Analysis of the impacts of the renewable cooling energy definition

Part 3 of the study
"Renewable Cooling under the Revised Renewable Energy Directive ENER/C1/2018-493"

Lukas Kranzl, Philipp Mascherbauer, Mostafa Fallahnejad, TU WIEN
Simon Pezzutto, Antonio Novelli, Andrea Zambito, Pietro Miraglio, Annamaria Belleri, Luigi Bottecchia, Sonia Gantioler, EURAC
Philippe Riviere, Alexandre Etienne, Pascal Stabat, Thomas Berthou, ARMINES
Jan Viegand, Christian Jensen, VIEGAND MAAGOE
Marcus Hummel, Andreas Müller, E-THINK
July – 2021

EUROPEAN COMMISSION

Directorate-General for Energy
Directorate C — Green Transition and Energy System Integration
Unit C.1 — Renewables and Energy System Integration

Contact: Eva Hoos

E-mail: Eva.Hoos@ec.europa.eu

European Commission
B-1049 Brussels

Analysis of the impacts of the renewable cooling energy definition

Part 3 of the study
“Renewable Cooling under the Revised Renewable Energy Directive ENER/C1/2018-493”

Directorate-General for Energy
ENER/C1/2018-493

2022 EN

Manuscript completed in July 2021

First edition

LEGAL NOTICE

PDF	ISBN 978-92-76-53164-7	doi: 10.2833/938645	MJ-07-22-385-EN-N

Luxembourg: Publications Office of the European Union, 2022

List of contents

List of figures

List of tables

1. Introduction

As part of the “Clean Energy for all Europeans” package [1], the EC proposed an update of the Renewable Energy Directive (RED - 2009/28/EC [2]). The revised RED was adopted in December 2018[3]). The RED II includes a specific chapter on mainstreaming renewable energy into heating and cooling (H&C), Article 23 and district heating and cooling (DHC), Article 24. To do so, the RED II requires Member States (MSs) to raise the share of renewable energy in H&C yearly by an average of 1.3 percentage points (ppt) from 2021 to 2030. MSs are allowed to count waste heat and cold in 1.3 ppt up to 40% of the increment. In case a MS decides not to use waste heat and cold to the avreae annual increase, it must implement an annual average of 1.1 ppt increase in the share of renewables in H&C. Additionally, the RED II also promotes renewable energy sources (RES) in district heating and cooling (DHC), requesting MSs to raise the share of RES and waste heat and cold by at least 1 percentage point yearly (2021-2030). MS can fulfil this 1 ppt increase by waste heat and cold without limitation.

While the RED II outlines the methodology to calculate RES shares for electricity, transport and heating, it does not provide methods on how to take into account renewable cooling. The RED II specifies that the EC shall adopt delegated acts to supplement the directive at the latest by the 31st of December 2021, including a methodology for calculating the amount of renewable energy utilized for cooling and district cooling (DC), and amend the directive accordingly.

In this context, the European Commission launched this study to develop a methodology for defining renewable cooling and for calculating corresponding RES-HC and RES shares. This also requires a rigorous analysis of the status quo of cooling technologies and the cooling related energy demand. The specific goals of the study are:

- Providing an overview of technologies for cooling, related technologies and their technological development trends;
- Quantifying actual cooling demand as well as its development until 2030 and 2050;
- Providing options of renewable cooling definitions, which are in line with the RED II as well as elaborating options of possible methods for calculating renewable energy shares;
- Investigating impacts of proposed definitions on renewable cooling, related methods on calculations;
- Delivering well-grounded recommendations for choosing a fitting definition of renewable cooling, calculation methods as well as on how statistical reporting can be improved and utilized for renewable cooling;

During the project duration (from end of 2019 until August 2021) a series of stakeholder consultation events took place, including a survey of EU-Member states energy statistics representatives and Eurostat, presentation and consultation at the CA-RES and CA-EED, two dedicated stakeholder workshops as well as bilateral meetings and consultations. These numerous feedbacks served to continuously improve and further develop the project results.

Throughout the project duration, the possibly expected impact of different RES-C definition options and design variants were studies and discussed with stakeholders and the European Commission. Selected results of these analyses are described in this report.

The first part of the report concerns the impacts of RES-C definition options on the RES HC and RES shares at both EU and MS level for different scenarios. In the second part, we analyze possible economic, social and environmental impacts, resulting from different scenarios.

2. Overall approach and scenario assumptions

The objective of the impact assessment was to assess different options on the current and expected future share of RES and RES-HC as well as on selected economic and environmental impacts in different Member States. A special focus was also put on calculating sensitivity analyses e.g. regarding the impact of different threshold levels and forms of the $s_{SPF,p,RE}$[1] function or regarding different evolution pathways of cooling demand. Moreover, two different scenarios were calculated for a baseline and a more ambitious development of innovative cooling technologies.

For the purpose of this assessment, the stock of cooling systems in each EU-MS was clustered by the type of equipment, by the use of different cold sources, by building category and by the use of local renewable energy input. For each of these clusters the share of these technologies by 2030 and 2050 as well as the related $SPF_{p,RE}$ was derived.

In order to determine the RES and RES HC volumes and shares for the years 2030 and 2050, various parameters had to be determined first, in particular (1) cooling demand up to the year 2030 and 2050, (2) evolution of SEER-values up to 2030 and 2050 and (3) reference renewable energy shares and volumes (i.e. yet without considering renewable cooling in the share calculations):

- The final energy consumption for cooling in the year 2016 was specified in report 1 of this study [1]. In order to derive cooling consumption projections for the target years 2030 and 2050 which are consistent with [3] on the one hand and with existing scenarios from the European Commission on the other hand, we derived a percentage increase from 2018 to 2030 and 2050 from the PRIMES-Model[2] run “EUCO 32-32,5”([7]). Subsequently, this growth rate was applied to the cooling consumption values in the base year.
- The increase in SEER values for each technology was projected by applying a cooling technology stock model for the years 2020, 2030 and 2050 based on [4, 5].
- To calculate the different scenarios, reference renewable shares, i.e. renewable energy shares without considering cooling energy, and the corresponding reference numerators and denominators are required as forecast for the related years. Also, these variables have been derived from the PRIMES-Model run “EUCO 32-32,5”.[3] We need to emphasize that these results are not scenarios achieving the targets of the green deal and corresponding GHG-emission reductions until 2030 and 2050.
- The evolution of the primary energy efficiency η of electricity generation is also a relevant input parameter for the fulfillment of SPF_p which is defined in primary energy terms. We distinguish two cases: the main case, where η is being kept constant and a second case where η linearly decreases from currently 2.1 to 1.05 in 2050.

These parameters are kept identical for the scenarios described below. Some of these scenario assumptions are also modified in parameter variation analyses (see e.g. chapter 3).

2016 was selected as the base year for the assessment of cooling energy consumption data (see [2] chapter 3). However, much of the data required for the revised calculation of RES-HC and RES shares is available for 2018, in particular nominators and denominators used by Eurostat (SHARES 2018 summary results) as the basis for calculating RES-HC and RES

[1] In order to clarify that we use the SPF in terms of primary energy we use the symbol SPF_p.

[2] in addition to the publicly available scenario data the European Commission provided more detailed results of this scenario on the heating and cooling sector for the purpose of these calculations

[3] In order to allow full consistency with the RES-HC and RES-Shares in the year 2018 published by Eurostat, we derived growth rates for the denominators from the PRIMES-Model run “EUCO 32-32,5”. With the resulting reference share (nominator/denominator) from the PRIMES-Model run, the nominator for 2030 and 2050 was calculated.

shares in EU Member States. Thus, in order to be more up-to-date and to provide a better understanding for the possible impacts on achieving the 2030 targets, in this chapter we apply the data from 2018, if available. For data that only exist for 2016, in particular cooling consumption data, we apply data from this year. Thus, whenever we use the term base year in this chapter, it is a mix of data available for 2018 and 2016. Considering this mixed approach, we make sure that we apply most recent data for the different domains relevant for the impact assessment.

Based on [2] chapter 3 technologies which are very likely to play a significant role in covering the future cooling demand were selected. Considering different cooling types and the possibility of these technologies to use different cold sources and the different energy carriers, which can be used to supply these technologies, a rich set of combinations can be derived. Considering only those combinations for each cooling type, for which technical solutions exist (see [2] chapter 3.1), 77 cooling technology clusters were considered in this impact assessment (see Table 6).

Dimension 1: Cooling type	Dimension 2: Energy Input	Dimension 3: Cold source (Heat sink)
Moveables	Electricity (grid)	Air
Small Split (<5kW)	Fuel (fossil)	Ambient water
Big Split (>5kW)	Electricity (local renewable)	Ground
Variable refrigerant flow systems	Fuel (renewable)	Aquifer
Rooftop + Packaged	Renewable Heat	Waste cold
Chiller <400 kW	Waste Heat	
Chiller >400 kW		

Figure 1: Concept for cooling technology clusters for the impact assessment and identification of innovative systems (marked green) according to the considerations of the renewable cooling definition options.

Out of the described cooling technology clusters, which we use for the foresight analysis, we determine “innovative” technologies as the ones using a cold source other than air and ambient water or using renewable energy as input to the cooling generator (see Figure).

Two main scenarios were developed to determine the inventory of cooling appliances in Europe for 2030 and 2050. For both scenarios, the same cooling demand and the same number of cooling appliances to cover this cooling demand are assumed. However, the scenarios differ in the percentage of different cold sources used by the respective technologies and in the percentage of technologies using renewable energy input.

In this respect we defined an "ambitious" scenario and a "baseline" scenario. For developing the scenarios, we considered the following constraints relevant for the diffusion of innovative cooling technologies:

- Some technologies are limited to new buildings and deep retrofitting of buildings (e.g. use of aquifers or ground heat exchangers in split systems). For the purpose of this estimation, the limit to new buildings and deep retrofitting of buildings was estimated as each 1.5% annually.
- Systems only applicable for district cooling or similar large scale applications (e.g. the use of waste heat). This market constraint was set to 1% for 2030 and 2050, i.e. that no more than 1% of the cooling demand is covered by these systems.

- Required space (e.g. for the case of solar thermal absorption systems). For these systems the possible market diffusion constraint was set to 15%.
- Market diffusion constraints on or how well developed the technology is for the market. For technologies which currently show a very low market share but are expected to develop in the future years the constraint was set to 30% for 2030 and 80% for 2050.

For the “baseline” scenario, we assumed half of the share of innovative cooling technologies along the border of the defined diffusion constraint. For the 2050 “ambitious” scenario we assumed that 100% of the technologies are at least partly powered by local renewable energy sources. We call such technologies “innovative” technologies in the further course of this work. The only exception are movables + window units. They are never considered to be powered by local renewable energy sources. The share of innovative technologies in 2030 is then linearly interpolated in between the base year and 2050 where 100% are considered renewable (except movables + window units). This results in a share of cooling technologies in the stock of systems in the two scenarios as shown in Figure .

The increase in energy efficiency of the technologies in the future is considered to be the same in both the “baseline” and the “ambitious” scenario. The energy efficiency for the technologies and their percentage distribution for the EU27+UK is shown in the Annex in Table 7 regarding 2030 and Table 8 regarding 2050.

Regarding the share of technologies, using local renewable energy input, it needs to be emphasized that the share of local renewable energy input is smaller, because part of the energy input is still used from the grid. I.e. these systems for which we assume a local renewable energy input, only cover part of their energy input by local concomitant renewables.

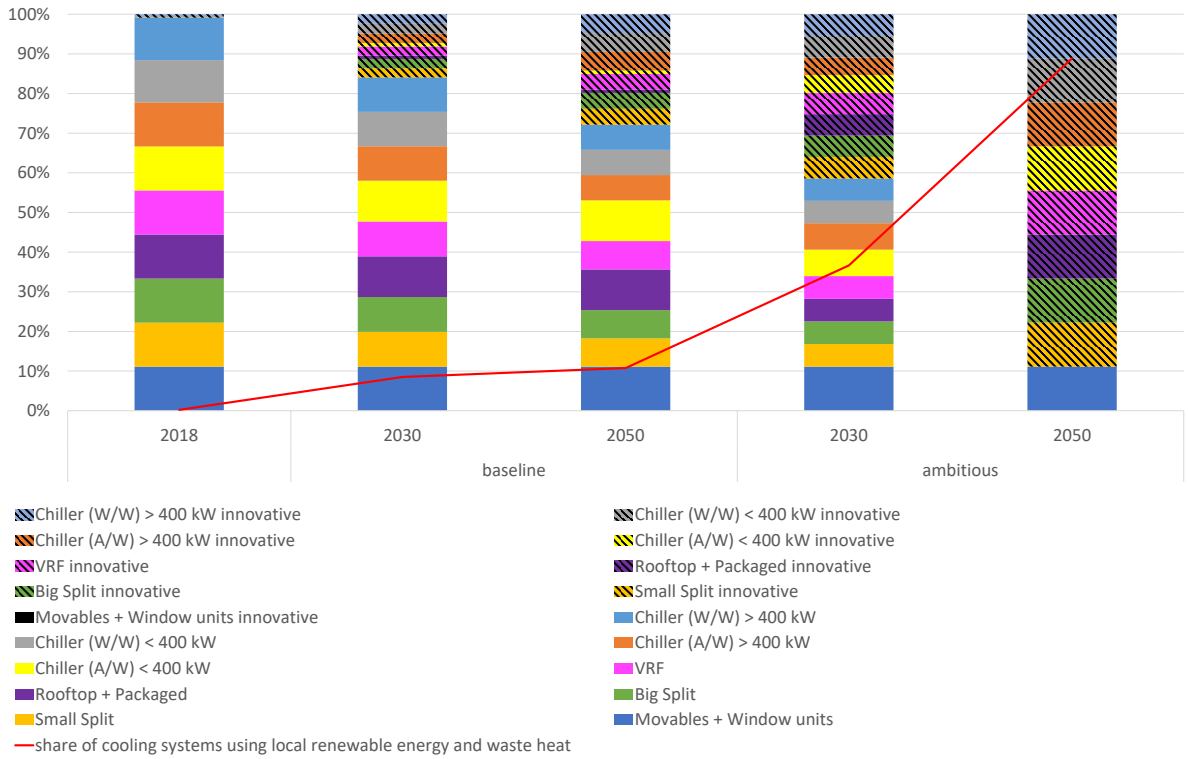

Figure 2: Share of cooling technology types in the stock of cooling systems and share of technologies using renewable local energy input in EU-27 in two scenarios.

In addition to a sensitivity analysis based on the SPF_P thresholds defined in [3] chapter 3.4, we show the impact of low SPF_P-thresholds on RES-Shares and RES-HC shares for different

Member States. Furthermore, as the cooling demand of each member state can only be an estimation, an analysis on the impact of the useful energy demand in different scenarios by 2030 and 2050 is carried out in chapter 3.5.

3. Analysis of the impacts of renewable cooling energy definition on RES-Shares

The following chapter describes various impact analyses which were performed on the renewable cooling energy definitions.

Chapter 3.1 and 3.2 addresses the impact of the different renewable cooling definition options proposed in [3] for the year 2018, 2030 and 2050. In Table 2 these definition options are illustrated which are namely 1.A1, 1.A2, 1.B and 2.A1, 2.A2, 2.B. For options starting with “1” the renewable useful energy used for cooling was added to the numerator and denominator of the current RES and RES HC shares. Options starting with “2” have the renewable useful energy used for cooling added to the nominator and the total useful energy used for cooling added to the denominator. A1 does not add any renewable energy input to the renewable cooling quantity. A2 adds local, concomitant renewable energy input to the renewable cooling quantity. Option B takes into account the final renewable energy of the grid additionally to A2.

In chapter 3.3 the impact of different SPF thresholds is analyzed. Chapter 3.4 elaborates the impact of the possible use of national η-values instead of an EU-wide value as proposed in [3]. In chapter 3.5 the influence of the future final cooling energy demand is discussed.

