

Are the EU climate ambitions reflected on member-state level for greenhouse gas reductions and renewable energy consumption shares?

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ABSTRACT

The aim of this paper is to review the objectives to mitigate greenhouse gas (GHG) emissions and to increase the renewable energy share (RES) in gross final energy consumption from the European Commission (EC) and the related member state contributions to reflect their consistency. Therefore, a base year correction is applied and the impact of every country is derived with the help of a weighting process. As a result, the Effort Sharing Regulation (ESR) of 2018 results in a negative target gap of −11%, while the proposal from 2021 can either decrease the GHG deviation to −5% or fulfill the objective. Though some countries have consistent targets, the annual GHG reduction rate of the EU has to be tripled up to −3% per year until 2030. The required objective for RES is achievable but the growth rate has to be increased to 2% to fulfill the announced ambitions by 2030. Finally, if the most ambitious option in the proposed directive is chosen, only eight member states have consistent efforts aligned with the Nationally Determined Contribution (NDC) target.

1. Introduction

The climate crisis effects different stakeholder groups with consequences and changes within their environment [1]. Each group has to act and implement measures to reduce the emissions of anthropogenic GHG. Nations are working on climate policies and laws to secure a decarbonized transition of the industry and private sectors. Several states announced commitments for reductions and claims, for example a net-zero neutrality of their country, or even implemented direct climate laws [2]. Moreover, they use policy instruments like technology restrictions [3,4] or oblige public and private sectors to be involved in the coverage of requested investments to ensure the transition process [5]. Between regions, different approaches and ambition levels can be discovered. Targets like NDCs set by government decisions [6] or goals on city level [7] can be found in order to limit carbon emissions for the main sectors of contribution: for energy generation and supply, buildings, agriculture and forestry, industry and transport.

Decarbonization scenarios (e.g. IEA APS, STEPS) [8] and grid mix projections [9] rely on announced pledges or stated policies from governmental institutions to model future developments for emission reductions and the extension of renewable energies. Since these models are used for strategic decisions on company level or linked policy

implications, it is necessary to review the backing of the EC by member states to estimate the fulfillment of the announcements [10]. Based on the different European climate legislations and released proposals, this paper deals with the comparison and analysis of the 2015 and 2020 NDC of the EC along with national targets and commitments for GHG mitigation within the ESR as well as the RES in the gross final energy consumption. To derive existing risks and opportunities (for e.g. corporate plans or actions) in the EU due to the member state efforts on overall GHG and RES ambitions as well as the appropriate development through the years, the objectives of this paper are: (1) the comparison of the targets from the EC and their member state contributions regarding their consistency (differences, deviations), (2) the examination of the equal target distribution regarding their emission responsibility under consideration of the declared mechanisms, (3) the derivation of a projection based on growth rates and the fulfillment status in 2019 regarding their ability to reach their announced objective based on the historic and current progress and (4) the classification of member state targets regarding their impact on overall EC target-level.

To meet the research goals, the paper is structured as follows: After the introduction to the topic of governmental climate policies and the research objective, key terms of the European climate policy are defined in the background information and a literature analysis is conducted

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(section 2). Then, the methodology is presented (section 3). Afterwards, the results, based on the analysis of the comparable target data, are shown in section 4. Beginning with the findings for the GHG policies and followed by the outcomes of the RES in gross final energy consumption, the member states are compared and classified. Finally, the insights are discussed (section 5), and concluding remarks are made (section 6).

2. Background

In preparation for the COP 21 in Paris 2015, the EC and the member states (European Council) reached an agreement on the first NDC, which had the aim of a -40% reduction on emissions by 2030 based on 1990 levels [11–13]. The agreement was the update of the previous program 20-20-20 by 2020, released in 2008, where the goal was to reduce emissions by -20% and increase energy efficiency and the RES by 20% until 2020 [14–16]. Moreover, due to the fact that historically more than 75% of all emissions are energy related [17], the increase of the RES for the gross final energy consumption was set to 32% [18]. Nowadays, the old GHG value is substituted by the new target of -55% based on the Green Deal at the end of 2020 and the RES target of 40% [19,20]. In order to fulfill the limits for the emitted GHG emissions the EC passed the European Climate Law [19], which is based on two main instruments: The European Trading Scheme (ETS) and the Effort Sharing Legislation (ESL). The ETS is a cap-and-trade mechanism for emission allowances in order to cut the emissions of the energy, industry and air transport sector, covering 45% of the European emissions [21]. The Effort Sharing Regulation as part of the ESL operates on the other half of the GHGs (55%) with the focus on the transport, building and agriculture sector as well as small industrial installations [22]. Therefore, each member state commits to a certain reduction level for their country as a contribution to the EU target. Historically, the announced ESR values from 2018 were meant to be in line with the NDC from 2015 (-40%), where the ETS aimed at a mitigation of -42% and the ESL of -29% (compared to 2005) [23]. The proposed ESR, which was released in July 2021 as part of the approach “Fit for 55”, is in line with the updated NDC of -55% GHG emissions compared to 1990. It aims at a reduction of -40% from 2005 levels. Furthermore, the ETS (-61%) shall be extended to all sectors [24,25]. In 2019, the EU emitted around 4 GtCO_{2eq} reducing the emissions by 1% in comparison to 2018 [26]. Based on different scenarios the remaining EU carbon budget equals 50 GtCO_{2eq} to limit global warming to 1.5 °C and around 90 GtCO_{2eq} for 2 °C from 2020 to 2100 [27].

Analyzing the consistency of objectives and frameworks within the EU relates this paper to different studies published in the field of policy reviews. Zell-Ziegler et al. (2021) using a systematic document analysis to review the sufficiency of nations regarding their environmental planning. Thereby, they identify that the National Energy and Climate Plans (NECP) and long-term strategies of the 27 European member states only result in an emission reduction of 41% and therefore require more ambitious policies and commitments to fulfill the European NDC [28]. Moreover, Williges et al. (2022) review NECPs of selected countries to assess the use of technologies regarding their environmental effectiveness and feasibility. Consequently, the plans could be less impactful or reduce the public acceptance in the present elaboration [29].

In addition, the governmental engagement for climate protection of cities in Europe is analyzed. Heidrich et al. (2016) evaluate cross-national policies of over 200 cities in order to state that cities look for superordinate guidance to align with national and international requirements [30]. Rivas et al. (2021) show that hundreds of cities, which are accepted in the Covenant of Mayors Initiative, are involved in climate protection but their ambitions differ widely based on their geographical location. However, reduction targets reaching or exceeding EU climate targets are already present [31]. Complementing this examination, Salvia et al. (2021) found that the average mitigation target is at -47% in GHG emissions for cities with own climate plans [32].

Graichen and Jörß (2017) conducted a comparison of the legislative proposal of the EC, Council and the European Parliament regarding the ESR 2018. Reviewing the member state contributions they determined significant deviations between the efforts in both proposals and the amendments leading to an unfulfilled emission reduction target in 2030 ($-38,7\%$ to -40% (NDC 2015)) [33]. Later, Meyer-Ohlendorf et al. (2018) reviewed the GHG budget as well as the climate policy architecture of the EU. Thereby they examine the required reduction pathways to align with a 1.5° budget and use these to determine reduction targets for the ETS and ESR for equal distribution and asymmetric efforts [27].

Lastly, Fotis et al. (2017, 2018, 2020) used empirical models to review the relation of renewable energy, economic growth and environmental policies regarding sustainable development. Revealing that GHG emissions are positively affected by GDP and negatively by renewable energies [34], leads to the requirement of increased capacities for renewables to align with policy objectives [35]. Moreover, a reduced dependency of energy imports is required for sustainable progression [36].

