts doubt on the usefulness of measure density measurements as a proxy for policy ambition and commitment.

Our findings come with two important caveats. First, our findings are based on a sample of European Union Member States. Whereas we are confident that the sample does not strongly affect the finding and that it applies to all EU countries, we do not know whether it is generalizable outside Europe. We call for further research into the issue of policy competition in the energy and climate field, and also for other countries. Second, our analysis investigates trends across European countries but ignores country-specific conditions (formal and informal institutions, history and general, including ideological, views on climate and energy policy) which are known to shape national climate and energy policy [48,74–77]. Additionally, here, we call for further research on the role of the political context and how it shapes policy priorities in different countries.

We find three implications of particular importance for European climate and energy policy. First, as mentioned above, we see that countries that set higher targets also tend to deploy more renewables and reduce their energy demand more. This suggests that targets matter, even if they are not always met, as they are more than external signals but actually signify what countries intend to do. Against this finding, the debate about increasing the European 2030 climate targets becomes even more salient; targets are more than mere declarations of intent, and are associated with more activity. Because the target structure for 2030 has changed, in that renewable energy targets are no longer legally binding on a domestic level but only the EU level, it remains to be seen how those targets trickle down to national targets, and whether this changes their directional force.

Second, our findings suggest that the COVID crisis is indeed a good time for renegotiating and tightening the energy and climate targets in the European Union, especially for energy efficiency. In terms of the broader economic context, the 2020s began in a similar way as the 2010s: with a major economic crisis. Anticipating a continued economic downturn, our findings suggest that energy demand will likely decrease in 2020 and subsequent years, so that much progress towards the 2030 energy efficiency targets may be "automatic". At least in the initial recovery packages, European countries and the Commission have earmarked substantial funds for green investments, including both efficiency and renewable energy policies [78]. As the main aim of these recovery packages is to increase economic growth, there is a risk that energy demand will increase again as the economy recovers. This reinforces the importance of the European 2030 target increase—it may be important to tighten targets and reinforce political action to avoid an energy demand and emissions rebound effect as economies recover in the coming years.

Finally, as anticipated by the EU and shown in previous research (Table 2), higher state affluence is associated with better performance in renewables deployment. However, as the costs of renewables continue to decrease [79], there is an opportunity to decouple state affluence from performance in deploying renewables in the 2030 target period: as renewables become cheaper than conventional energy, poorer countries should increasingly shift investments towards renewables. During the economic downturn in the COVID crisis, such decoupling may be necessary to keep and increase the renewables deployment pace towards the 2030 targets.

While the key contribution of this paper is empirical, our findings allow for three theoretical contributions. First, we show that there can be competition not only between policy areas, such as for example social and climate policy, but also within a policy field—here, two policies within the climate and energy field to some extent compete. Second, we show that countries tend to prioritize either renewables or energy efficiency, so instead of being viewed as "climate leaders or laggards", they are leaders or laggards in one policy only. Third, we provide evidence of a disconnect between the stages in the policy cycle, supporting previous findings by Knill et al. [34,80].

6. Conclusions and Policy Implications

Our analysis shows that European Union Member States tend to prioritize within the climate and energy policy agenda. Most countries set more ambitious targets for renewables than for energy efficiency. Most importantly, we show that most countries perform well in one policy, but rarely in both. Our multivariate analysis shows that although much of the difference in performance can be attributed to policy-external factors, the observed prioritization is associated with differences in policy efforts and ambition. As such, the two policies are not synergistic, but to some extent compete with each other.

This observation of prioritization and (limited) policy competition has implications for European energy and climate policy making. Our findings show, in addition to the prioritization and competition, that the decreasing energy demand in many Member States is mainly a result of economic crisis rather than policy action. Therefore, the prioritization of energy efficiency measures offers a loop-hole to formally fulfil European climate target obligations, but without undertaking particularly strong policy measures. Nonetheless, we also show that targets matter—higher targets are associated with faster system change. As the European 2030 and 2050 climate targets are stepped up, either the energy efficiency or the renewables target, or both, must be raised substantially to incentivize and force Member States to step up their actions. In the efficiency field, to be helpful for the aim of full energy decarbonization, such efforts should aim to decouple energy efficiency from economic growth cycles; if this is impossible or not desired, countries may consider refocusing their efforts even more towards renewables. Two arguments speak in favor of the latter, "renewables first", strategy. First, with falling prices for the deployment of renewables, the deployment of renewables can be decoupled from state affluence, which has been an important policy-external predictor of renewable energy progress in the past. Second, the deployment of renewables targets is the only strategy that will bring EU carbon neutrality by 2050: for the climate, the amount of carbon emitted, not the amount of energy consumed, is the relevant parameter [11]. From that, it follows that the EU's strategy of "energy efficiency first" [81] is not necessarily the most effective policy approach to eliminate CO_2 emissions from the energy sector.

Appendix A. Leaders/Laggards Division

Table A1. Division from the climate performance index. Countries with >60 index points were categorized as leaders, countries with 60 to 47 index points as intermediates and countries with <46 index points as laggards.

Country	Index Points	Group
Sweden	75.77	Leader
Denmark	71.14	Leader
United Kingdom	69.8	Leader
Lithuania	66.22	Leader
Finland	63.25	Leader
Luxembourg	60.91	Leader
Malta	60.76	Leader
Latvia	60.75	Leader
France	57.9	Intermediate
Croatia	56.97	Intermediate
Germany	55.78	Intermediate
Romania	54.85	Intermediate
Portugal	54.1	Intermediate
Italy	53.92	Intermediate
Slovakia	52.69	Intermediate
Greece	52.59	Intermediate
Netherlands	50.89	Intermediate
Estonia	48.05	Intermediate
Spain	46.03	Intermediate
Belgium	45.73	Laggard
Austria	44.74	Laggard
Ireland	44.04	Laggard
Czechia	42.93	Laggard
Slovenia	41.91	Laggard
Cyprus	41.66	Laggard
Hungary	41.17	Laggard
Bulgaria	40.12	Laggard
Poland	39.98	Laggard

Appendix B. Country Sample MLR

Table A2. Overview of countries in our sample for the MLR. Missing countries were excluded due to missing data on the 10 independent variables. Our sample contains 18 out of 28 countries.

Country	In Sample or Excluded due to Missing Data
Austria	In the final sample
Belgium	In the final sample
Bulgaria	Missing data
Cyprus	Missing data
Czechia	In the final sample
Germany	In the final sample
Denmark	In the final sample
Estonia	In the final sample
Spain	In the final sample
Finland	In the final sample
France	In the final sample
United Kingdom	In the final sample
Greece	Missing data
Croatia	In the final sample

Table A2. *Cont.*

Country	In Sample or Excluded due to Missing Data
Hungary	Missing data
Ireland	Missing data
Italy	In the final sample
Lithuania	Missing data
Luxemburg	Missing data
Latvia	In the final sample
Malta	Missing data
Netherlands	Missing data
Poland	In the final sample
Portugal	In the final sample
Romania	In the final sample
Sweden	In the final sample
Slovenia	In the final sample
Slovakia	Missing data

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