Table 1 presents the different sensitivity analysis that have been carried out in the course of this study. The columns “Main calculation in this document” describes the method that is generally used in each sensitivity analysis. For example the comparison of the “Eta development by 2050” between *constant* and *decreasing* is carried out with the share calculation option 1.A1, EU-eta values etc. The table also provides an overview in which chapter each analysis can be found.

Table 1: Dimensions of impact assessment calculation

	Main calculation in this document	Other calculation variations	Where to find it in this report (chapter/figure)
Share calculation options	**1.A1**	1.A2, 1.B, 2.A1, 2.A2, 2B	Chapter 3.1, 3.2
Eta development by 2050:	**constant**	decreasing	Chapter 3.4
Eta national vs. EU	**EU**	national	Chapter 3.4
SPF_p threshold forms	**2**	1	Chapter 3.3; Additional results in the annex Table 42 , Table 44
SPF_p threshold values	**Low: 2,8**	Several variations	Figure 17-19
T_RE[4] considered	**Yes**	No	Results in the annex: Table 42, Table 43, Table 44, Table 45
Development of UED	**RES-C_EUCO**	other scenarios	Chapter 3.5

Table 2: Renewable cooling share calculation options. [5]

$Q_{C\_Supply\_RE}$ … supplied cooling energy which is considered renewable
E_{INPUT_RE} … final energy used for cooling which is considered renewable including renewable local energy, renewable heat and in the case of the RES calculation also waste heat as renewable input.
$E_{INPUT\_RE\_GRID}$ … electricity from the grid used for cooling which was generated by renewable sources
Q_{C_Supply} … total supplied cooling energy

1		
A1	A2	B
$RES = \frac{RES_{ref_{numerator}} + Q_{C\_Supply\_RE}}{RES_{ref_{denominator}} + Q_{C\_Supply\_RE}}$	$RES = \frac{RES_{ref_{numerator}} + Q_{C\_Supply\_RE} + E_{INPUT\_RE}}{RES_{ref_{denominator}} + Q_{C\_Supply\_re}}$	$RES = \frac{RES_{ref_{numerator}} + Q_{-Supply\_RE} + E_{INPUT\_RE} + E_{INPUT\_RE\_GRID}}{RES_{ref_{denominator}} + Q_{C\_Supply\_RE} + E_{INPUT\_RE} + E_{INPUT\_RE\_GRID}}$
2		
A1	A2	B
$RES = \frac{RES_{ref_{numerator}} + Q_{C\_Supply\_RE}}{RES_{ref_{denominator}} + Q_{C\_Supply}}$	$RES = \frac{RES_{ref_{numerator}} + Q_{C\_Supply\_RE} + E_{INPUT\_RE}}{RES_{ref_{denominator}} + Q_{C\_Supply}}$	$RES = \frac{RES_{ref_{numerator}} + Q_{supply\_re} + E_{INPUT\_RE} + E_{INPUT\_RE\_GRID}}{RES_{ref_{denominator}} + Q_{C\_Supply}}$

As discussed in [3], the study team did not identify a clear preference between the progressive 1 threshold form (based on a high and a low threshold) and progressive 2 threshold form (based only on a minimum threshold). Due to the timing of the calculations, the results in this

[4] T_RE is used as a "renewable bonus" modifying the SPF_p to SPF_{p_re} which is described in [3] in chapter 3.4.4.

[5] In this table only the calculation for the RES share is shown. For the RES HC the method is the same except that E_{re} does not include waste heat as a renewable energy input.

chapter are carried out for the progressive 2 method[6]. During the further discussions and analyses in the project, the decision was taken to propose the progressive 1 method in the calculation method.

3.1. Impact on RES and RES-HC shares in the base year 2018

In this section, we analyse the impact on RES-Shares of different renewable cooling definition options proposed in [3] chapter 3.

For proposed parameter settings and for the proposed SPF_P-thresholds (see [3] chapter 3), the results for the base year 2018 in general do not show a strong impact of renewable cooling definition options on RES-HC and RES shares. This is because almost none of the cooling technologies in the stock of systems today reaches the SPF_{P_MIN} threshold[7]. This can be observed in Figure 3 and Figure 4 as option 1.A1 does not differ significantly from the reference share. Option 1.A2 shows only slightly different results (mostly not visible in the figure below) which is due to the fact, that in 2018 the share of locally produced renewable energy is insignificantly small compared to the total cooling energy consumption.[8] Options 2.A1 and 2.A2 show a reduction in the respective shares as the total cold supply is added to the denominator. Options 1.B and 2.B (see [2] chapter 3) result in a visible difference from the reference share in some countries as the renewable electricity from the grid is considered, which for some countries leads to the fact that a considerable share of cooling systems fulfils the SPF_{P_RE} threshold. In general, calculating the RES and RES HC with option (2) always results in a lower share compared to the reference share whereas option (1) increases the overall RES and RES HC share.

[6] Method where a single minimum SPF threshold is used to calculate the renewable share which is explained in [3] chapter 3.4.3 and also illustrated in chapter 3.3 of this report.

[7] As discussed in [3], the study team did not identify a clear preference between the progressive 1 threshold form (based on a high and a low threshold) and progressive 2 threshold form (based only on a minimum threshold). Due to the timing of the calculations, the results in this chapter are carried out for the progressive 2 method. During the further discussions and analyses in the project, the decision was taken to propose the progressive 1 method in the calculation method.

[8] As described in the methodology report [3] we propose that local, concomitant renewable energy input is only considered when measured on-site on cooling system level. We assume that this is hardly the case for the base year.

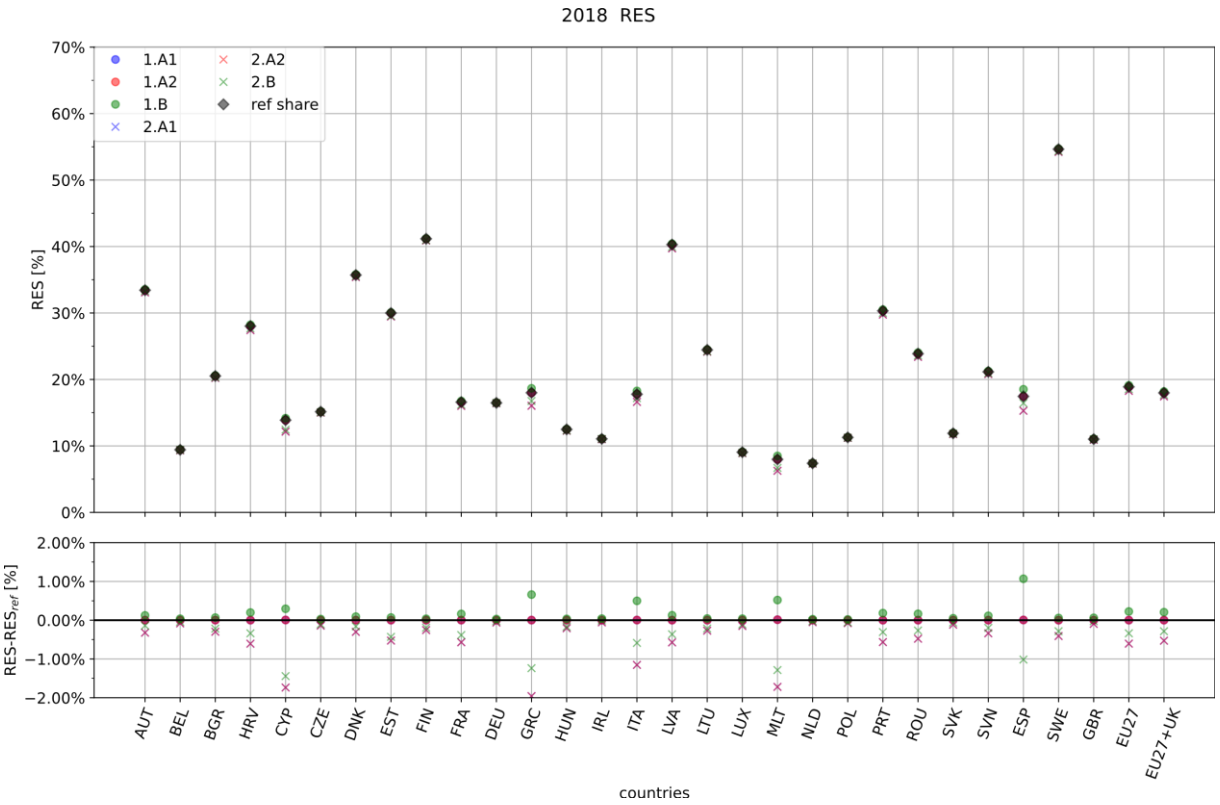

Figure 3: Share of RES for all EU member states as well as EU27 and EU27+UK in 2018. Top: RES as percentage. Bottom: Difference between calculation methods and the reference share.

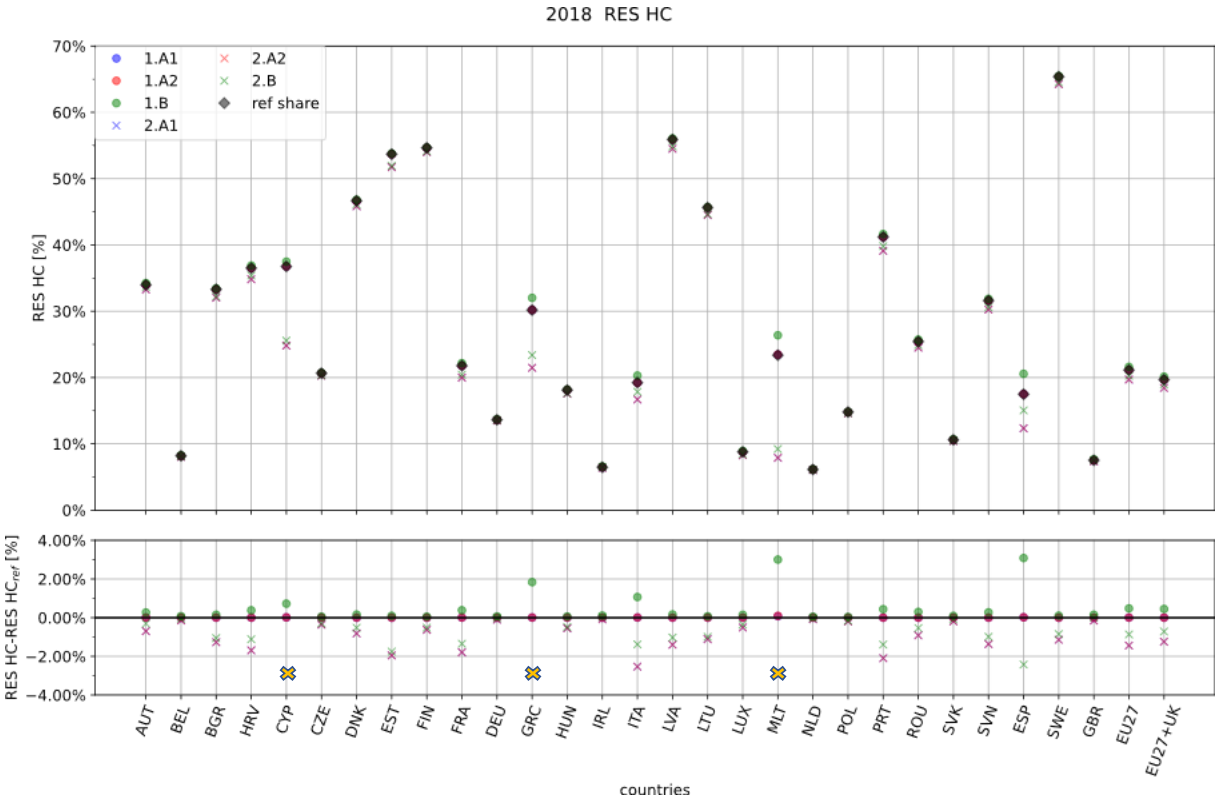

Figure 4: Share of RES in HC for all EU member states as well as EU27 and EU27+UK in 2018. Top: RES HC as percentage. Bottom: Difference between calculation methods and the reference share.[9]

[9] The yellow cross in the graphic indicates that values are cut off by in the bottom graph. These values are only visible in the top graph.

Conclusion: For the year 2018 the impact of option 1 is not visible except for option 1B where the renewable electricity from the grid is counted as well. Option 2 results in every country in a lower RES and RES HC as the renewable input is neglectable because no technologies reach the minimum SPF threshold.

3.2. Impact on RES and RES-HC shares for 2030 and 2050

For the sake of simplicity, only the "ambitious" scenario will be discussed in detail in this section. The results for the "baseline" scenario are listed in the Annex.

Figure 5 and Figure 6 show the resulting RES and RES HC shares for the year 2030 for each country and the EU27 plus EU27+UK under the assumptions described in [3] chapter 3[10]. It is visible that southern countries (in particular MT, CY, GR, ES, IT and to some extent also FR) with a high cooling demand, are affected much more by the different RES-C definition options. For northern countries, results differ only marginally between the RES-C definition options. The graph in the middle represents the increase in RES and RES HC compared to the year 2018. Countries with a greater increase in RES and RES HC will achieve the EU goals set for 2030 more easily or with less effort. The difference between the "ref-share" values and the different RES-C definition option shares indicates whether it is easier or more difficult to achieve the annual RES-HC 1.3 ppt increase. The exact values for the difference between 2030 and 2018 for each country are listen in the annex.

The bottom graph illustrates the difference of the RES-C definition options to the reference share in 2030. In general, the RES HC share is stronger affected by the different RES-C definition options than the RES share. This is due to the fact, that the RES HC also takes waste heat into account and numerator and denominator in the reference share for RES HC are smaller. Therefore, the addition in numerator and denominator has a bigger influence on the result for RES-HC than for RES shares.

Note that in the bottom graph of Figure 5, Figure 6, Figure 7 and Figure 8 the y-axis is limited to +-4% and +-5% respectively. Countries where calculation options exceed these boundaries are not visible in the bottom graph.

For the assumption of the useful energy demand, data was taken from Eurostat in the baseyear. To calculate the UED in 2030 and 2050 data from EUCO3232.5 [7] was used as described in chapter 2. Because of some differences in the base year between EUCO 3232.5 and Eurostat in some countries, (namely Croatia, Cyprus, Denmark, Estonia and Lithuania) the rise in reference RES and RES HC was either very small or even negative from 2018 to 2030. To correct this inconsistency, we assumed a fixed increase in RES HC of 11% for these countries. The reference RES HC nominator was adapted so the RES HC share would reach 11%, in line with the requirements of the RED II. The absolute change in the RES HC nominator was then increased by the same amount. This way it was ensured that Croatia, Cyprus, Denmark, Estonia and Lithuania have a realistic reference share that does not decline from 2018 to 2030.

Figure 5 to Figure 9 show the results for the years 2030 and 2050 under the assumption of a constant primary energy efficiency value of electricity generation η. While this does not reflect the expected and envisaged changes of electricity generation in the energy transition and

[10] This holds for all assumptions except for the form of the $s_{SPF\_P\_RE}$ threshold. As discussed in [3], the study team did not identify a clear preference between the progressive 1 threshold form (based on a high and a low threshold) and progressive 2 threshold form (based only on a minimum threshold). Due to the timing of the calculations, the results in this chapter are carried out for the progressive 2 method. During the further discussions and analyses in the project, the decision was taken to propose the progressive 1 method in the calculation method.

decarbonization process, it should help to isolate the impacts of the RES-C definition as such, without considering the overall process of the changing energy system. Subsequently, the analysis is carried out as an additional variation under the assumption of increasing primary energy efficiency (η) (Figure 10 to Figure 13). Additional analyses on the impact of applying national η-values are presented in chapter 3.4.