3. Methodology

To fulfill the research objectives, the paper follows the methodological procedure shown in Fig. 1. For the examination, the published data on state and commission level for targets and commitments are gathered (1). Therefore, the NECPs from each member state, the EC directives regarding the RES and the climate law as well as the regulation proposals regarding the binding annual GHG emission reductions by member states from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement are used. Besides the collection of the announced objectives, the current and historic GHG emission values for all member states, emission sectors and time periods from 1990 to 2019 are collected from the European Environmental Agency database [26]. Moreover, the RES in gross final energy consumption is gathered [37,38]. With the help of these statistics, the base year correction for GHG reduction contributions is performed (2). Based on equation (1), each ESR member state target to reduce the related emissions with a reference year based in 2005 is converted to 1990 to align the subordinate contribution with the top-level objective of the EC (NDC 2020). Considering that the reduction targets imply a fixed boundary for the allowed annual GHG emissions of each country, this limit can be transferred to 1990 with the required relative reduction to achieve the announced GHG reduction amount in 2030 (normalization). Thereby, only the ESR covered sector emissions are used. After the database is created, the comparison can be conducted (3). Then, the differences and deviations of the set values for future GHG emission reductions and RES in gross final energy consumption are calculated. The next step of the comparison deals with the determination of the member state impact based on their deviations in relation to the EC goal. Based on a weighting process, where the deviation is set into relation to the EC commitment, the impact of each member state target fulfillment status is calculated analog to equation (2). Therefore, the computed difference of the objective and the EU NDC is put in relation to the share of each category (GHG or RES). As a result, a map of the EU is illustrated depending on the member state deviations highlighting the entire development regarding gaps and necessary progressions to secure the achievement of the objectives.

The third research objective is to examine the distribution of the

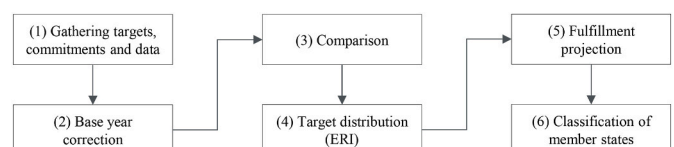


Fig. 1. Methodological procedure.

member state contributions compared to their annual emitted emissions to review an alternative allocation mechanism. In the valid ESR directive, the member state efforts are balanced based on the GDP of each country to allow the reduction of economic inequality (section 2). Nevertheless, this approach has to cover the entire GHG emission reduction of the EC. To review the distribution process from a new perspective, the emission responsibility index (ERI) is implemented with the help of equation (3) (4). Thereby, the main goal is to verify the covered proportions of each country for emission cutting. It relies on the ESR and NDC target as well as the corresponding emission shares and is used to revise the relation of committed efforts by member states and the accruing responsibility of the released GHG. If a value is equal or higher than 1, a country manages a reduction target that is at least equal to their annual local emission production. Moreover, the surplus can be used to balance the undercuts. If the number is below 1, regions are contributing less effort to the goal of the EC than they are emitting. In total, the sum of all country specific ERIs has to be 1 to cover the proposed member state contributions for the EC target. Next, the deviation value regarding the already achieved growth, which can be computed by equation (4), is relevant to identify the reduction effort that has to be made in the next years. It is determined by the difference of the already accomplished progress in relation to the missing amount for the upcoming years. In addition, the fulfillment status from 1990 to 2019 is used to measure the advancement from the base year of emission accounting to today, to determine the remaining gap to achieve the 2030 target and derive requested and historic growth rates to project future developments (5). Afterwards, the analysis of the created results is used to classify the effect of each country on the EC target (6). Based on the combination of the results a portfolio analysis is created, showing the changes within the valid commitments from the ESR by 2018 and the proposed adjustment options from July 2021. Thereby, a country has a consistent state if both contributions are in line with the target, inconsistent if one category effort is deviating and highly inconsistent if both commitments negatively impact the EC ambitions.

4.1. Commitments and member state impact

4.1.1. Greenhouse gas emissions

The first objective of this paper aims on the comparison of the national contributions with the EC targets. Therefore, an overview of the member state targets for the valid ESR option and the proposed ones, categorized by three gradations, is shown in Fig. 2. The member state efforts (ESR 2018) with the original reference year of 2005 vary from 0% to the maximum amount of −40%. Correcting the base year for the reduction effort to the NDC level (1990), the range changes from minimum +26% (increase of emissions) to −57%. Comparing the 2018 ESR numbers, which were meant to fulfill −30% (1990), to the current aim of −55% to review the historic consistency of the ESR progress shows that some countries correspond or even overfulfill the required goal but 13 nations have contributions below the requested GHG reduction share covered by the ESR sectors.

To adjust this circumstance, a proposal to raise the state efforts (EU27) was announced in July 2021 [24,25]. Consequently, the contributions can be put in relation to the current −55% NDC target with a specific reduction share for the emission sectors covered by ESR. Since there are two options for each country, one can differentiate between option 1 (−40%) and option 2 (−35%), where the range for emission reduction can be distinguished between −10 and −50% (1) and −5 to −45% (2). However, both variants are suggestions from the EC for the member states and the overall reduction target can be reached with different configurations of measures and commitments. For both, GHG emission reduction numbers increase for every country compared to the previous ones, but still not every target is on the required level and up to five countries are allowed to increase emissions. When the base year is set to 1990, the contributions vary resulting to the highest relative emission reduction in Estonia (−63 resp. −60%) and the smallest change in Portugal (+9 resp. +17%). It can be stated that the five highest emitting countries reduce their target discrepancy, but the number of states that are above the required reduction level is not increasing rapidly (from 11 to 13 (option 2) to 15 (option 1)).

$$ESR\ Target_{1990} = 1 - GHG\ emissions_{2005} * (1 - ESR\ Target_{2005}) / GHG\ emissions_{1990} \quad (1)$$

$$Weighted\ Target\ Deviation = (GHG\ emissions_{1990} * (1 - NDC_{2020})) - (GHG\ emissions_{1990} * (1 - ESR\ Target_{1990})) / Total\ GHG\ emissions_{1990} \quad (2)$$

$$Emission\ Responsibility\ Index = ESR\ Target_{1990} * GHG\ emission\ share_{1990} / NDC\ Target_{2020} / GHG\ emission\ share_{2005} \quad (3)$$

$$Deviation\ Value = GHG\ emissions_{2019} - (GHG\ emissions_{1990} * (1 - NDC\ Target_{2020})) / GHG\ emissions_{2019} \quad (4)$$

4. Results

The analysis of the different ambition levels on state and EU level is based on the current approved directives and guidelines represented by the ESR from 2018 and the NDC of the EC from 2020. Moreover, the recently announced proposal “Fit for 55” from July 2021 to adjust the ESR from 2018 to achieve the NDC is reviewed to consider the submitted changes. In addition, the adaptations for the RES are illustrated. Consequently, each subchapter deals with one objective of the paper. To maintain a clear overview the five biggest emitters of the EU27 as well as the extrema are highlighted [26].

Next, to prepare the classification of member states in section 4.4 as fourth objective of this paper the different targets and their adjusted proposals that are currently in discussion for each member state can be set in relation to their impact on EC level. Based on the found differences within the contributions, every target deviation sums up to a missing progress to the overall EC NDC. For this reason, the present target differences are weighted. The evaluation of the valid objectives (NDC 2020 and ESR 2018) is illustrated in Fig. 3 (left) (Appendix: Table 5). All member states of the EU are categorized analog the results of previous actions. Thereby, a country can either have a target impact that is consistent or inconsistent with the required contribution shares of the ESR. It can be noticed that some high target differences (e.g. Malta) have a low effect on the total target fulfillment of the EC due to their small absolute size. In contrast, the deviations of the higher GHG contributors, such as Italy or Spain, have a higher lever on the total target level. All in all, the aggregated deviations have to be balanced by overfulfillments from member states with higher impacts. If the ESR