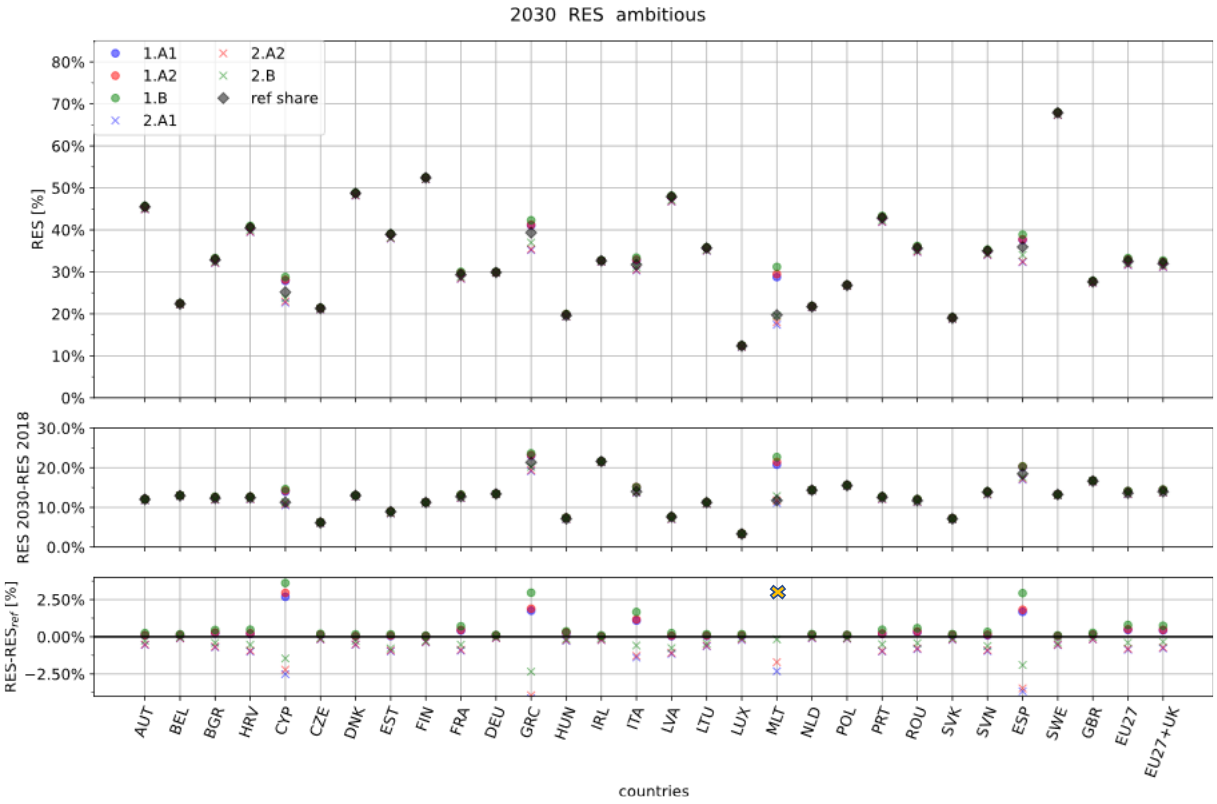

Figure 5: Share of RES for all EU member states as well as EU27 and EU27+UK in 2030, assuming constant η. Top: Share of RES as percentage. Middle: Difference in shares compared to 2018. Bottom: Difference between calculation methods and the reference share.

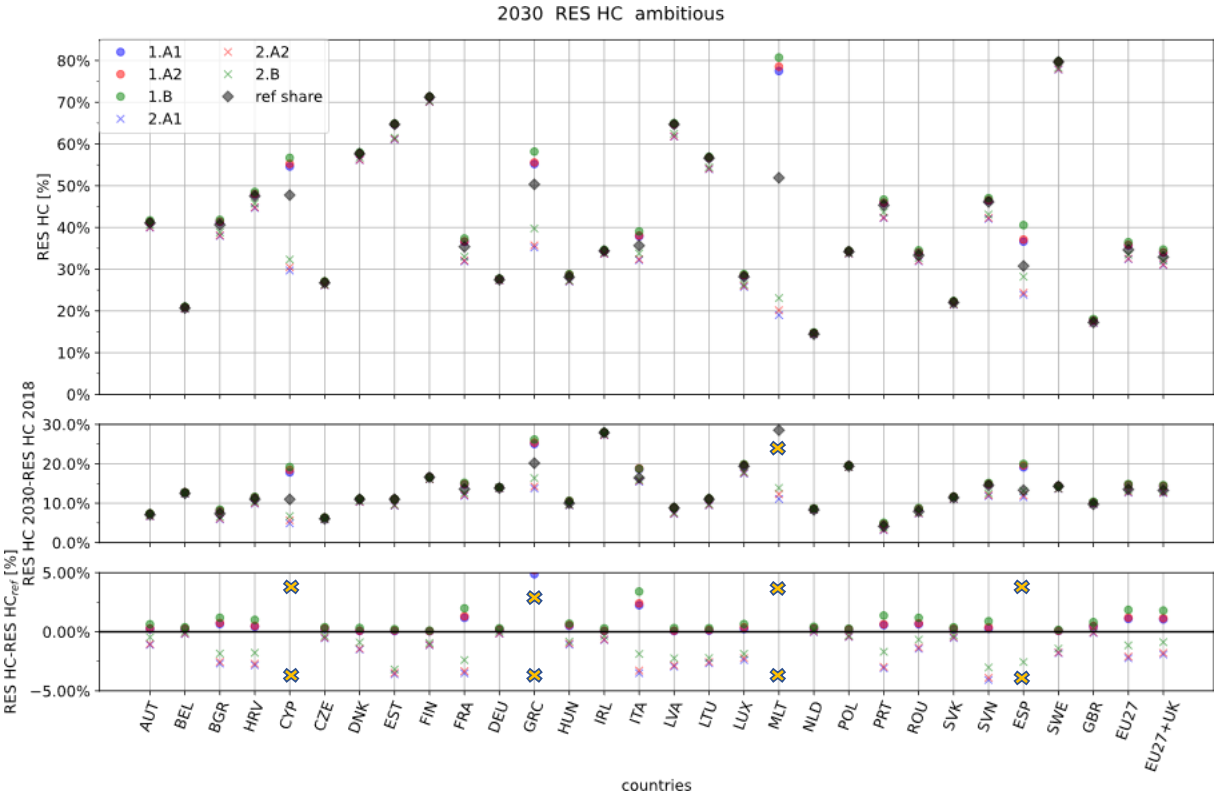

Figure 6: Share of RES HC for all EU member states as well as EU27 and EU27+UK in 2030, assuming constant η. Top: Share of RES HC as percentage. Middle: Difference in shares compared to 2018. Bottom: Difference between calculation methods and the reference share.[5]

Figure 7 and Figure 8 present the RES and RES HC shares for the year 2050. The top graph illustrates the total results whereas the bottom graph displays the difference of the different methods to the reference share. Again, the southern countries with high cooling demand show much higher deviations compared to the reference share than the rest of the Member States.

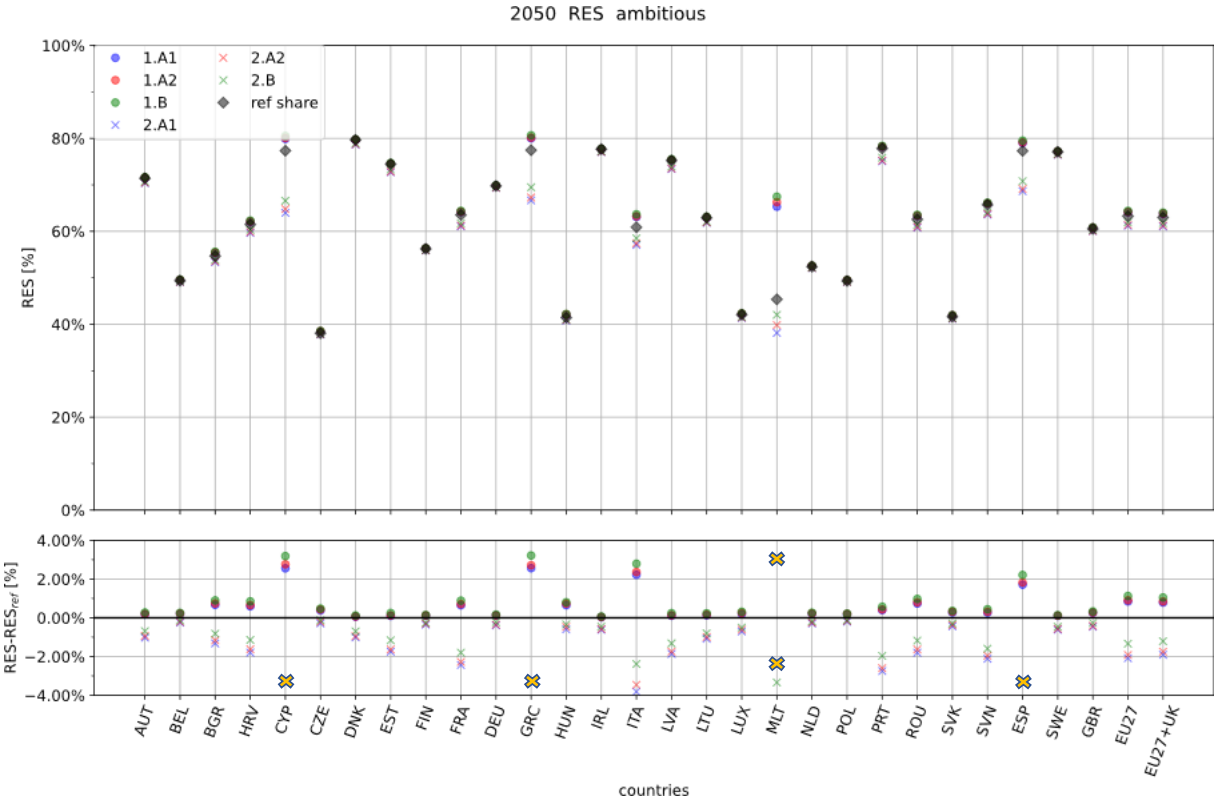

Figure 7: Share of RES for all EU member states as well as EU27 and EU27+UK in 2050, assuming constant η. Top: Share of RES as percentage. Bottom: Difference between calculation methods and the reference share.

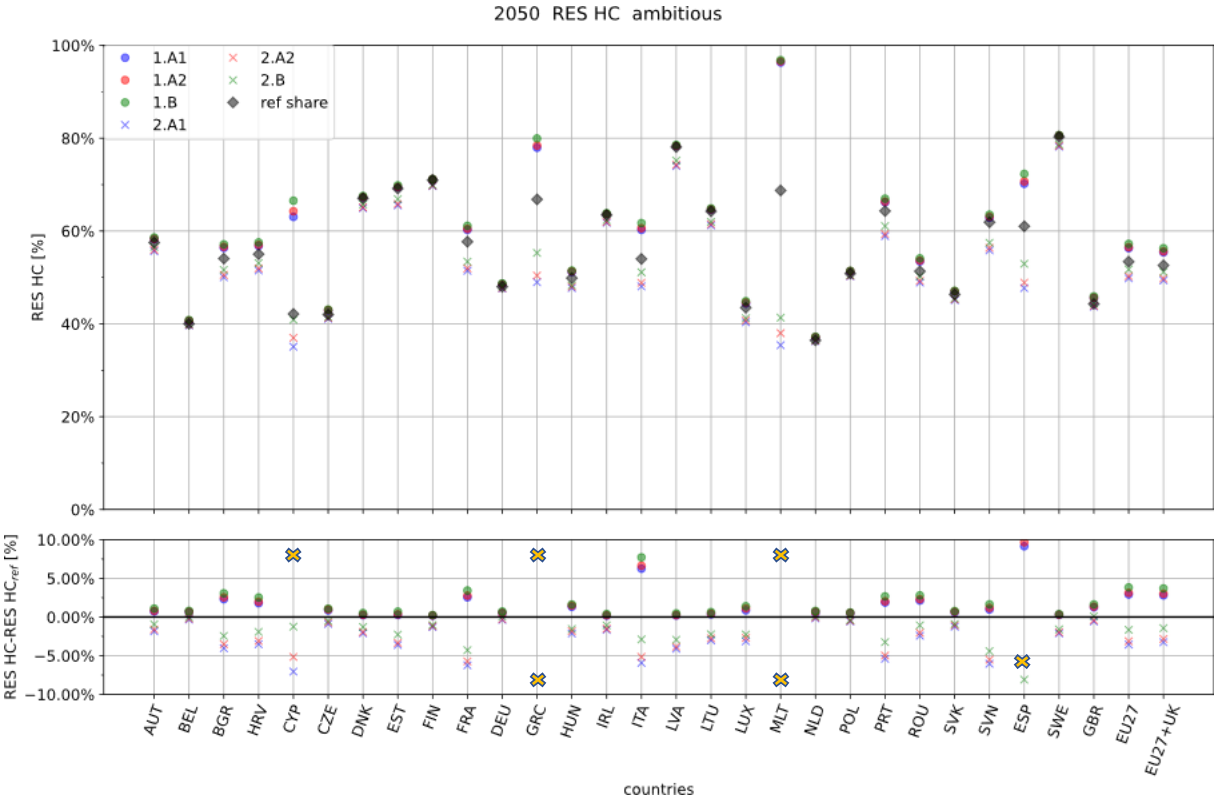

Figure 8: Share of RES HC for all EU member states as well as EU27 and EU27+UK in 2050, assuming constant η. Top: Share of RES HC as percentage. Bottom: Difference between calculation methods and the reference share.

The observations made in the RES HC are the same for the RES. The data is provided in the result tables of the Annex.

For 2050 the difference between the “ambitious” and the “baseline” scenario becomes very visible. This can be observed in Figure 9 where the difference for all 6 calculation methods between the “ambitious” and the “baseline” scenario is visualized for the EU27. A large increase means that the respective option is affected strongly by the chosen scenario. This, in turn means that the different options give different incentives to promote the use of renewable or highly efficient technologies because the ambitious scenario is characterized by a higher percentage of innovative, highly efficient technologies.

In general option (2) results in a more significant difference between the two scenarios. Among the definition options (A1, A2, B) A2 delivers the largest difference for the RES and RES HC share between the “baseline” and the “ambitious” scenario. Since the only difference between those two scenarios (“ambitious” and “baseline”) are the different percentages in used innovative technologies, it can be derived that option 2.A2 creates a larger incentive to use innovative cooling technologies. Option B shows the smallest difference among the options A1, A2 and B. In particular, in countries with high renewable share in the grid, Option B would give almost no incentive at all to promote renewable cooling technologies.