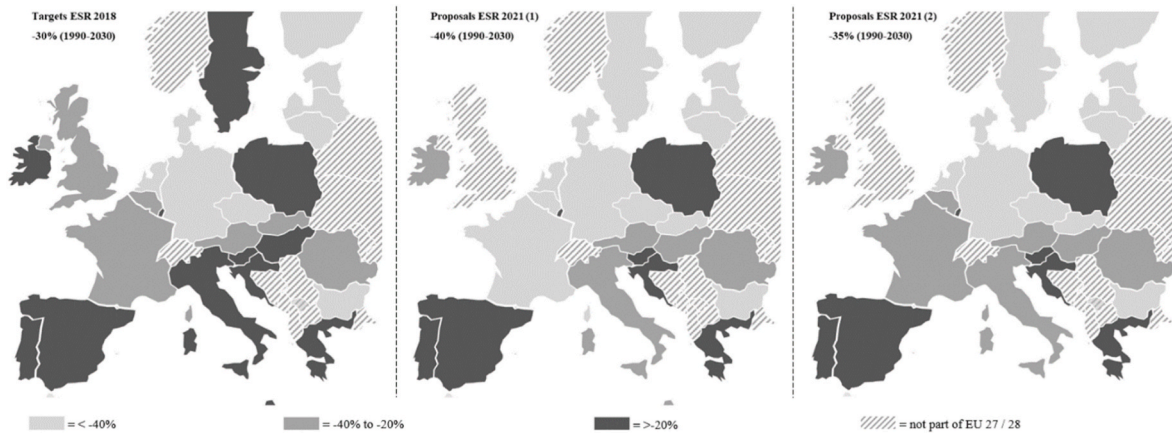


Fig. 2. Valid member state contributions (ESR 2018) and proposed options for member state contributions (ESR 2021).

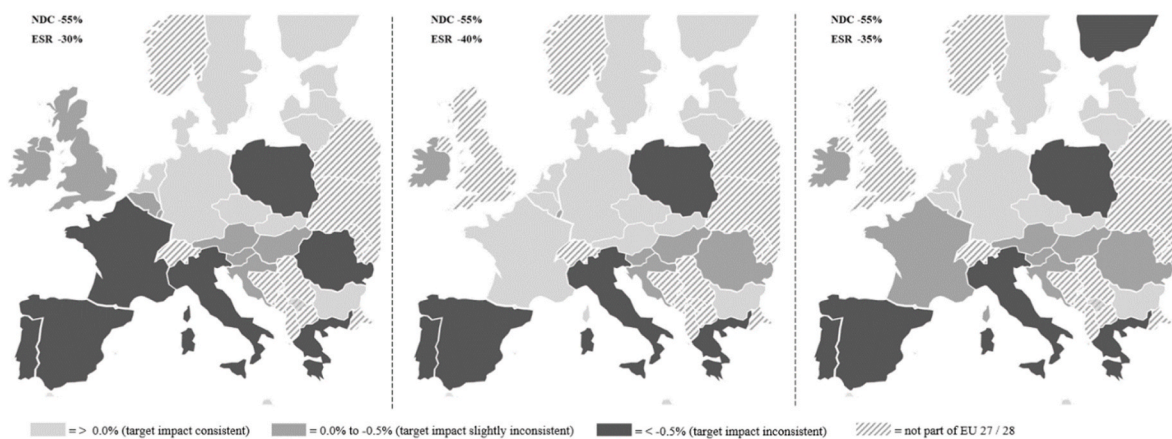


Fig. 3. Weighted deviations of EC NDC with valid member state contributions (ESR 2018) and contribution proposals (ESR 2021).

2018 numbers are set in context with the tightened NDC, with a required reduction share of -40% for the ESR, an overall deviation occurs equal to -11% . In this case, 13 countries of the European Union set higher contributions than required, but based on their GHG emission shares those extensions have a low impact on the total fulfillment status of the EC. In contrast, weighted member state efforts from France, Italy and Spain lead to a higher deviation due to their undercutting contribution. As a result, the negative discrepancies cannot be covered entirely.

The proposed adaptations of the ESR lead to a shift. The images (Fig. 3) illustrate the relation of both ESR contribution options from 2021 to the aligned NDC. Neither the weighted deviations of the single states nor the overall progress stays the same in both options. The range of direct impact on the aspired emission mitigation varies from an underperformance of -2.2% / -2.6% in Spain to $+4.4\%$ / $+3.2\%$ in Germany for option 1/2. For Germany, it can be observed that a raise of 5% in the contribution level (base year 2005) can lead to an impact difference of 1.2%. In the combination of option 1, more than half of the EU member states have a consistent target impact and can rebalance the weighted differences from the deviating states. In option 2, the 14 consistent countries are not able to ensure the achievement of the EC ambition. Consequently, the commitments can either lead to a fulfillment of $+1\%$ (option 1) or to a deviation of -5% (option 2) regarding the EC ambition level (NDC 2020).

4.1.2. Renewable energy share in gross final energy consumption

Also, the EC updated the Renewable Energy Directive (RED II), which equals a share of 32% of RE for gross final energy consumption by 2030 [18]. With the release of the proposal for “Fit for 55” of the EU in

July 2021, a raise of the RES up to 40% was presented (RED III) [19,20]. In order to analyze the collected data, no further adjustments for comparability have to be conducted. Analog to the GHG reduction targets, the goal has to be reached based on collaboration of each country. Regions that are more suitable for the use of renewable energy based on their geographical profile or their higher economic and financial development have to step in for those states that have not [39].

Consequently, not all targets have to be in line with the objectives of 32% (2030) and 40% (2030 proposal). The valid targets, which match with the 32% RES, vary from minimum 12% up to a maximum value of 65%. The adjusted numbers propose to increase the level of RES from at least 27% up to 71% to be consistent with 40% RES. It can be noticed that 13 countries set their limit for the current RES higher than requested (e.g. Spain). Also, for the proposal of 2021, eleven states exceed the necessary goal. In contrast, some governments such as Germany, Italy or Poland committed a smaller goal for the RES. To review the balancing mechanism and the effort distribution, the target difference is weighted based on the RES in gross final energy consumption in relation to the overall share and consume of the EU. The European Union is illustrated by Fig. 4 (Appendix: Table 8), which shows the weighted deviations between targets and proposals from member states and the EC. The two scenarios of ambition levels are comparable and similar to the classification of countries for their GHG emission reductions. The states are categorized by their target consistency based on their impact to the EC objective. In contrast to the GHG emissions, the map shows less inconsistent states than (closely) consistent areas, which indicates target consistency to achieve the EC goals. However, one can observe deviations in central Europe, mainly represented by Germany and Poland.

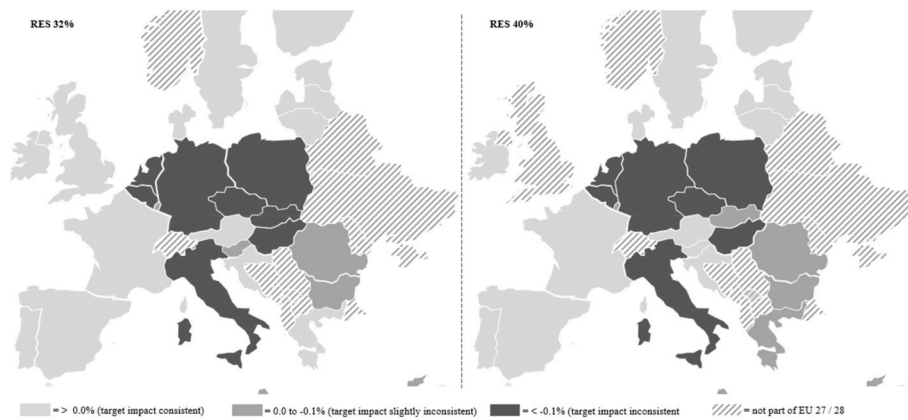


Fig. 4. Weighted deviations of targets (a) and proposals (b) from member states and the European Commission for the RES.

Moreover, Italy is inconsistent and inflicting the EC progress due to negative impact. In southeast Europe, Bulgaria and Romania are affecting the progress negatively. Despite the proposed target adjustments, only Slovakia and Slovenia could improve their state while Greece is downgraded. Nevertheless, the most countries are consistent with their positive target deviation impact to the aligned EC target.

As a result, the currently valid target commitments overfulfill the EC ambition of 32% in 2030 by 3.2% with highest contribution by Sweden (+1%). On the opposite site, countries like Germany (−0.4%) and Italy (−0.2%) are responsible for a negative deviation. If the proposed numbers will be adapted to the RED III, the EC lacks −0.2% to achieve the required 40% RES in gross final energy consumption on member state target level. Some regions like Poland (−0.6%) increase their difference while other states like Belgium (−0.3%) or the Netherlands (−0.2%) decrease their impacts but are not able to cover the gaps.

4.2. Target distribution

The next step in the field of GHG reduction ambitions deals with the relation of the responsibility of emitted emissions and the member state target contributions to examine the equality of the target distribution. To enable an equitable impact of all countries, which allows those with a smaller economy to grow, the EC process relies on the bigger states to balance the possible lever with higher commitments based on GDP relations. Therefore, the ERI can be defined. This value is introduced to comprehend the shifts within the valid ESR and the proposal. The applied approach can only succeed if the missing contributions are balanced by others, resulting in an average ERI value of 1 for the EU27.

In the past, the efforts were divided analog to their responsibility of origin. As a result, all required reductions were covered by the sum of all member state commitments and the ERI value exceeds the requested distribution unit of 1 as shown in Table 1 (Appendix: Table 6).

Nevertheless, with the raise of the NDC the analysis leads to a ratio of 0.87. Reviewing the proposed adaptations, the score could increase to 1.00 (opt. 1) or to 0.89 (opt. 2). The first proposed raise of efforts could create a state of complete coverage, while the second tightening equals a deviation of 0.1 for the reduction load. Reviewing the five biggest

emitters, only Germany shows a rate that can balance missing reduction efforts from other member states. Although some countries like France, Italy and Poland belong to the group of regions that have higher GDPs than the average EC, they are not improving their shares. Moreover, with their current and proposed contributions they are not covering the proportion of their own annually released GHG emissions. As a result, they still rely on extensions of other countries and can not cover the upcoming emissions of states that try to catch up economically.

4.3. Projections for target fulfillment

To derive a projection based on growth rates for future possibilities to achieve the announced objectives of the NDC, the current progress for GHG reductions and RES is used to compare the historic annual rates to the demanded ratio (objective 3). In Table 2 (Appendix: Tables 4 and 5) the units for GHG emissions are shown. First, from 1990 to 2019, the covered ESR sectors decreased by −11.3%. Countries like France or Germany have decreased their corresponding emissions while other emitters such as Spain or Poland increased their emissions. In total, ten countries increased their annual released CO_{2eq}-emissions. In addition, the average growth rate for the last ten years can be derived. The mean value of the EC is at −0.8% per year. The largest reduction regarding the biggest pollutants can be found in Italy and the largest raise in Poland. Lastly, the required growth rate for the field of GHG emissions to reach the committed efforts (NDC -40% and -55%) from 2019 to 2030 is shown.

The average reduction rate to achieve the NDC 2015 would be a decrease of −1.9% annually, which is not corresponding with the growth rate of the past ten years of −0.8%. Moreover, the required change to fulfill the NDC 2020 equals −2.9% on yearly basis in average over the EU27. Comparing the historic values for each country with the calculated rate to achieve the proposed objective, countries need to accelerate their development rapidly. For example, Spain (2010–2019: −0.4%; 2019–2030: −5.1%) would need to multiply their annual emission decrease rate by almost 13 times. Furthermore, 25 states have an annual reduction rate which is not aligned with the required development for the renewed NDC. Only Sweden and Cyprus have an average reduction rate higher than requested. Moreover, nine states increase their annual emissions while only three countries already achieved the required level for 2030. Consequently, the missing progress regarding the total emission can be derived for all member states (on EC level −32.3% for current NDC -55%).

The development for RES is shown in Table 3 (Appendix: Tables 7 and 8). Based on the information of 2019, the target for 2020 for the RES in gross final energy consumption is almost reached. To ensure the valid objective of 32% RES, the EC needs to build up the share in gross final energy consumption by 12.3% until 2030. For the adjusted proposal of 40% RES in 2030, the target gap equals 20.3%. Next, the average growth

Table 1
Member state emission responsibility index (ERI) [26,40–74].

	ERI NDC (40%) ESR (2018)	ERI NDC (55%) ESR (2018)	ERI NDC (55%) ESR 1 (2021)	ERI NDC (55%) ESR 2 (2021)
EC	1.16	0.87	1.00	0.89
DE	1.94	1.46	1.51	1.38
FR	0.96	0.72	0.84	0.73
IT	0.57	0.42	0.58	0.47
PL	0.33	0.25	0.42	0.30
ES	−0.23	−0.17	0.09	−0.02

Table 2

Current progress as well as average and required growth rates for GHG reductions [26,40–74].

	Current Progress 2005–2019	Current Progress 1990–2019	Average Growth Rate 2010–2019	Required Growth Rate for Target Fulfillment NDC (40%)	Required Growth Rate for Target Fulfillment NDC (55%)	Deviation Value 2019 Target NDC (40%)	Deviation Value 2019 Target NDC (55%)
EC	−10.7%	−11.3%	−0.8%	−1.9%	−2.9%	−21.0%	−32.3%
DE	−9.6%	−25.1%	−0.5%	−0.6%	−1.8%	−6.5%	−19.9%
FR	−13.9%	−6.5%	−1.1%	−2.3%	−3.3%	−25.1%	−35.8%
IT	−15.7%	0.3%	−1.2%	−2.7%	−3.6%	−30.2%	−40.1%
PL	12.7%	9.5%	0.0%	−3.3%	−4.1%	−36.1%	−45.2%
ES	−8.2%	36.7%	−0.4%	−4.4%	−5.1%	−48.8%	−56.1%

Table 3

Current progress as well as average and required growth rates for RES [26,40–74].

	Current Value 2019	Average Growth Rate 2005–2019	Required Growth Rate for Target Fulfillment	Required Growth Rate for Proposal Fulfillment
EC	19.7%	0.7%	1.1%	1.8%
DE	17.4%	0.8%	1.3%	2.1%
FR	17.2%	0.5%	1.3%	2.1%
IT	18.2%	0.9%	1.3%	2.0%
PL	12.2%	0.3%	1.8%	2.5%
ES	18.4%	0.6%	1.2%	2.0%

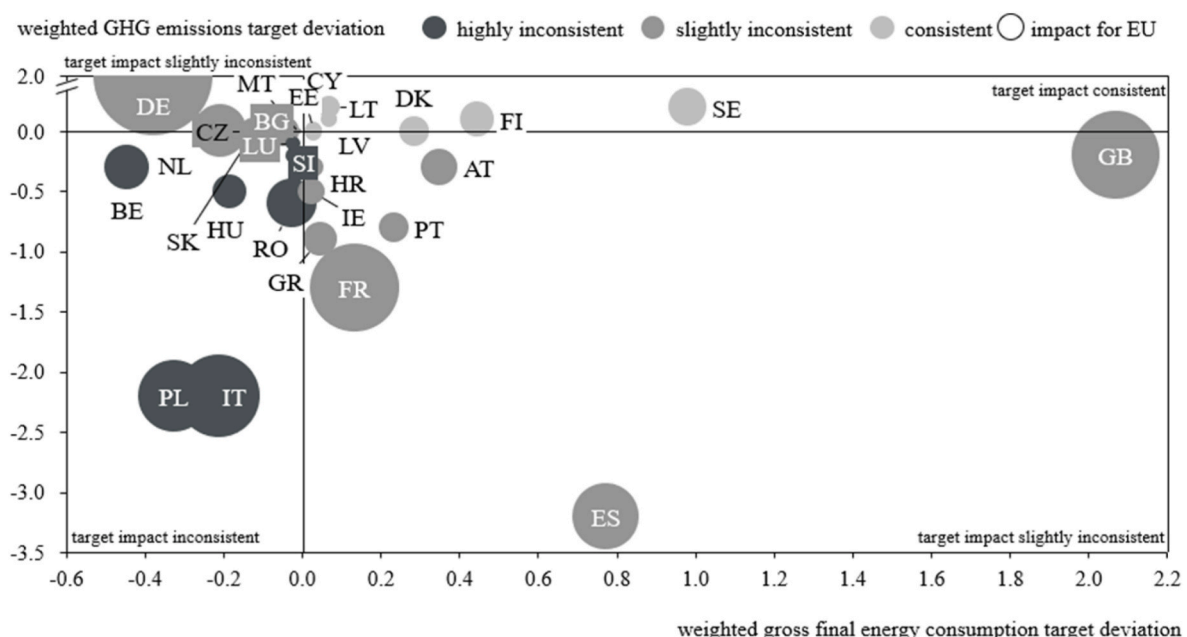
rate of the past 15 years can be observed. The extension of renewable energies results into increasing RES in gross final energy consumption. The average increase differs from 0.4% to 1.4%. The member states with the highest growth rate can be found in Italy (+0.9%) and the lowest increase in Poland (+0.3%). To close the target gaps until 2030 an average growth rate of 1.1% (32% RES) and 1.8% (40% RES) per year is requested for the EC. This means that only six countries can achieve the proposed objective by 2030 with their remaining growth rates.