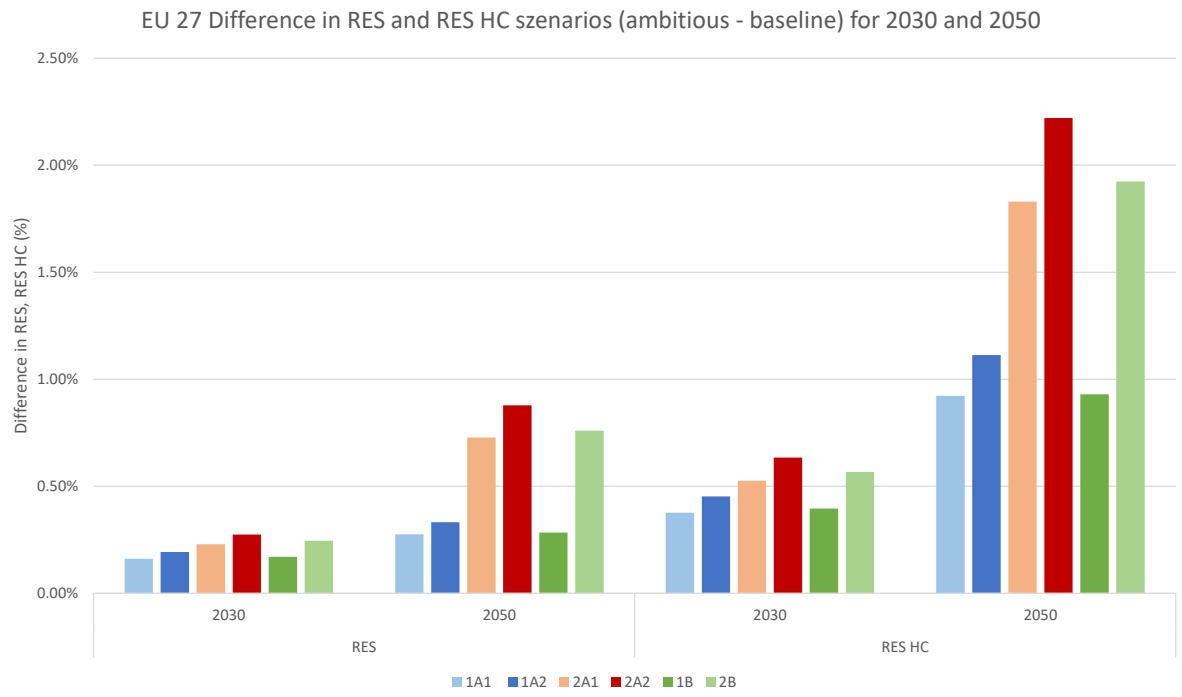

Figure 9: Difference between “ambitious” and “baseline” scenario in RES and RES HC shares for EU27 for the different renewable cooling definition options, assuming constant η.

Figure 10 to Figure 13 represent the same results as Figure 6 to Figure 9, however assuming increasing η (described in [2] chapter 3.4.2”SPF metrics”), with which the SEER is converted to SPF_p. It is assumed that 1/η reaches 1.05 in 2050 and for 2030 the value for η is interpolated between 2021 and 2050. Therefore, 1/η results in 1.77 for 2030. This leads to higher RES and RES HC shares than in the previous calculation, because a higher share of cooling supply reaches the SPF threshold and thus is counted as renewable.

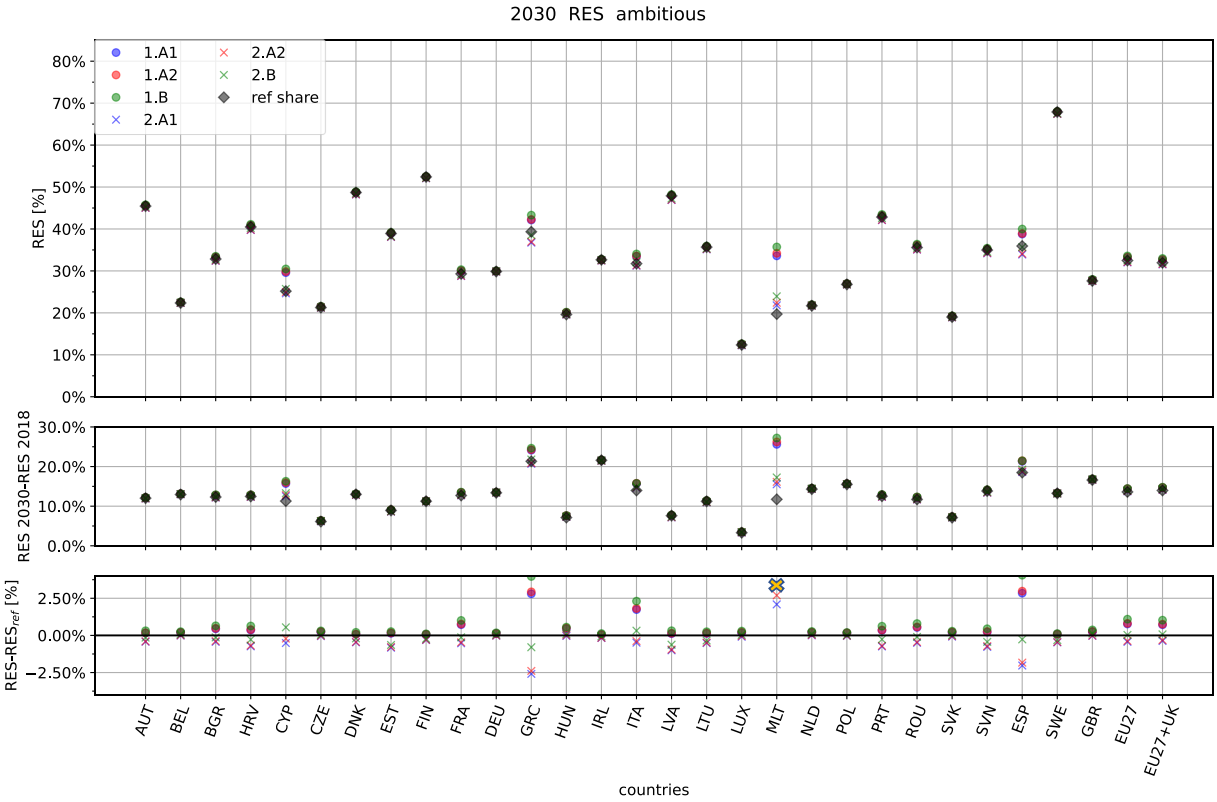

Figure 10: Share of RES for all EU member states as well as EU27 and EU27+UK in 2030. Top: Share of RES as percentage, assuming 1/η is 1.77. Middle: Difference in shares compared to 2018. Bottom: Difference between calculation methods and the reference share.

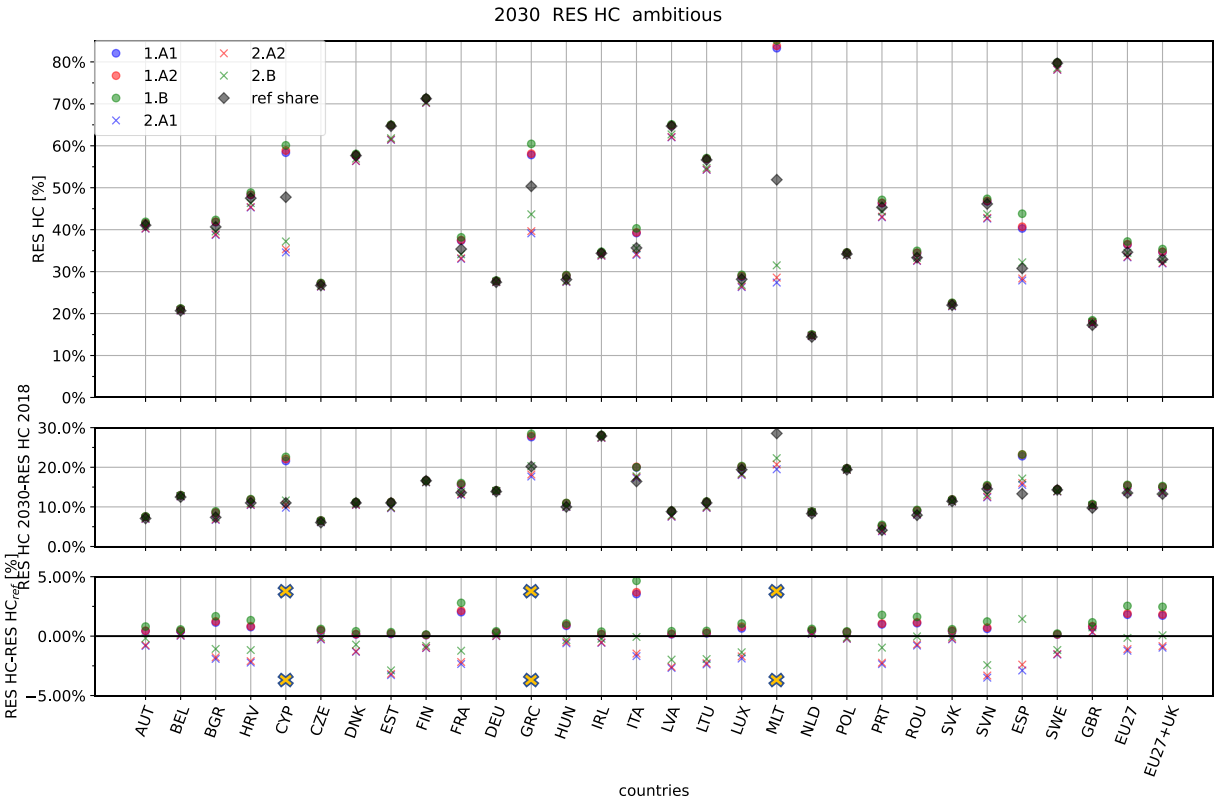

Figure 11: Share of RES HC for all EU member states as well as EU27 and EU27+UK in 2030. Top: Share of RES HC as percentage, assuming 1/η is 1.77. Middle: Difference in shares compared to 2018. Bottom: Difference between calculation methods and the reference share.

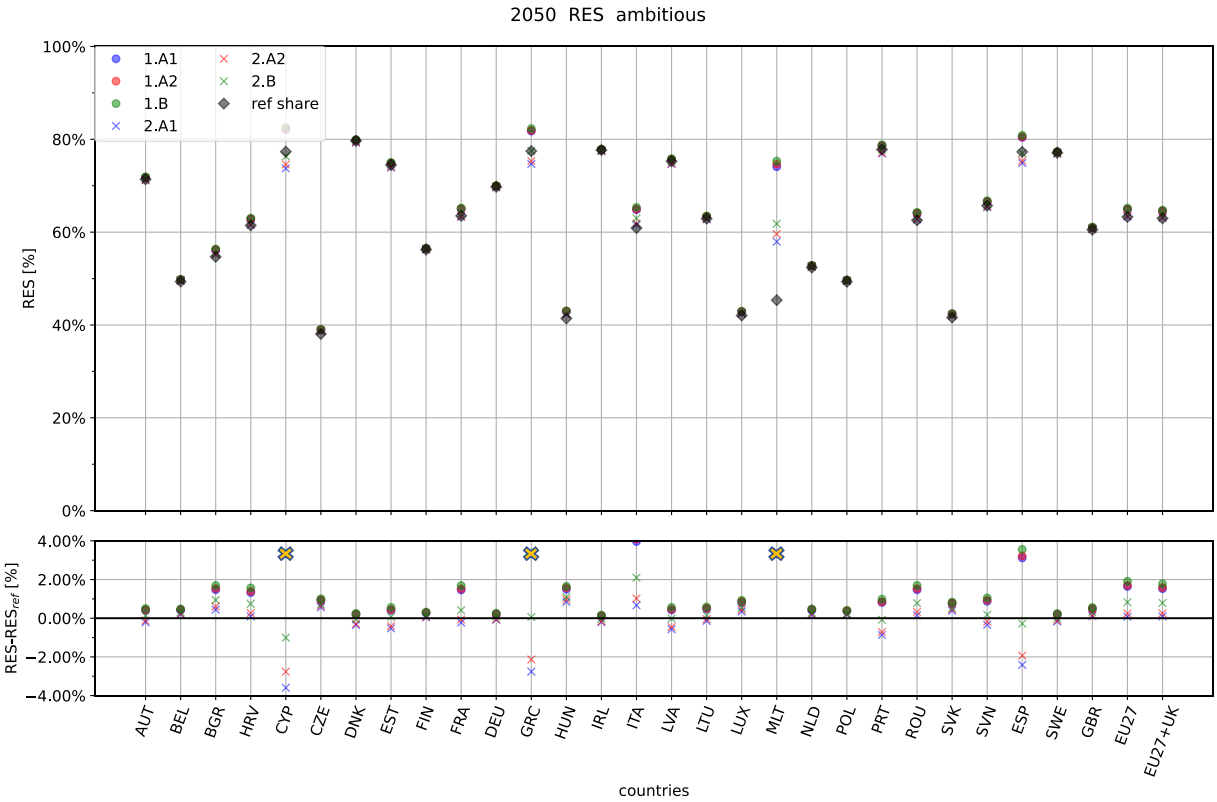

Figure 12: Share of RES for all EU member states as well as EU27 and EU27+UK in 2050. Top: Share of RES as percentage, assuming 1/η is 1.05. Bottom: Difference between calculation methods and the reference share.

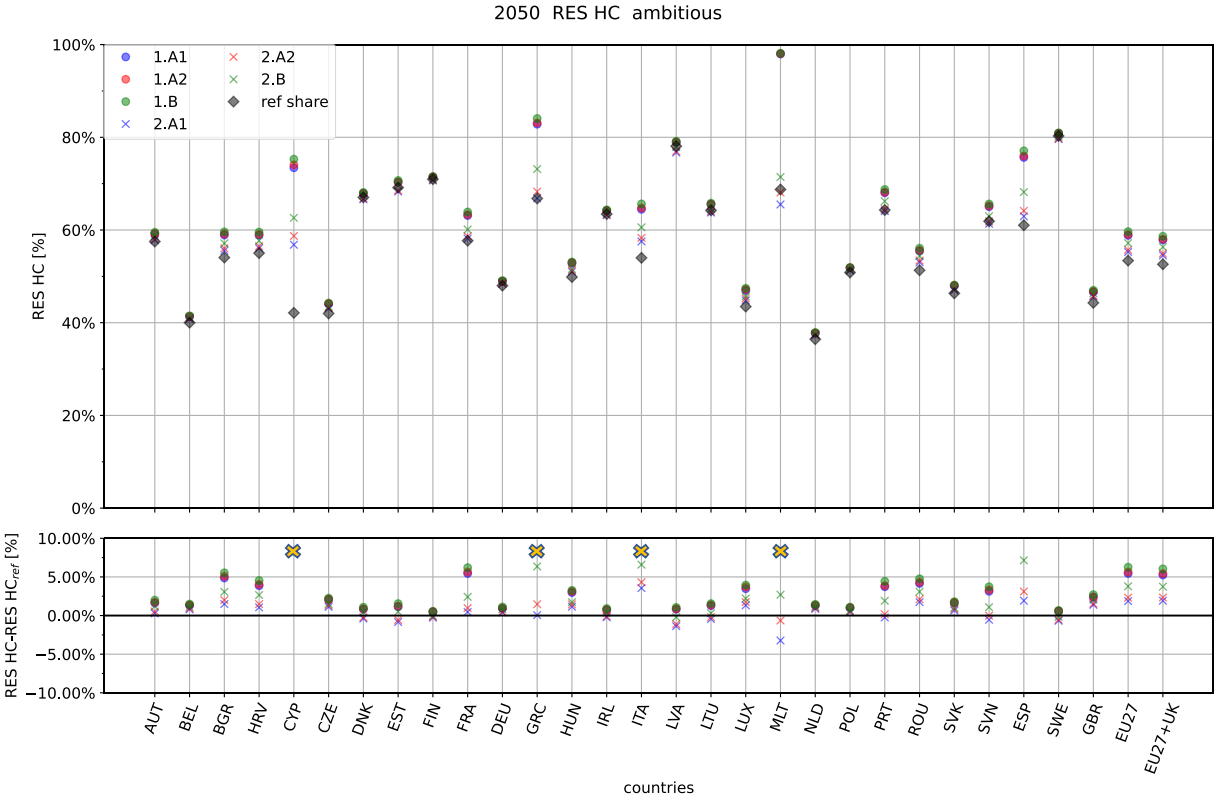

Figure 13: Share of RES HC for all EU member states as well as EU27 and EU27+UK in 2050. Top: Share of RES HC as percentage, assuming 1/η is 1.05. Bottom: Difference between calculation methods and the reference share.

Conclusion: In summary the calculation option 1 results generally in higher RES and RES HC shares whereas option 2 generally results in lower RES and RES HC shares compared to option 1. The calculation option 2A2 provides the highest incentive to use energy efficient technology whereas option B provides no incentive to use energy efficient technology in countries with high renewable share in the grid.