4.4. Classification of member states

The contributions of each country can be used to identify regions that will have more challenges on their decarbonization pathway and energy transition. Therefore, the last research objective deals with the classification of each member state in relation to their impact on the committed

targets of the EC. Based on the weighted deviations for GHG emissions and the RES in gross final energy consumption, Figs. 5 and 6 show the positioning of each country in a portfolio analysis for the possible ESR and RED combinations. Thereby, the country size demonstrates the relevance of the contribution share regarding the overall EC progress.

All figures reveal the mentioned relations of member states to meet the matched objectives. Nevertheless, the process of target setting and the discussion between member states and commissions recognizes the lack of potentials for some countries to change and develop as fast as others. Therefore, deviations are acceptable and included if the balancing mechanism can adjust the effort to achieve the EC target. Fig. 5 illustrates the valid ESR (2018), RED II and NDC 2020 situation. As presented in section 4.1, the weighted targets and commitments lead to a deviation of −11% for GHGs and an overfulfillment of 3.2% for RES by 2030. Consequently, only six member states are consistent in both dimensions. Moreover, regions such as Sweden, Denmark or the Baltic states only have small relevance within the EU. Regarding the five biggest emitters, no country is positioned in the aimed area of the NDC 2020. Germany, Spain and France are lacking behind in either the RES or the GHG emissions and Italy and Poland have a negative target impact in both dimensions. The proposed options are shown in Fig. 6. In comparison to the valid combination, most member states approach the point of origin which implies improvements for option 1. Now, eight countries are consistent with both indicators (including France). The target share that is derived from the NDC for the sectors covered by the ESR (−40%) is reached by the weighted sum of member state efforts. Therefore, the balancing mechanism works. For the level of RES a slight overall deviation of −0.2% occurs. As a result, the most ambitious

**Fig. 5.** Classification of member states regarding target deviation impact (ESR 2018) on EC target achievement (NDC 2020).

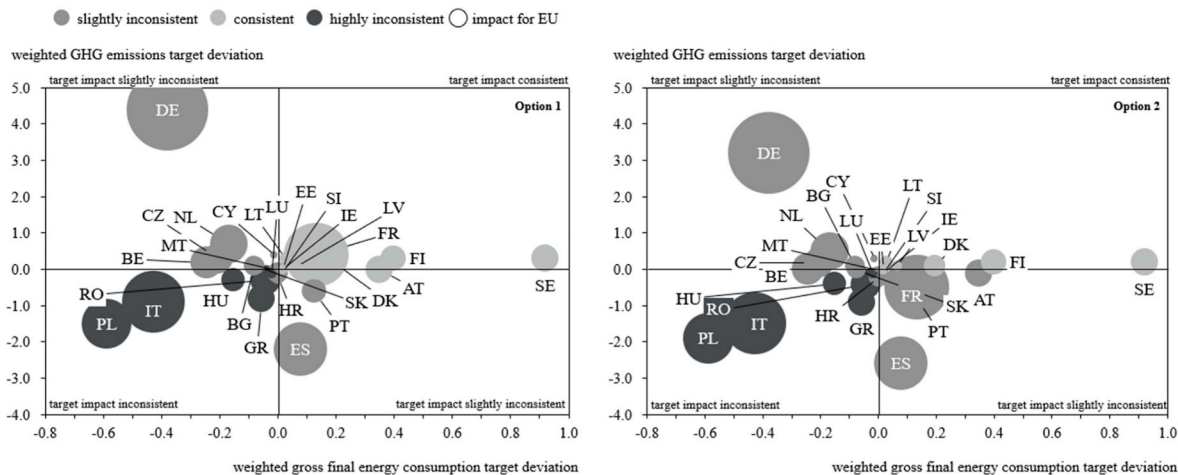


Fig. 6. Classification of member states regarding target deviation impact (ESR 2021 option 1 + 2) on EC target achievement.

option that was proposed is not completely able to fulfill the overall objectives of the NDC, which was submitted by the EC. The last combination, ESR proposal option 2 and RED III, is displayed on the right. For this mix, the member state commitments are not consistent with both topics. Only six countries reach the state of consistency and all five nations with the highest relevance are (slightly) inconsistent. This results in a weighted deviation of -5% regarding the emission reduction and -0.2% for RES.

5. Discussion

Comparing the valid and proposed contributions shows that they are mainly inconsistent with the EC goals. To meet the NDC, the ESR covered sectors have to be reduced by -40% by 2030. In 2030, this is currently not given with a deviation of -11% ($380 \text{ MtCO}_{2\text{eq}}$) and -5% ($167 \text{ MtCO}_{2\text{eq}}$) in option 2 [26]. Only option 1 tightened the targets to reach the objective for GHG reductions. Furthermore, the reallocation of the efforts with an ERI of 1 fits for option 1 of the proposal. The current situation and the second option of the update only reaches 0.9 and ensures no complete coverage of the released emissions. Consequently, a shift towards a reduced deviation can be found, but the consistency of EC and member state targets is not given for all possibilities. A different situation can be found in the analysis of the RES in gross final energy consumption. With valid targets leading to an overfulfillment of 3.2% to reach a share of 32% in the EC, the balancing mechanism is successful. Furthermore, the proposed tightening of the targets up to a share of 40% by 2030 leads to a slight deviation of -0.2% .

All in all, the raise of the EC ambition level from 2° up to well-below 2° requires an increase of contributions. This ambition is not fully represented with the suggested efforts in July 2021, but the proposal improves the target setting. Nevertheless, the different aims do not reach the necessary numbers in total and are not equal to a 1.5° scenario, which allows a total emission budget of $43 \text{ Gt CO}_{2\text{eq}}$ until 2050 [75]. To enter this path, a reduction rate of -71% by 2030 compared to 1990 would be required, which indicates a target level of -60% for the sectors covered by the ESR [27]. Moreover, an annual reduction rate of $293 \text{ MtCO}_{2\text{eq}}$ is required to achieve the 1.5° scenario, which equals a decrease of -4% yearly for all sectors and not only the latest average of -1.8% (-0.8% on ESR level) from 2010 to 2019 [27]. Otherwise the implemented measures on EU-level and the current development the remaining carbon budget for 1.5°C would be used by 2032 and for 2°C by 2042 [27]. Underpinned by the reduction rates of the past ten years, many countries have to double or triple their annual decrease, while a level of maximum emission shrinking rates of -5 to -7% per year can be assumed with disruptive changes in society or events like Covid-19 [76]. Like that, the required growth rates for the increase of renewable

energies in gross final energy consumption have to double to close the remaining gaps of -13.1% ($32\% \text{ RES}$) or -17.9% ($40\% \text{ RES}$).