3.3. Different s_{spfP_re} methodologies and thresholds

The different s_{spfP_re} calculation methods are described in [3] chapter 3.4.3 the resulting RES and RES HC. The 3 different SEER threshold definition options are depicted in Figure 14. For the calculations in this report we use Option 3 (progressive 2).

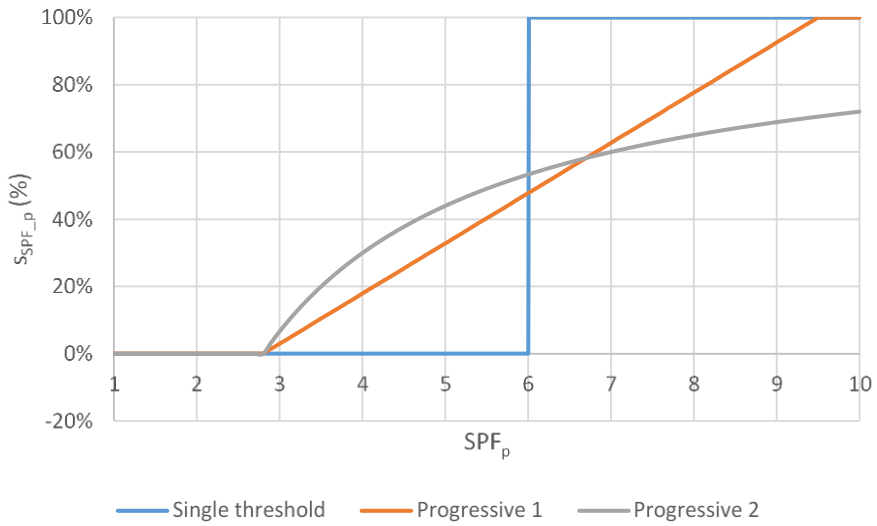

Figure 14: SPF_P threshold definition options 1, 2 and 3.

In this chapter, the impact of the proposed value of 2.8 (corresponds to a SEER of 6) is compared to an SPF_P threshold of 2 (SEER=4.2) and 3.8 (SEER=8). For the sake of simplicity, the following graphs will only be displayed for the ambitious scenario and the RES HC share. Compared to the option 2 (progressive 1), which was finally proposed in [3], the results presented here will lead to slightly different results but do not substantially change the conclusion that can be derived.

Figure 15 shows the calculated RES HC share for each country for the 3 different SEER options and the reference share. The impact of the threshold is especially strong for the countries with high cooling demand. Most noticeable are the results with a SEER of 4, where almost 100% of the technologies are counted as renewable and therefore the resulting share is visibly higher in every country. In countries where the shares do not differ significantly, the impact of renewable cooling on the RES HC is simply very low.

Results up to Figure 19 are again derived by assuming constant $1/\eta$, while Figure 20 assumes decreasing $1/\eta$ by 2030.

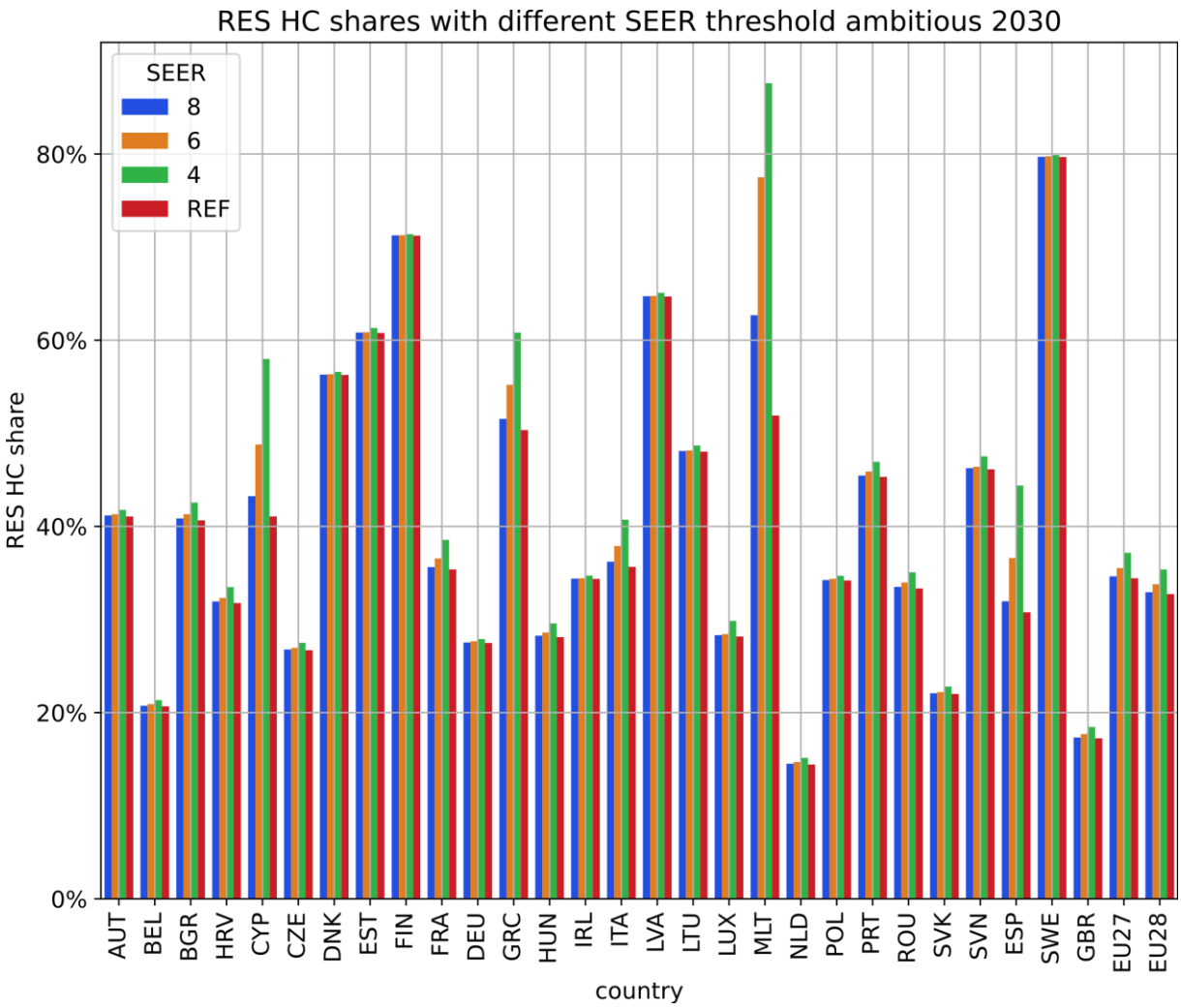

Figure 15: Share of RES HC for all member states with different SEER thresholds in 2030 for the ambitious scenario.

For the base year the results of options with threshold 6 and 8 are indifferent (Figure 16) because hardly any of the current technologies reaches a SEER of 6 today. Again, the RES-HC is higher for some countries when the SEER is set to 4.

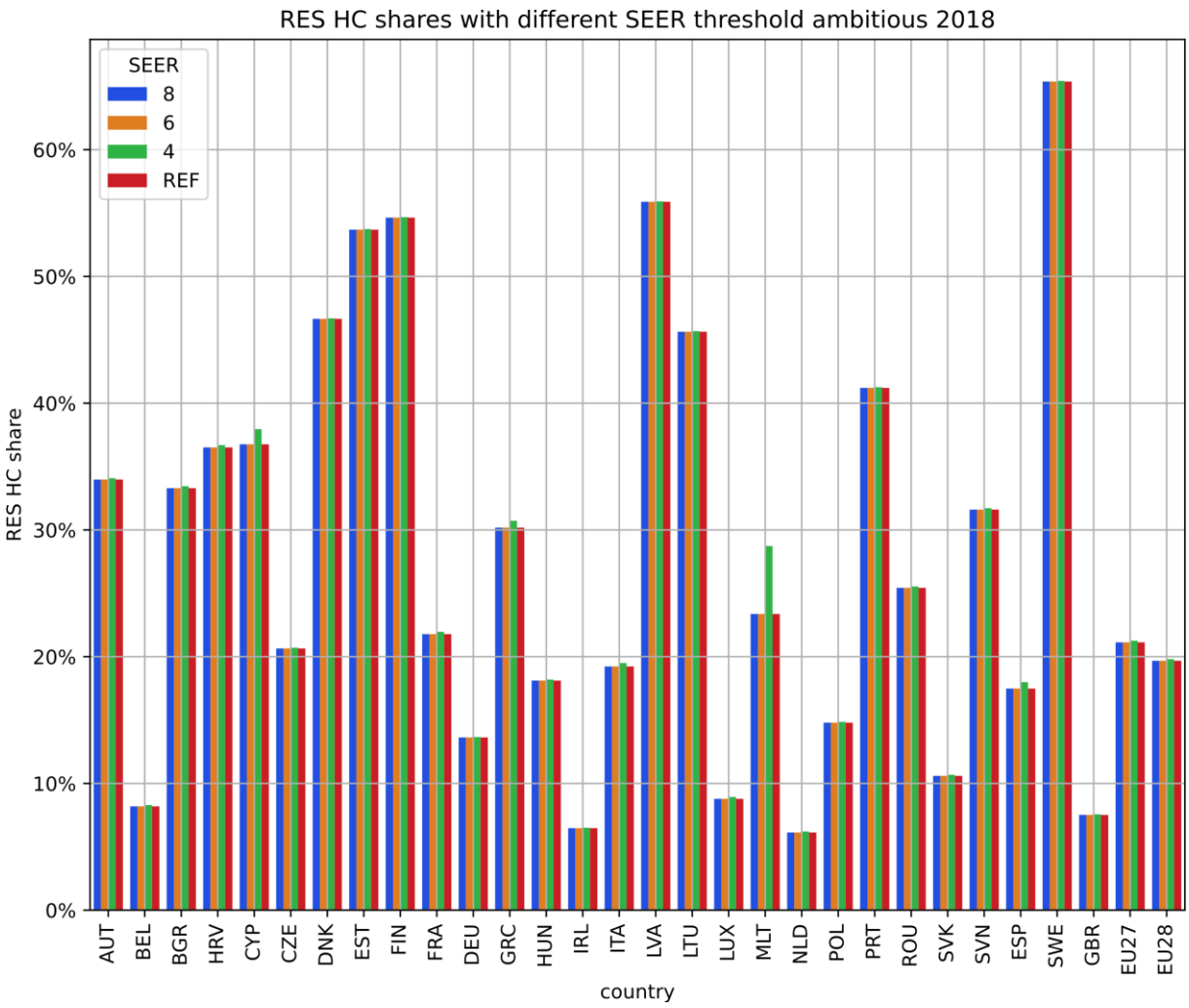

Figure 16: Share of RES HC for all member states with different SEER thresholds in 2018

For the year 2050 we see a clear difference between the three threshold choices in Figure 17. Even with a SEER of 8, there is an increase in RES HC in every country. This is also due to the fact that the ambitious scenario is depicted here, where 100% of the technologies are partly powered by local renewable energies in 2050.

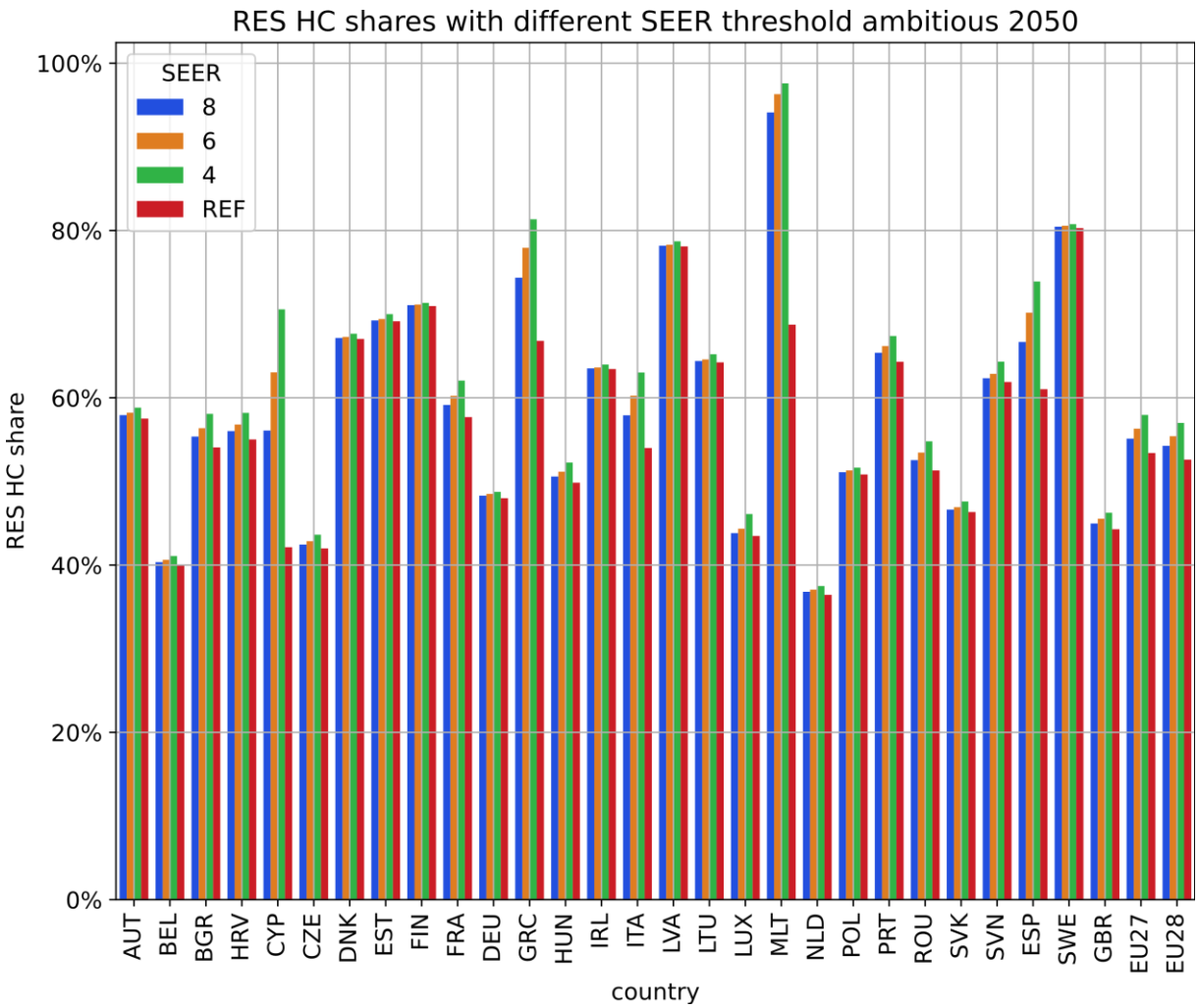

Figure 17: Share of RES HC for all member states with different SEER thresholds in 2050 for the ambitious scenario.

In order to evaluate the impact of the chosen SEER threshold for the EU27 in more detail Figure 18 gives an overview of the resulting RES HC and RES share for different SEER and their corresponding SPF_P thresholds. Again, the figure visualizes the results for the ambitious scenario. With the chosen SEER threshold of 6, the RES HC will increase by ~1.1% and the RES by ~0.5% compared to the reference share.

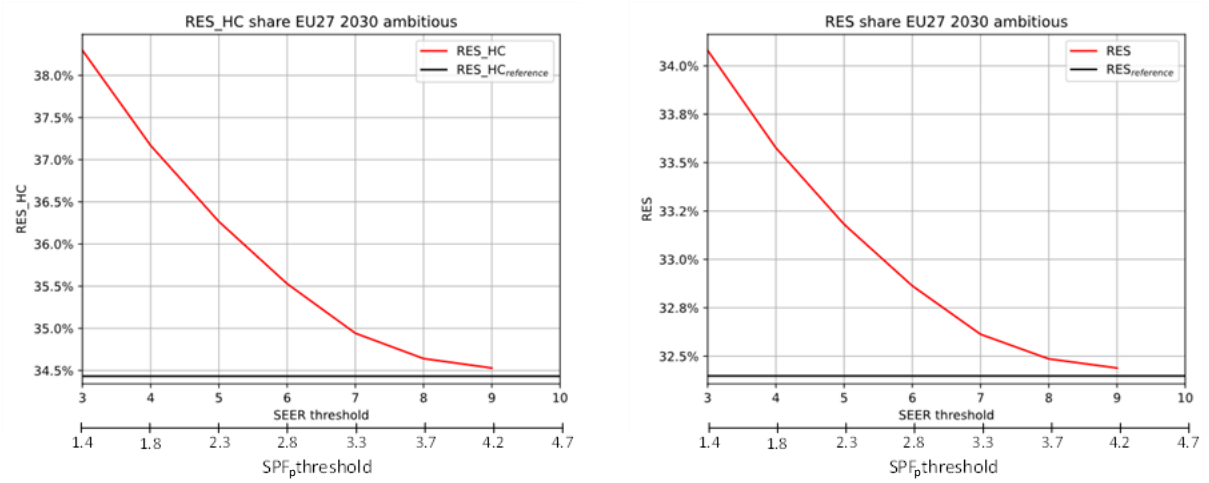

Figure 18: RES HC and RES share in dependence of the chosen SEER and SPF_p threshold for the year 2030.

In comparison, in the base year neither the RES HC nor the RES share change with a SEER of 6 (Figure 19) because hardly any current technology surpasses this threshold and the local renewable energy input to cooling generators is minimal.

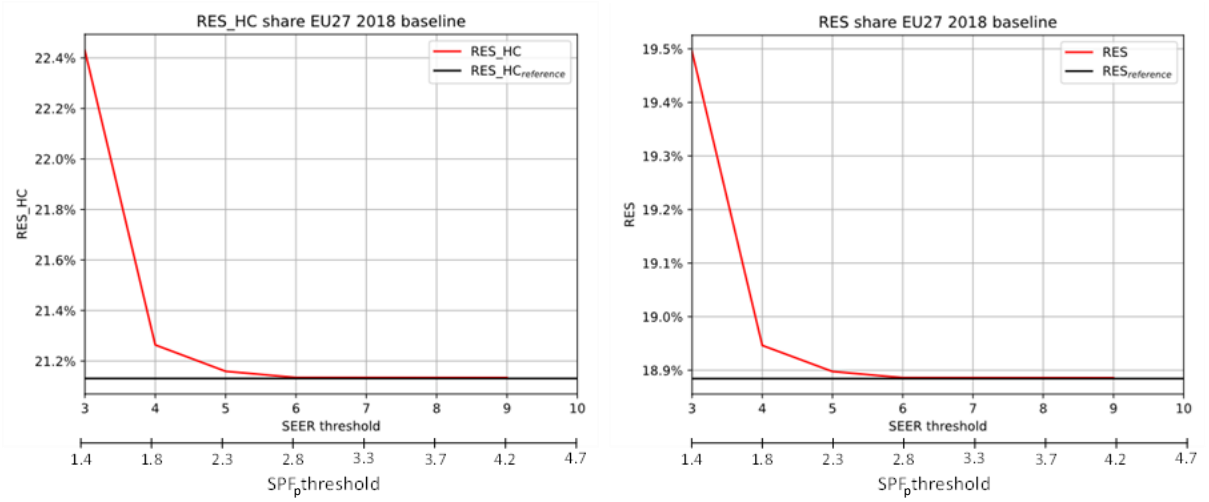

Figure 19: RES HC and RES share in dependence of the chosen SEER and SPF_p threshold for the year 2018.

Figure 20 is the pendant to Figure 18 only with a different conversion factor from SPF_P to SEER, reflecting the envisaged transition of the electricity generation. It is visible that compared to Figure 18 the resulting RES and RES HC are increasing.

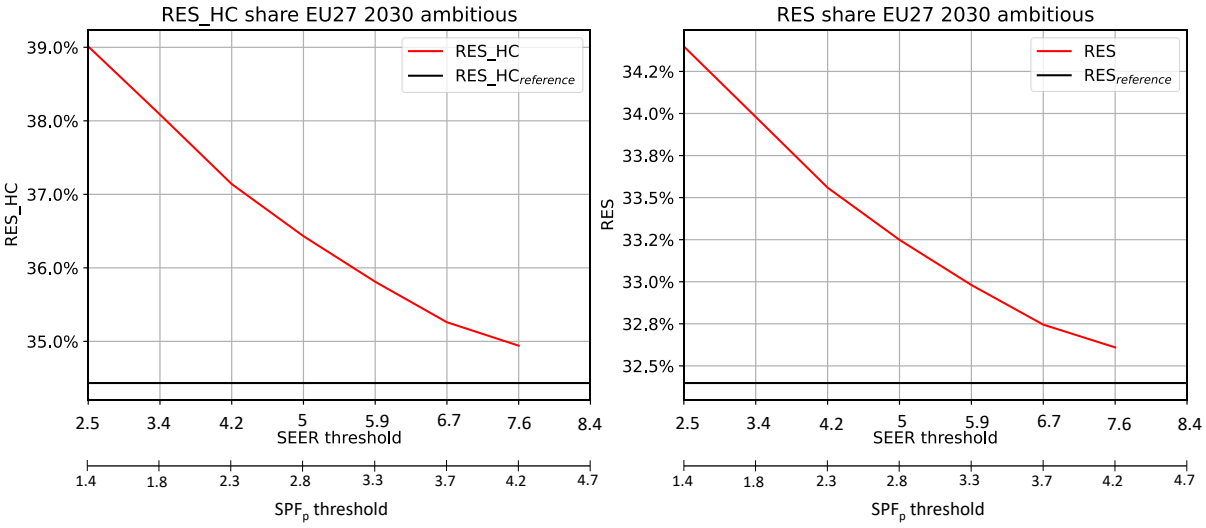

Figure 20: RES HC and RES share in dependence of the chosen SEER and SPF_p threshold for the year 2030 with a value of $1/\eta$ of 1.77.

Conclusion: In this chapter the significance of the SPF threshold was demonstrated. With a low threshold, any technology will count at least partly as renewable, thus the incentive to increase energy efficiency will be lost. The evaluation was carried out with a fixed conversion factor from SEER to SPF. If this conversion factor is reduced, the resulting RES and RES HC are going to increase.

3.4. Impact of national η-values instead of EU-wide value

In this part of the study the impact of the possible use of national η-values instead of EU-wide value as proposed in [3] is discussed. The used η-values for the year 2018 of each country are depicted in Table 3. To calculate the η-values for 2030 and 2050 it was assumed that the value of $1/\eta$ is 1.05 for 2050 in every country. For 2030 this value is then linearly approximated. The resulting values for $1/\eta$ are also provided in Table 3. For simplicity and to make comparison easier the results will be displayed next to the results with a steady EU-wide η-values only for the ambitious scenario and only for the RES-HC share. The exact results for ambitious and baseline scenario are provided in the Annex (Table 38, Table 39, Table 40 and Table 41).

In Figure 21 the resulting RES HC share difference between the reference share and the calculated share with either national or EU-wide η-values is depicted. Countries with a high η-value will slightly increase their share compared to when calculated with EU-wide values. Only for very few countries (Cyprus, France) the calculation with EU-wide η-values will result in a higher RES HC shares compared to a calculation with national values. For countries where $1/\eta$ results in a value around 2, there is no difference visible between the two options. The maximum increase in the resulting RES HC achieves Croatia with an increase of almost 0.3% compared to the resulting share when calculated with EU-wide shares.

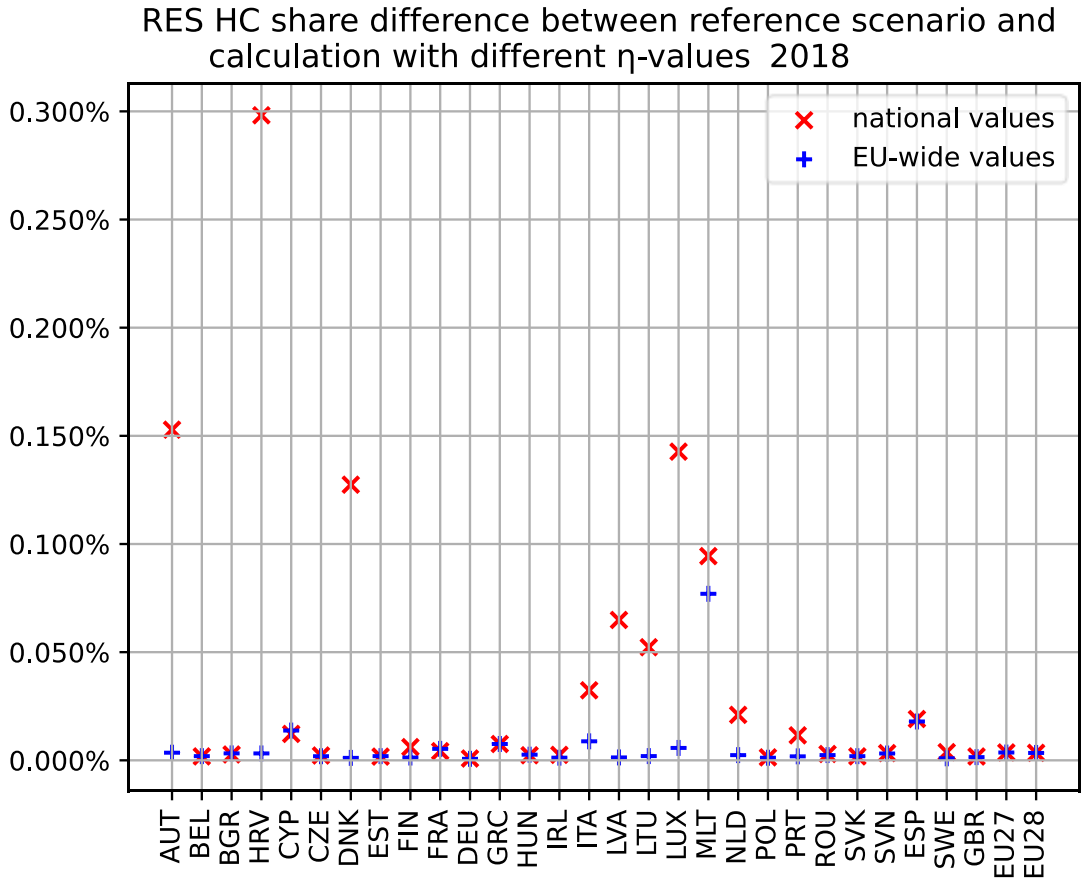

Figure 21: RES HC share difference between reference scenario and calculation with EU-wide and national η-values for the year 2018.

Because it was estimated that the value of $1/\eta$ will decrease to 1.05 until 2050 and the 2030 value will be linearly interpolated for national η-values, the same was done for the EU-wide values, in order to get a representative comparison.

In 2030 it can be observed that countries with initially higher η-values than EU average will increase their resulting RES HC share compared to the calculation with EU-wide values (Figure 22). On the contrary, countries which have a lower η-value now achieve visibly better results when calculating with EU-wide values (Cyprus, France, Hungary, Bulgaria). On European level the calculation with national values leads to a higher overall RES HC share but the difference is very small.

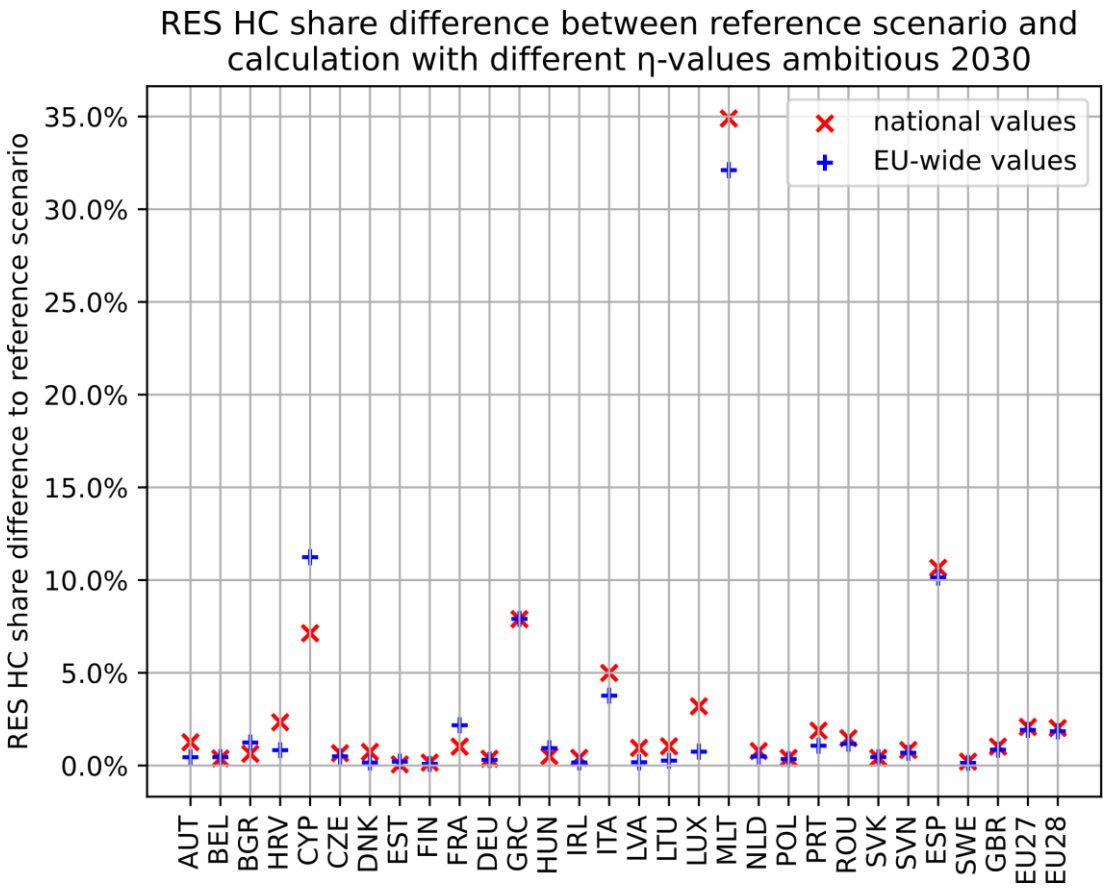

Figure 22: RES HC share difference between reference scenario and calculation with EU-wide and national η-values for the year 2030 in the ambitious scenario.

Because of these fluctuations between the choice of national and EU-wide η-values, the question arises: How do the shares on European level differ, if every country is free to choose between the two options? We assume that every country is going to choose the option resulting in the higher RES and RES HC share. We call this option "min η-values" as every country chooses the option with the smaller η-value. The resulting shares for the EU27 are depicted in Figure 23 for 2030 in the ambitious scenario. If countries can choose between EU-wide and national η-values the increase in overall RES and RES HC is significant. The "*min η-values"* option results in an increased RES HC of 4.1% and 4.3% compared to the national and EU-wide η-values respectively. The RES share rises by 2% and 2.1%. From this result it can be deducted that EU-wide η-values would give the highest incentive for using renewable energy to achieve climate goals. National values already result in slightly higher shares without any change in technology or renewable input. If each country can choose between EU-wide and national values, the incentive is further reduced by a large margin.