Besides the inconsistency of the target setting and distribution process, the analysis exposed one more topic: The evaluation of the progress. Hence, targets are set and actions are planned, the implemented progress is important. The ESR is only one lever of the European Climate Law. The other major one is the ETS. Until 2019, the trading scheme reduced the $\text{CO}_{2\text{eq}}$ -emissions from the included sectors by -59% in the EU since 1990 [26]. The proposal suggests a reduction effort of -65% in 2030 compared to 1990. As a result, only six percent are left for reduction. This means that the ETS is outperforming the ESR regarding absolute reductions in the same period (ESR sector -11.3%). Therefore, the total target achievement of the EC (1990–2019: -33%) is mainly reliant on the ETS. Moreover, the ETS has to balance the remaining reductions efforts and the absolute growth of the ESR sector emissions [26].

6. Conclusion

The work from Greichen and Jörß (2017), Meyer-Ohlendorf et al. (2018), Zell-Ziegler et al. (2021), Rivas et al. (2021) and Salvia et al. (2021) revealed that the policy ambitions and committed actions can differ within the European Union. Therefore, this paper dealt with the analysis of EC and member state objectives. As a result, many countries of the EU are not reflected with their GHG reduction efforts. The ESR proposal (-40%) leads to a deviation up to -5% which is still an inconsistent improvement compared to the EC objective. Additionally, the used mechanism of target distribution is not always consistent regarding the responsibility for emitted emissions. To achieve the NDC in the ESR sectors, annual GHG reduction rate has to be tripled (-3%). For the RES in gross final energy consumption member states contribute almost consistent efforts to the aim of the EC (-0.2%) but the required growth rate has to be doubled as well. The classification of all member states illustrated that in the best case only eight nations have consistent and reflected commitments for both categories of action. As a result, 19 member states show risks for target support of the EC objectives. In addition, it has to be stated that the overall EC objective follows a well-below 2°C reduction path, whereby an aligned 1.5°C scenario would require a contribution target of -60% for GHGs emitted by the sectors currently covered by the ESR.

The identified target inconsistency and the insufficient growth rates of GHG emissions and the RES can lead to annual exceedings of carbon budgets. To ensure a sustainable transition and to fulfill the Green Deal as well as the state of climate neutrality in 2050, the European climate policy has to adapt. In order to comply with the carbon budget approach and to enable tightened ambition levels, the deviating emissions have to

be monitored annually and reconsidered for new mid and long-term objectives. Member states, which show a slow progress and collect multiple discrepancies, have to balance their historic undercuts with faster descending pathways. Therefore, countries have to work out additional action plans and adapt the NECPs accordingly. Additionally, to level the impact of the ETS and non ETS sectors regarding GHG reduction impact, the trading scheme must be extended to accelerate the decarbonization of the ESR categories. Moreover, the targets for the final energy consumption should be further defined on a subordinated level (electricity and heating) to ensure measures for both applications and hotspots of all covered sectors [77].

As economic growth relates to higher environmental pollution, the lack of equal distributed efforts can be balanced by the EC by implementing allocation constraints to oblige member states with leading GDPs to cover at least the same amount of emissions with their contributions as they emit compared to the EU. Moreover, a budget banking approach and a trading market for overshooting efforts could create an economic incentive to improve fulfillments.

Abbreviations

APS	Announced Pledges Scenario
ERI	Emission Responsibility Index
ETS	European Trading Scheme
GDP	Gross Domestic Product
NDC	Nationally Determined Contribution
RE	Renewable Energy
RES	Renewable Energy Share
EC	European Commission
ESR	Effort Sharing Regulation
ESL	Effort Sharing Legislation
GHG	Greenhouse Gases
NECP	National Energy and Climate Plan
RED	Renewable Energy Directive
STEPS	Stated Policies Scenario

Appendix

Table 4

Current values, targets and proposals regarding emission reduction based on the ESR [26,40–74].

	Current Progress 2005–2019	Current Progress 1990–2019	Target Value (ESR) 2005–2030	Target Value (ESR) 1990–2030	Target Proposal Value (ESR 1) 2005–2030	Target Proposal Value (ESR 1) 1990–2030	Target Proposal Value (ESR 2) 2005–2030	Target Proposal Value (ESR 2) 1990–2030	Average Growth Rate 2010–2019
EC	–10.7%	–11.3%	–29%	–30%	–40%	–40%	–35%	–35%	–0.8%
BE	–12.3%	–6.1%	–35%	–30%	–49%	–45%	–44%	–40%	–1.2%
BG	8.3%	–36.6%	0%	–41%	–10%	–47%	–5%	–44%	1.1%
DK	–12.5%	–16.5%	–39%	–42%	–50%	–52%	–45%	–48%	–0.9%
DE	–9.6%	–25.1%	–38%	–49%	–50%	–59%	–44%	–54%	–0.5%
EE	7.0%	–32.2%	–13%	–45%	–27%	–54%	–22%	–51%	0.6%
FI	–16.1%	–26.8%	–39%	–47%	–50%	–56%	–45%	–52%	–1.6%
FR	–13.9%	–6.5%	–37%	–32%	–47%	–42%	–42%	–37%	–1.1%
GR	–27.6%	–4.4%	–16%	+11%	–22%	+3%	–17%	+10%	–2.4%
IE	–5.3%	19.3%	–30%	–12%	–50%	–37%	–45%	–31%	0.3%
IT	–15.7%	0.3%	–33%	–20%	–43%	–32%	–38%	–26%	–1.2%
HR	–3.0%	5.2%	–7%	+1%	–16%	–9%	–11%	–3%	–0.3%
LV	6.1%	–48.1%	–6%	–54%	–18%	–60%	–13%	–57%	0.1%
LT	15.2%	–45.0%	–9%	–57%	–22%	–63%	–17%	–60%	1.4%
LU	–10.2%	79.9%	–40%	+20%	–50%	0%	–45%	+10%	–0.4%
MT	21.5%	46.5%	–19%	–2%	–38%	–25%	–33%	–19%	2.5%
NL	–13.8%	–20.1%	–36%	–41%	–50%	–54%	–45%	–49%	–2.0%
AT	–13.5%	4.4%	–36%	–23%	–50%	–40%	–45%	–34%	–0.2%
PL	12.7%	9.5%	–7%	–10%	–17%	–19%	–11%	–14%	0.0%
PT	–16.4%	26.5%	–17%	+26%	–28%	+9%	–23%	+17%	–0.9%
RO	10.2%	–11.5%	–2%	–21%	–12%	–29%	–7%	–25%	1.6%
SE	–25.5%	–35.0%	–40%	–48%	–50%	–56%	–45%	–52%	–2.3%
SK	–6.4%	–32.9%	–12%	–37%	–22%	–44%	–17%	–41%	–0.4%
SI	–4.9%	27.0%	–15%	+13%	–28%	–4%	–23%	+3%	–0.8%
ES	–8.2%	36.7%	–26%	+10%	–37%	–6%	–32%	+1%	–0.4%

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Lastly, further research is required for standalone legislations and actions for climate protection that may extend the not yet decided proposal from the EC on national level. For example, some countries already set additional target boundaries for emission reduction or could withdraw their commitments while the “Fit for 55” is discussed on member state level before a binding decision under the ordinary legislative procedure is made.

Disclaimer

The results, opinions and conclusions expressed in this paper are not necessarily those of Volkswagen AG.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 4 (continued)

	Current Progress 2005–2019	Current Progress 1990–2019	Target Value (ESR) 2005–2030	Target Value (ESR) 1990–2030	Target Proposal Value (ESR 1) 2005–2030	Target Proposal Value (ESR 1) 1990–2030	Target Proposal Value (ESR 2) 2005–2030	Target Proposal Value (ESR 2) 1990–2030	Average Growth Rate 2010–2019
CZ	2.8%	−29.1%	−14%	−41%	−28%	−50%	−22%	−46%	0.3%
HU	−7.7%	−16.5%	−7%	−16%	−18%	−26%	−13%	−21%	0.4%
CY	−2.0%	−43.7%	−24%	−56%	−35%	−63%	−30%	−60%	−1.0%
UK	−18.6%	−21.0%	−37%	−39%					−1.0%

Table 5

Comparison of emission reduction targets and their progress and impact [26,40–74].

	Target Diff. NDC (40%) ESR (2018)	Target Diff. NDC (55%) ESR (2018)	Target Diff. NDC (55%) ESR 1 (2021)	Target Diff. NDC (55%) ESR 2 (2021)	Weighted Target Deviation NDC (40%) ESR (2018)	Weighted Target Deviation NDC (55%) ESR (2018)	Weighted Target Deviation NDC (55%) ESR 1 (2021)	Weighted Target Deviation NDC (55%) ESR 2 (2021)	Required Growth Rate for Target Fulfillment NDC (40%)	Required Growth Rate for Target Fulfillment NDC (55%)
EC					0.8%	−10.5%	0.7%	−4.6%	−1.9%	−2.9%
BE	0%	−10%	5%	0%	0.0%	−0.3%	0.2%	0.0%	−2.3%	−3.3%
BG	11%	1%	7%	4%	0.2%	0.0%	0.1%	0.1%	0.9%	−0.5%
DK	12%	2%	12%	8%	0.2%	0.0%	0.2%	0.1%	−1.5%	−2.6%
DE	19%	9%	19%	14%	3.7%	2.0%	4.4%	3.2%	−0.6%	−1.8%
EE	15%	5%	14%	11%	0.0%	0.0%	0.0%	0.0%	0.3%	−1.0%
FI	17%	7%	16%	12%	0.2%	0.1%	0.3%	0.2%	−0.4%	−1.6%
FR	2%	−8%	2%	−3%	0.2%	−1.3%	0.4%	−0.5%	−2.3%	−3.3%
GR	−41%	−51%	−43%	−50%	−0.6%	−0.9%	−0.8%	−0.9%	−2.4%	−3.4%
IE	−18%	−28%	−3%	−9%	−0.3%	−0.5%	−0.1%	−0.2%	−3.8%	−4.5%
IT	−10%	−20%	−8%	−14%	−0.9%	−2.2%	−0.9%	−1.5%	−2.7%	−3.6%
HR	−31%	−41%	−31%	−37%	−0.2%	−0.3%	−0.2%	−0.2%	−3.0%	−3.9%
LV	24%	14%	20%	17%	0.1%	0.1%	0.1%	0.1%	3.2%	1.4%
LT	27%	17%	23%	20%	0.3%	0.2%	0.3%	0.2%	2.5%	0.8%
LU	−50%	−60%	−40%	−50%	−0.1%	−0.1%	−0.1%	−0.1%	−5.6%	−6.1%
MT	−28%	−38%	−15%	−21%	0.0%	0.0%	0.0%	0.0%	−4.7%	−5.4%
NL	11%	1%	14%	9%	0.5%	0.0%	0.7%	0.5%	−1.1%	−2.3%
AT	−7%	−17%	0%	−6%	−0.1%	−0.3%	0.0%	−0.1%	−3.0%	−3.9%
PL	−20%	−30%	−21%	−26%	−1.2%	−2.2%	−1.5%	−1.9%	−3.3%	−4.1%
PT	−56%	−66%	−49%	−57%	−0.6%	−0.8%	−0.6%	−0.7%	−4.1%	−4.8%
RO	−9%	−19%	−11%	−15%	−0.2%	−0.6%	−0.3%	−0.4%	−1.9%	−2.9%
SE	18%	8%	16%	12%	0.3%	0.2%	0.3%	0.2%	0.7%	−0.7%
SK	7%	−3%	4%	1%	0.1%	0.0%	0.1%	0.0%	0.4%	−1.0%
SI	−43%	−53%	−36%	−43%	−0.1%	−0.2%	−0.1%	−0.1%	−4.1%	−4.8%
ES	−40%	−50%	−34%	−41%	−2.2%	−3.2%	−2.2%	−2.6%	−4.4%	−5.1%
CZ	11%	1%	10%	6%	0.3%	0.0%	0.3%	0.2%	−0.1%	−1.4%
HU	−14%	−24%	−14%	−19%	−0.3%	−0.5%	−0.3%	−0.4%	−1.5%	−2.6%
CY	26%	16%	23%	20%	0.4%	0.3%	0.4%	0.3%	2.2%	0.6%
UK	9%	−1%			1.3%	−0.2%			−1.0%	−2.2%

Table 6

Member state contributions, emission responsibility index (ERI) and current progress [26,40–74].

	Contribution NDC (40%) ESR (2018)	Contribution NDC (55%) ESR (2018)	Contribution NDC (55%) ESR 1 (2021)	Contribution NDC (55%) ESR 2 (2021)	ERI NDC (40%) ESR (2018)	ERI NDC (55%) ESR (2018)	ERI NDC (55%) ESR 1 (2021)	ERI NDC (55%) ESR 2 (2021)	Deviation Value 2019 Target NDC (40%)	Deviation Value 2019 Target NDC (55%)
EC					1.16	0.87	1.00	0.89	−21.0%	−32.3%
BE	2.7%	2.0%	3.0%	2.7%	0.94	0.70	0.90	0.80	−25.4%	−36.1%
BG	1.9%	1.4%	1.6%	1.5%	2.34	1.76	1.73	1.62	10.4%	−5.3%
DK	2.0%	1.5%	1.9%	1.7%	1.45	1.09	1.17	1.06	−16.2%	−28.1%
DE	32.6%	24.5%	29.5%	27.0%	1.94	1.46	1.51	1.38	−6.5%	−19.9%
EE	0.5%	0.3%	0.4%	0.4%	2.35	1.76	1.81	1.71	3.3%	−11.5%
FI	2.1%	1.5%	1.9%	1.7%	1.77	1.33	1.38	1.27	−4.4%	−18.1%
FR	13.8%	10.4%	13.9%	12.1%	0.96	0.72	0.84	0.73	−25.1%	−35.8%
GR	−0.6%	−0.4%	−0.1%	−0.4%	−0.27	−0.21	−0.05	−0.16	−26.8%	−37.3%
IE	0.6%	0.4%	1.4%	1.1%	0.31	0.23	0.63	0.52	−41.3%	−49.7%
IT	6.5%	4.9%	7.8%	6.3%	0.57	0.42	0.58	0.47	−30.2%	−40.1%
HR	0.0%	0.0%	0.1%	0.0%	−0.03	−0.02	0.17	0.07	−33.5%	−43.0%
LV	1.1%	0.8%	0.9%	0.9%	3.65	2.74	2.61	2.50	34.8%	15.6%
LT	1.8%	1.4%	1.5%	1.5%	3.92	2.94	2.81	2.70	27.3%	9.2%
LU	−0.1%	−0.1%	0.0%	−0.1%	−0.33	−0.25	0.00	−0.11	−61.1%	−66.6%
MT	0.0%	0.0%	0.0%	0.0%	0.06	0.05	0.45	0.34	−52.2%	−59.1%
NL	5.9%	4.5%	5.9%	5.4%	1.45	1.09	1.24	1.13	−12.4%	−24.9%

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Table 6 (continued)

	Contribution NDC (40%) ESR (2018)	Contribution NDC (55%) ESR (2018)	Contribution NDC (55%) ESR 1 (2021)	Contribution NDC (55%) ESR 2 (2021)	ERI NDC (40%) ESR (2018)	ERI NDC (55%) ESR (2018)	ERI NDC (55%) ESR 1 (2021)	ERI NDC (55%) ESR 2 (2021)	Deviation Value 2019 Target NDC (40%)	Deviation Value 2019 Target NDC (55%)
AT	1.3%	0.9%	1.6%	1.4%	0.62	0.47	0.70	0.59	−33.0%	−42.5%
PL	2.0%	1.5%	3.0%	2.1%	0.33	0.25	0.42	0.30	−36.1%	−45.2%
PT	−0.9%	−0.7%	−0.2%	−0.5%	−0.56	−0.42	−0.13	−0.23	−44.7%	−52.6%
RO	1.8%	1.4%	1.9%	1.6%	0.88	0.66	0.78	0.67	−20.9%	−32.2%
SE	2.7%	2.0%	2.4%	2.2%	1.80	1.35	1.38	1.27	7.7%	−7.7%
SK	1.3%	1.0%	1.2%	1.1%	1.71	1.28	1.31	1.21	4.4%	−10.5%
SI	−0.1%	−0.1%	0.0%	0.0%	−0.33	−0.25	0.06	−0.04	−44.9%	−52.7%
ES	−1.9%	−1.4%	0.8%	−0.2%	−0.23	−0.17	0.09	−0.02	−48.8%	−56.1%
CZ	3.6%	2.7%	3.3%	3.0%	1.95	1.46	1.56	1.43	−1.3%	−15.4%
HU	1.0%	0.7%	1.2%	1.0%	0.58	0.43	0.61	0.50	−16.1%	−28.1%
CY	2.7%	2.0%	2.2%	2.1%	3.25	2.44	2.33	2.22	24.4%	6.6%
UK	18.5%	13.8%			1.32	0.99			−11.4%	−24.1%

Table 7

Current values, targets and proposals regarding RES for gross final energy consumption [18,24,37,38,40–63,65,70–74,78].