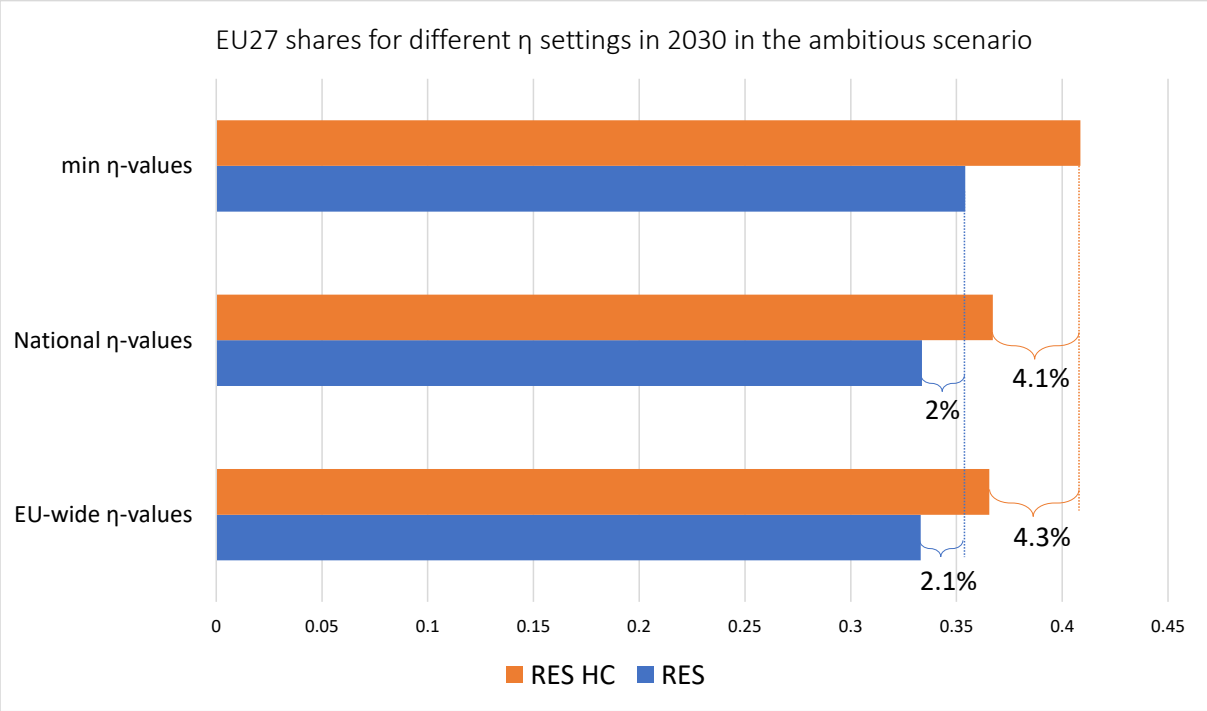

Figure 23: EU27 RES and RES HC share for different choice of η-values (EU-wide and national).

However, the effects of national and EU-wide η-values is non-existent in 2050 anymore (Figure 24). This is because of the initial assumption of 1/η-values of 1.05 for every country in 2050.

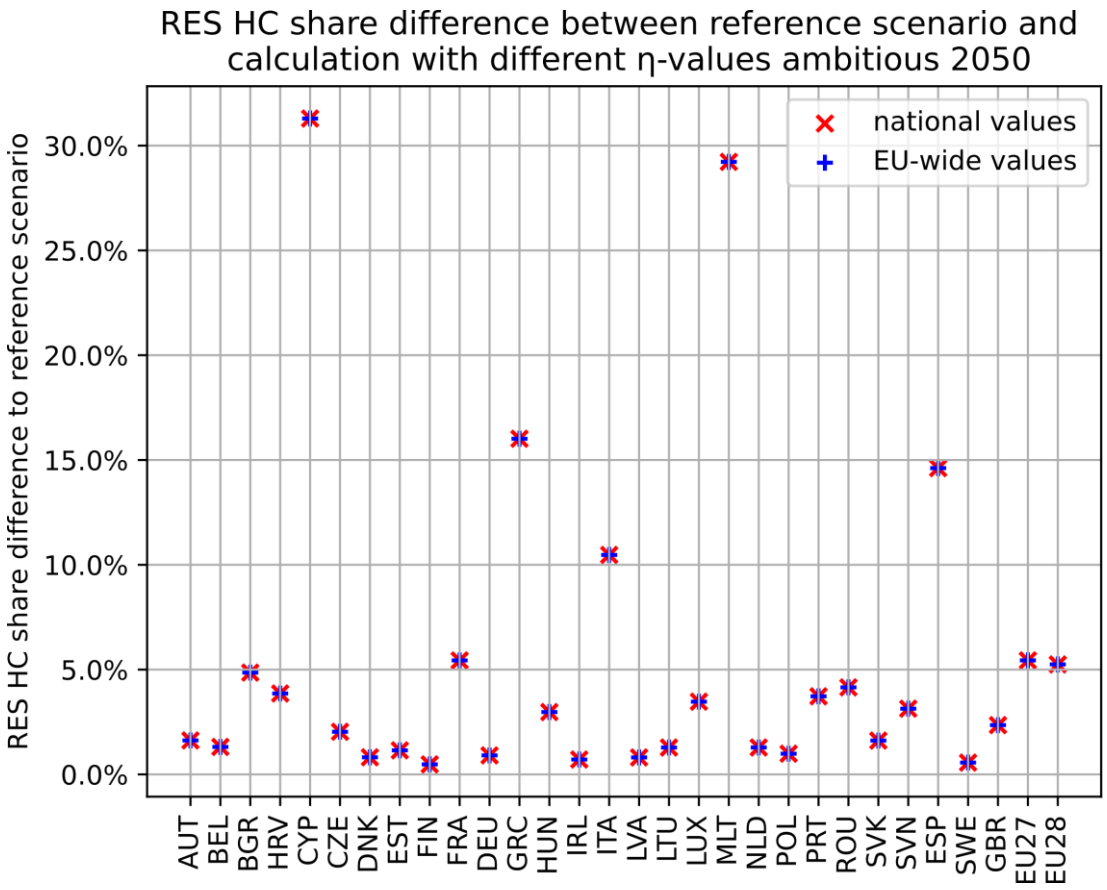

Figure 24: RES HC share difference between reference scenario and calculation with EU-wide and national η-values for the year 2050 in the ambitious scenario

Table 3: η-values for every EU country in 2018

Country	η 2018	$\frac{1}{\eta}$ 2018	$\frac{1}{\eta}$ 2030	$\frac{1}{\eta}$ 2050
EU27	49.4%	2.03	1.63	1.05
EU28	49.6%	2.02	1.62	1.05
BE	45.0%	2.22	1.83	1.05
BG	39.7%	2.52	2.12	1.05
CZ	52.5%	1.91	1.51	1.05
DK	88.3%	1.13	0.74	1.05
DE	51.7%	1.94	1.54	1.05
EE	38.6%	2.59	2.20	1.05
IE	58.1%	1.72	1.33	1.05
GR	47.6%	2.10	1.71	1.05
ES	48.8%	2.05	1.66	1.05
FR	39.0%	2.56	2.17	1.05
HR	79.1%	1.26	0.87	1.05
IT	55.3%	1.81	1.42	1.05
CY	40.5%	2.47	2.07	1.05
LV	83.1%	1.20	0.81	1.05
LT	72.0%	1.39	1.00	1.05
LU	71.2%	1.40	1.01	1.05
HU	40.3%	2.48	2.09	1.05
MT	53.5%	1.87	1.47	1.05
NL	58.1%	1.72	1.33	1.05
AT	79.1%	1.26	0.87	1.05
PL	51.0%	1.96	1.57	1.05
PT	59.4%	1.68	1.29	1.05
RO	52.2%	1.92	1.52	1.05
SI	50.1%	2.00	1.60	1.05
SK	46.3%	2.16	1.76	1.05
FI	56.4%	1.77	1.38	1.05
SE	55.5%	1.80	1.41	1.05
UK	51.3%	1.95	1.55	1.05

Conclusion: The usage of national η-values compared to EU-wide η-values has a limited impact on the baseyear but will increase the total share of countries with a high η-value compared to the EU-wide value by a small amount. For the year 2030 the difference between those two options is most pronounced. The usage of national η-values will either increase or

decrease the resulting RES and RES HC compared to the calculation with EU-wide values. In 2050 this effect is no longer present as every country is assumed to have a 1/η-value of 1.05.

3.5. Impact of different Useful Energy Demand (UED) levels

As the evolution of the UED for cooling in the coming years and decades is subject to uncertainty, its sensitivity on the results has to be evaluated. As a reference we listed different studies and their estimation of the UED for each country. The values on country level are listed in Table 9. Figure 25 shows the different UEDs of the studies for the EU27+UK. "RES-C_{FP}" represents the data from the five Porter analysis which was conducted in the report 1 of this study [2]. Those results are not available on country level. As described in chapter 2, for the impact assessment described in the previous chapters, we used a scenario based on EUCO3232.5, indicated in the figure below as "RES-C_EUCO".

HRE (Heat Roadmap Europe https://heatroadmap.eu/wp-content/uploads/2018/11/HRE4_D3.2.pdf) represents results from the Horizon 2020 project of the same name. Under the label "SET NAV" we show scenario results from the corresponding H2020 project [6].

It is visible that the UED in different scenarios varies significantly, especially for the year 2050. Therefore, we calculate another 2 scenarios with different UED assumptions (Figure 25) where we use the data from the studies "SET NAV" and "HRE". This way the impact of much higher UEDs in the future is analyzed. The UED data for these 3 scenarios can be found in Table 9 in the Annex.

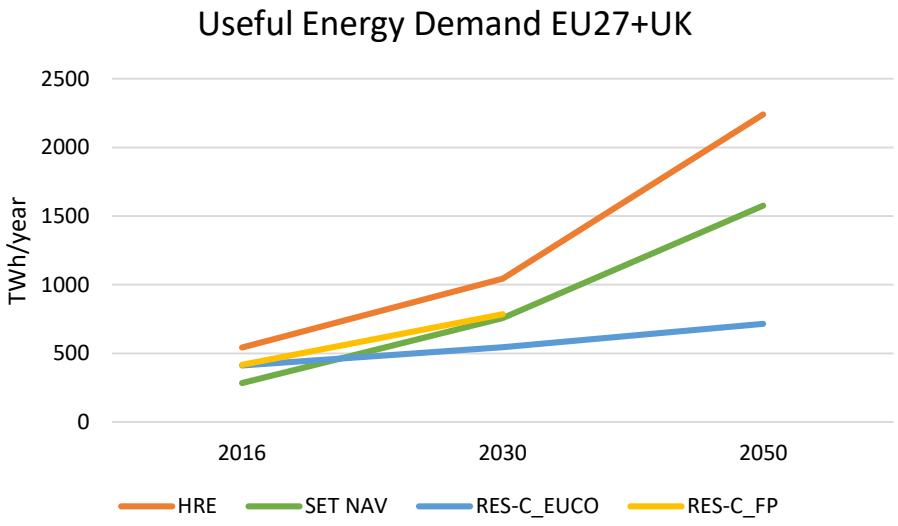

Figure 25: Useful Energy Demand for space cooling by 2030 and 2050, EU27+UK in different studies.

Table 4: Useful cooling energy demand in total for the EU27 + UK in different studies.

	2016 [TWh/year]	2030 [TWh/year]	2050 [TWh/year]
HRE	542	1045	2241
RES-C EUCO 3232.5	446	652	870
SET NAV	285	757	1576
RES-C	411	545	715

In the following, the impact assessment was carried out for these three cooling demand scenarios (HRE, SET NAV and RES-C). As a comparison, the reference share was added as well. For the base year the resulting RES and RES HC shares are minimal. But in the years 2030 and 2050 where the cooling demand differs strongly, the resulting shares increase with higher cooling demand. This is not surprising as the SEER of the different technologies was not differentiated in between the demand scenarios. Therefore, a higher cooling demand inevitably results in a higher RES and RES HC as the added value to the reference numerator and denominator rises. In the base year the different scenarios don't have an impact on the resulting shares. Figure 26 and Figure 27 show the resulting RES HC in the years 2030 and 2050 for the ambitious scenario. It is clearly visible that in between the studies there are large differences in some countries, whereas in other countries the resulting RES HC are very similar.

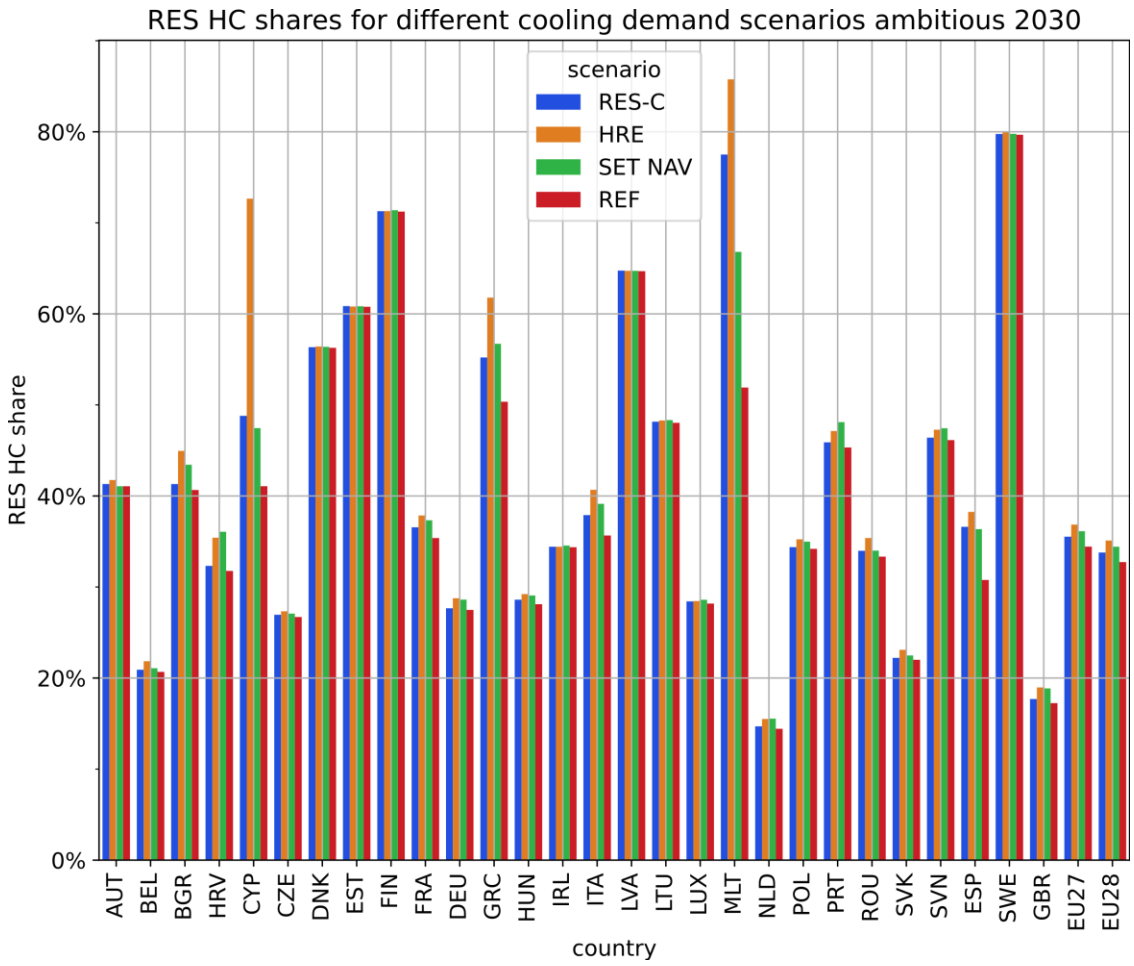

Figure 26: RES HC shares for different cooling demand scenarios for all EU member states in the ambitious scenario 2030.