	Current Value 2019	Target Value 2020	Target Value 2030	Target Proposal 2030	Average Growth Rate 2005–2019
EC	19.7%	20%	32%	40%	0.7%
BE	9.9%	13%	18%	32%	0.5%
BG	21.6%	16%	27%	31%	0.8%
DK	37.2%	30%	54%	55%	1.3%
DE	17.4%	18%	30%	38%	0.8%
EE	31.9%	25%	42%	46%	0.9%
FI	43.1%	38%	51%	57%	1.0%
FR	17.2%	23%	33%	41%	0.5%
GR	19.7%	18%	35%	36%	0.9%
IE	12.0%	16%	34%	40%	0.6%
IT	18.2%	17%	30%	36%	0.9%
HR	28.5%	20%	36%	40%	1.0%
LV	41.0%	40%	50%	57%	0.6%
LT	25.5%	23%	45%	45%	0.7%
LU	7.0%	11%	25%	34%	0.4%
MT	8.5%	10%	12%	27%	0.6%
NL	8.8%	14%	27%	36%	0.4%
AT	33.6%	34%	46%	54%	0.6%
PL	12.2%	15%	27%	31%	0.3%
PT	30.6%	31%	47%	48%	0.7%
RO	24.3%	24%	31%	38%	0.4%
SE	56.4%	49%	65%	71%	1.1%
SK	17.0%	14%	19%	32%	0.7%
SI	22.0%	25%	27%	43%	0.4%
ES	18.4%	20%	42%	41%	0.6%
CZ	16.2%	14%	22%	31%	0.7%
HU	12.6%	15%	21%	31%	0.6%
CY	13.8%	13%	23%	31%	0.7%
UK	12.3%	15%	50%		0.7%

Table 8

Comparison of RES progress in 2019 and the announced targets [18,24,37,38,40–63,65,70–74,78].

	Current -Target Diff. 2019–2020	Current -Target Diff. 2019–2030	Current - Target Proposal Diff. 2019–2030	Target Value Diff. Member State/EC	Target Proposal Diff. Member State/EC	Weighted Target Value Deviation State/EC	Weighted Target Proposal Deviation State/EC	Weighted Current Value to Target Deviation	Weighted Current Value to Proposal Deviation	Required Growth Rate for Target Fulfillment	Required Growth Rate for Proposal Fulfillment
EC	−0.3%	−12.3%	−20.3%			3.2%	−0.2%	−13.1%	−17.9%	1.1%	1.8%
BE	−3.1%	−7.6%	−22.1%	−15%	−8%	−0.4%	−0.2%	−0.7%	−0.9%	2.0%	2.7%
BG	5.6%	−5.4%	−9.4%	−5%	−9%	0.0%	−0.1%	−0.1%	−0.2%	0.9%	1.7%
DK	7.2%	−16.8%	−17.8%	22%	15%	0.3%	0.2%	0.1%	0.0%	−0.5%	0.3%
DE	−0.6%	−12.6%	−20.6%	−2%	−2%	−0.4%	−0.4%	−2.8%	−4.3%	1.3%	2.1%
EE	6.9%	−10.1%	−14.1%	10%	6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%
FI	5.1%	−7.9%	−13.9%	19%	17%	0.4%	0.4%	0.3%	0.1%	−1.0%	−0.3%
FR	−5.8%	−15.8%	−23.8%	1%	1%	0.1%	0.1%	−1.9%	−3.0%	1.3%	2.1%
GR	1.7%	−15.3%	−16.3%	3%	−4%	0.0%	−0.1%	−0.2%	−0.3%	1.1%	1.8%
IE	−4.0%	−3.8%	−28.0%	2%	0%	0.0%	0.0%	−0.2%	−0.3%	1.8%	2.5%

(continued on next page)

Table 8 (continued)

	Current -Target Diff. 2019–2020	Current -Target Diff. 2019–2030	Current - Target Proposal Diff. 2019–2030	Target Value Diff. Member State/EC	Target Proposal Diff. Member State/EC	Weighted Target Value Deviation State/EC	Weighted Target Proposal Deviation State/EC	Weighted Current Value to Target Deviation	Weighted Current Value to Proposal Deviation	Required Growth Rate for Target Fulfillment	Required Growth Rate for Proposal Fulfillment
IT	1.2%	−11.8%	−17.8%	−2%	−4%	−0.2%	−0.4%	−1.5%	−2.3%	1.3%	2.0%
HR	8.5%	−7.9%	−11.5%	4%	0%	0.0%	0.0%	0.0%	−0.1%	0.3%	1.0%
LV	1.0%	−9.0%	−16.0%	18%	17%	0.1%	0.1%	0.0%	0.0%	−0.8%	−0.1%
LT	2.5%	−19.5%	−19.5%	13%	5%	0.1%	0.0%	0.0%	−0.1%	0.6%	1.3%
LU	−4.0%	−16.9%	−27.0%	−7%	−6%	0.0%	0.0%	−0.1%	−0.1%	2.3%	3.0%
MT	−1.5%	−2.1%	−18.5%	−21%	−13%	0.0%	0.0%	0.0%	0.0%	2.1%	2.9%
NL	−5.2%	−18.2%	−27.2%	−5%	−4%	−0.2%	−0.2%	−1.0%	−1.3%	2.1%	2.8%
AT	−0.4%	−11.4%	−20.4%	14%	14%	0.3%	0.3%	0.0%	−0.2%	−0.1%	0.6%
PL	−2.8%	−14.8%	−18.8%	−5%	−9%	−0.3%	−0.6%	−1.3%	−1.8%	1.8%	2.5%
PT	−0.4%	−16.4%	−17.4%	15%	8%	0.2%	0.1%	0.0%	−0.1%	0.1%	0.9%
RO	0.3%	−6.5%	−13.7%	−1%	−2%	0.0%	0.0%	−0.2%	−0.4%	0.7%	1.4%
SE	7.4%	−8.6%	−14.6%	33%	31%	1.0%	0.9%	0.7%	0.5%	−2.2%	−1.5%
SK	3.0%	−2.2%	−15.0%	−13%	−8%	−0.1%	−0.1%	−0.1%	−0.2%	1.4%	2.1%
SI	−3.0%	−5.0%	−21.0%	−5%	3%	0.0%	0.0%	0.0%	−0.1%	0.9%	1.6%
ES	−1.6%	−23.6%	−22.6%	10%	1%	0.8%	0.1%	−1.1%	−1.7%	1.2%	2.0%
CZ	2.2%	−5.8%	−14.8%	−10%	−9%	−0.2%	−0.2%	−0.4%	−0.5%	1.4%	2.2%
HU	−2.0%	−8.4%	−18.4%	−11%	−9%	−0.2%	−0.2%	−0.3%	−0.5%	1.8%	2.5%
CY	0.8%	−9.2%	−17.2%	−9%	−9%	0.0%	0.0%	0.0%	0.0%	1.7%	2.4%
UK	−2.7%	−37.7%		18%		2.1%		−2.3%		1.8%	

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