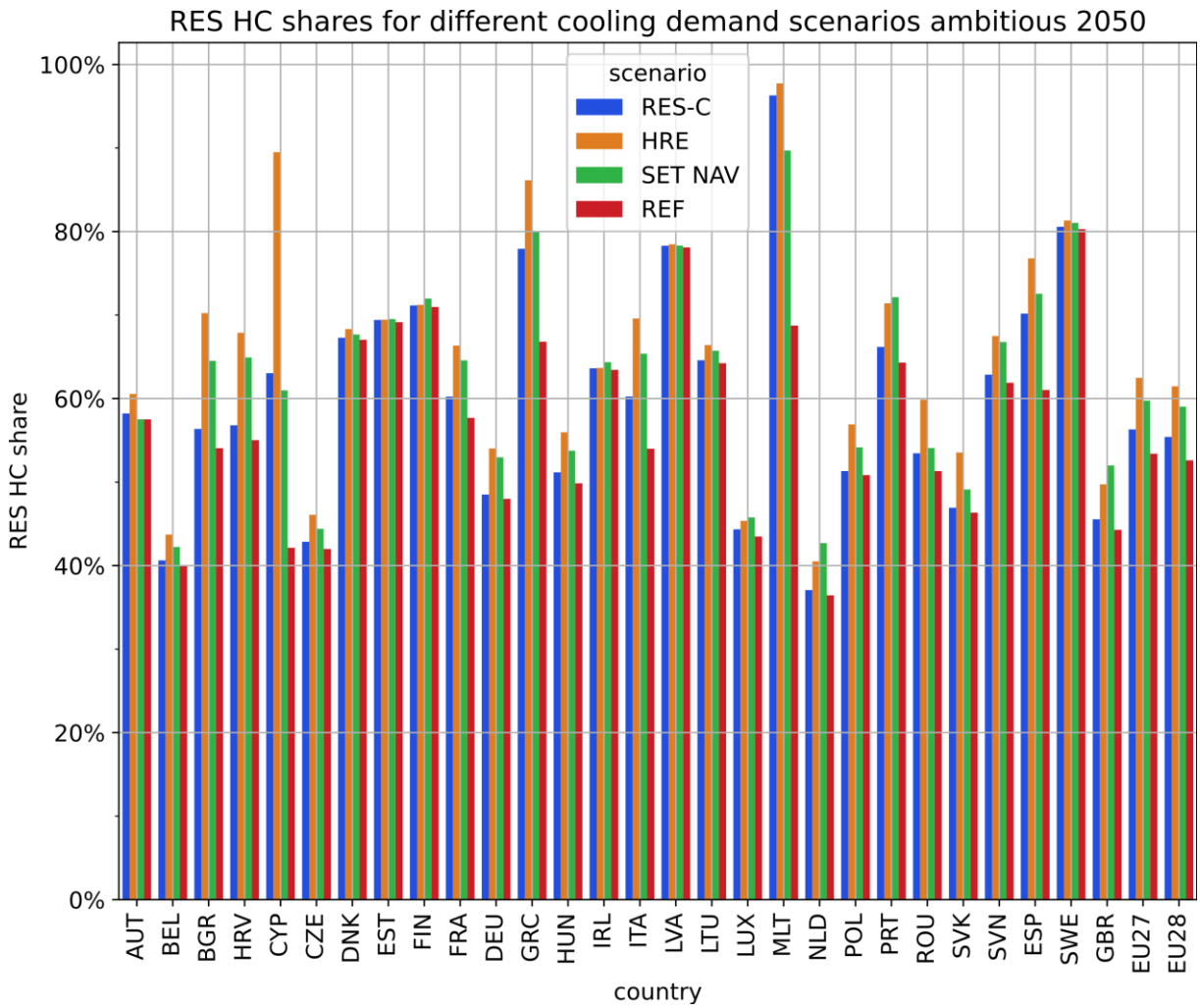

Figure 27: RES HC shares for different cooling demand scenarios for all EU member states in the ambitious scenario 2050.

The data for these scenarios and for the baseline scenario can be found in the Annex in Table 10, Table 12 and Table 14.

Conclusion: The cooling demand inevitably has a strong impact on the resulting RES and RES HC if SPF thresholds are met because the added values to reference numerator and denominator rise.

4. Analysis of the socio-economic and environmental impacts of the renewable cooling energy definitions

In this chapter, we analyse the possible economic, social, and environmental impacts, resulting from different renewable cooling definition options. We consider two scenarios for the future, a Baseline and an Ambitious one, regarding the different share of innovative cooling technologies according to the assumptions described in chapter 2 and applied in chapter 3.

4.1. Methodology for estimating the socio-economic and environmental impacts of renewable cooling definition options

In the following, we describe the methodology for estimating the socio-economic and environmental impacts of various renewable cooling definition options. We start with the description of the methodology we use to carry out the analysis for the base year, followed by the methodology for the impacts in 2030 and 2050.

4.1.1. Environmental impact (GHG emissions)

The greenhouse gas (GHG) emissions are computed considering the cooling technology clusters described above (see chapter 2) and implementing **(**Eq**.) 1** [178]. The calculation is applied for the base year starting from the final cooling consumption at the national level (EU27+UK), from the renewable cooling options and the results of the stock model. Then, the emissions are updated according to different renewable cooling options and considering growing cooling trends (chapters 2 and 3.5).

Equation **(**Eq**.) 1** provides an aggregated value of GHG emissions, for the year t, at the national level expressed in megatons of carbon dioxide equivalent per year ($MtCO_2eq/y$).

$$GHG^t = \sum_{i=1}^{n} {E^t}_{Input,i} * {GWP^t}_{E.i} + \sum_{i=1}^{j} {Fuel^t}_{Input,i} * {GWP^t}_{Fuel.i} + \sum_{i=1}^{k} {Stock^t}_{i} * {GWP^t}_{rfg.i} \qquad (Eq.)\ 1$$

Where:

- n = number of electricity-dependent technology clusters.
- j = number of fuel-dependent technology clusters.
- k = number of technology clusters with a stock number.
- ${E^t}_{Input,i}$= Final electricity consumption for the technology for the i-th cluster and the t-th year. This parameter is the final electricity energy consumption needed to run cooling systems.
- ${GWP^t}_{E.i}$= the global warming potential for final electricity consumption for the i-th cluster and the t-th year.
- ${Fuel^t}_{Input,i}$= Fuel consumption for the technology for the i-th cluster and the t-th year.
- ${GWP^t}_{Fuel.i}$= Global Warming Potential (GWP) for the type of fuel being used for the i-th cluster and the t-th year.

- $Stock^{t}{}_{i}$= number of units for technology for the i-th cluster and the t-th year.
- $GWP^{t}{}_{rfg.i}$= GWP per unit for the type of refrigerant.

4.1.2. Socio-economic impact

The socio-economic impact assessment is based on the estimation of direct employment due to cooling and renewable cooling options. The starting point for the estimation of the socio-economic impact is the identification of the total revenues due to cooling and renewable cooling. Then, the total revenues are split into their industry, wholesaler, retailer, and installer components. Besides this, revenues for the maintenance sector are also computed. Each sectorial revenue is then divided by the relative wages, taken from [8]. These wages constants, which are reported in Table 5 below, are calculated as companies' revenues divided by the staff number, and are used in the denominator of equations (Eq.) 2 to (Eq.) 7 compute the direct employments. The industry, wholesaler, retailer, installer, and maintenance sectors are part of the cooling socio-economic impact assessment carried out in equations (Eq.) 2 to (Eq.) 7 [9].

$$Job^{t,i}_{Industry} = \frac{ACQ_{t,i}\ x\ (1 - InstFrac_i)\ x\ ManuFrac_i}{Wages^{t,i}_{Industry}} \quad \textit{(Eq.) 2}$$

$$Job^{t,i}_{Wholesaler} = \frac{ACQ_{t,i}\ x\ (1 - InstFrac_i)\ x\ WholeFrac_i}{Wages^{t,i}_{Wholesaler}} \quad \textit{(Eq.) 3}$$

$$Job^{t,i}_{Retailer} = \frac{ACQ_{t,i}\ x\ (1 - InstFrac_i)\ x\ RetailFrac_i}{Wages^{i}_{Retailer}} \quad \textit{(Eq.) 4}$$

$$Job^{t,i}_{Installer} = \frac{ACQ_{t,i} * InstFrac_i}{(1 + VATavg)\ x\ Wages^{i}_{Installer}} \quad \textit{(Eq.) 5}$$

$$Job^{t,i}_{Maintenance} = \frac{MAINT_i}{(1 + VATavg)\ x\ Wages^{i}_{Maintenance}} \quad \textit{(Eq.) 6}$$

$$ACQ_i = Sales_i * Price_i \quad \textit{(Eq.) 7}$$

Where:

- $ACQ_{t,i}$ Acquisition costs for year t and technology cluster i. Acquisition costs include purchase costs, installation costs, and end-of-life costs. They include VATs for the residential sector. Acquisition costs are computed per technology cluster and considering products' prices each year. Sales and prices derive from the stock model and the forecasting of the share of cooling technologies task 1/6.
- $InstFrac$ Installation fraction of the cost [9]. Installation costs are a part of the product price. From a general point of view, they are assumed to vary over time and depending on specific scenarios (as the product price). However, in this calculation, this fraction is considered constant over time for the specific technology cluster.
- $ManuFrac_i$ Manufacturer fraction of the costs [9]. Considered constant over time for the specific technology cluster. It is assumed that associated OEM (original equipment manufacturer) jobs and Service jobs are each of the same order of magnitude.

- $WholeFrac_i$Wholesaler fraction of the costs [9]. Considered constant over time for the specific technology cluster.
- $RetailFrac_i$ Retailer fraction of costs [9]. Considered constant over time for the specific technology cluster.
- $VATavg$ average vat [9]. Considered constant over time for the specific technology cluster.
- $MAINT_i$ Maintenance costs per unit [9]. It might vary according to market projections.
- Wages: These are not actual wages, but an indicator defined as total company revenue divided by staff, expressed in 'million euros/employee' [9]. They are assumed to be constant over time and they are listed in the following table.

Table 5: employment parameters expressed in M€. The values are related to the year 2015 and are related to the five sectors [9]

Wage category	M€
Manufacturer's 'wages'	0.054
Wholesale 'wages'	0.270
Retail 'wages'	0.065
Installation 'wages'	0.108
Maintenance 'wages'	0.108

The impact of the renewable cooling option(s) is derived by multiplying each job equation for the renewable cooling share. It is worth noting that each numerator of equations (Eq.) 2 to (Eq.) 7 is proportional to the revenues related to renewable cooling.

Impact on the overall EU and MSs: hypothesis and assumptions for the environmental and socio-economic frameworks.

1. The scenarios are based on the data used for the definition of the renewable cooling technology clusters, on the shares of cooling technologies in the stock of cooling systems (which are different for every scenario), and on the emissions factors provided by Koffi et al. [8].
   To predict the annual installations from 2018 until 2030 and 2030 until 2050 the raise in useful cooling energy demand was used as well as the lifetime of each system. It was estimated that part of the total stock has to be renewed depending on the respective lifetime. The total stock was derived from the stock model (see chapter 2). In addition to the renewed technologies, new installations have to be made in order to cover the rising cooling demand. To calculate these new installations, the efficiency and full load hours are assumed to remain constant over the years and are taken from the base year 2018. We carry out the analysis for a set of technology clusters, identifying the possible and most relevant combinations of cooling technologies (see [2]) and different cooling distribution technologies. This set of technology clusters covers both the space cooling and the process cooling sectors (see [2]).
2. The impact assessment is characterized by a top-down approach. According to López-Aparicio et al. (2017) [13] this means that the data is collected at regional or national level (EU27+UK) and then distributed on space exploiting the different types of auxiliary data (e.g., population density, land cover, etc.).

3. The emissions are calculated using the final energy consumption for each proposed cooling technology cluster. Both the results, i.e., the overall and the renewable share, for all the different clusters are then aggregated at MS level. Results are expressed in megatons (Mt) of Carbon dioxide (CO_2) equivalent (eq.).
4. The applied methodology has the aim to identify the effects of the renewable cooling and its proposed options, according to the proposed scenarios[11] and does not consider the combined effect of other measures that, especially in the residential and service sector, might incentivize the adoption of more efficient technologies (e.g., building-related measures etc.). This is in line with other extensive studies [9].

4.2. Description of the data sources for the socio-economic and environmental impact assessment

In this subsection, we describe in detail the data we use for both the environmental and the socio-economic parts of the impact assessment, also providing the sources of these data. We will often refer to the formulas presented in the previous subsection. This will contribute to a clear and transparent documentation of our methodology and will help to interpret the results contained in the following subsections.

Concerning the economic part of the impact assessment, the starting point of our analysis is represented by the acquisition costs contained in the report [10]. Both the purchasing prices and the installation shares of the main cooling technologies are included in this document, are the costs are assumed to be uniform for all the European Union. For the cooling technologies that use ground heat exchangers, we estimated the further installation costs using the information contained in [11] and [12]. As a result of this data gathering, we obtain detailed acquisition costs for all the cooling technology clusters identified in the appendix (Table 6 in the Annex) of the present report, divided into purchasing prices and installation costs, for the base year as well as for 2030 and 2050. We then split the revenues coming from the purchases into the industry, wholesale, and retail sectors. To do this, we used the shares provided by [9]. To obtain the revenue outputs at MS level, we used the number of new installations per year provided in [2] (Annex: “Building stock analysis - complete results for final space cooling consumption in the residential and service sectors”). Finally, to produce the job indicators described in the previous section and related to each sector (Industry, Wholesale, Retail), we used the estimated wages contained in Table 5 and taken from [9].

For calculating the greenhouse gases emissions per country, we use the emission factors contained in [8]. In particular, we use the emission factors for electricity at national level calculated in [8] using a standard approach. We use the same standard approach in [8] also for renewable energies, i.e., electric energy from PV, heat from solar thermal, and waste heat. Indeed, we believe that using the life cycle assessment (LCA) approach only for renewable energies would create a negative bias towards the technologies using those energy sources. To compensate the fact that the standard approach gives emission factors constantly equal to zero for renewable energies, we consider the share of local renewable energy input for the PV supported cooling systems. In this way, only the share of energy demand which is supplied by the local PV systems is counted with 0 emission factor, while the share of energy supplied from the grid is counted with the national emission factors for electricity. The F-gas emission factors are taken from [9] and assumed to remain constants in the coming year. All these emission factors are combined in our calculations, using formula (Eq.) 1, with some data provided by our project, in particular: the number of active cooling units and the consumptions in TWh/year by technology, see Chapter 2.3; the technology shares, see the appendix (Annex).

[11] The detailed scenario assumptions will be developed and discussed in a later stage of the project.

Finally, we use the renewable shares related to every cooling technology cluster, see the appendix (Annex) of the present report, to produce all the outputs relative to renewable cooling.

4.3. Results for the base year 2016

In this subsection, we outline the results of our analysis of the environmental and socio-economic impacts of the cooling sector in the 27 EU Member States and in the United Kingdom in the base year, according to the chosen definition of renewable cooling.

4.3.1. Environmental impact

The following graph shows the total greenhouse gas (GHG) emissions related to cooling in the Member States of the European Union and in the United Kingdom. The GHG emissions are expressed in million tons of CO_2 equivalent per year ($MtCO_2$-eq/year) and they are divided into emissions coming from non-renewable technologies (NOT REN) and renewable ones (REN). The distinction between non-renewable technologies and renewable ones is being made based on the SPF_p and SPFp_RE thresholds described in [3] (Chapter 3) and also applied in the previous chapters of the impact assessment (chapter 3). We want to emphasize that the distinction in this case does not depend on the choice of the renewable cooling definition option but only on the SPF_P threshold applied. Therefore, the same sensitivity as above is carried out regarding the impact of lower SPF_P threshold. The emissions related to renewable cooling are barely visible in this graph due to their very limited amount in the base year. This aspect is further analyzed in Figure 28.

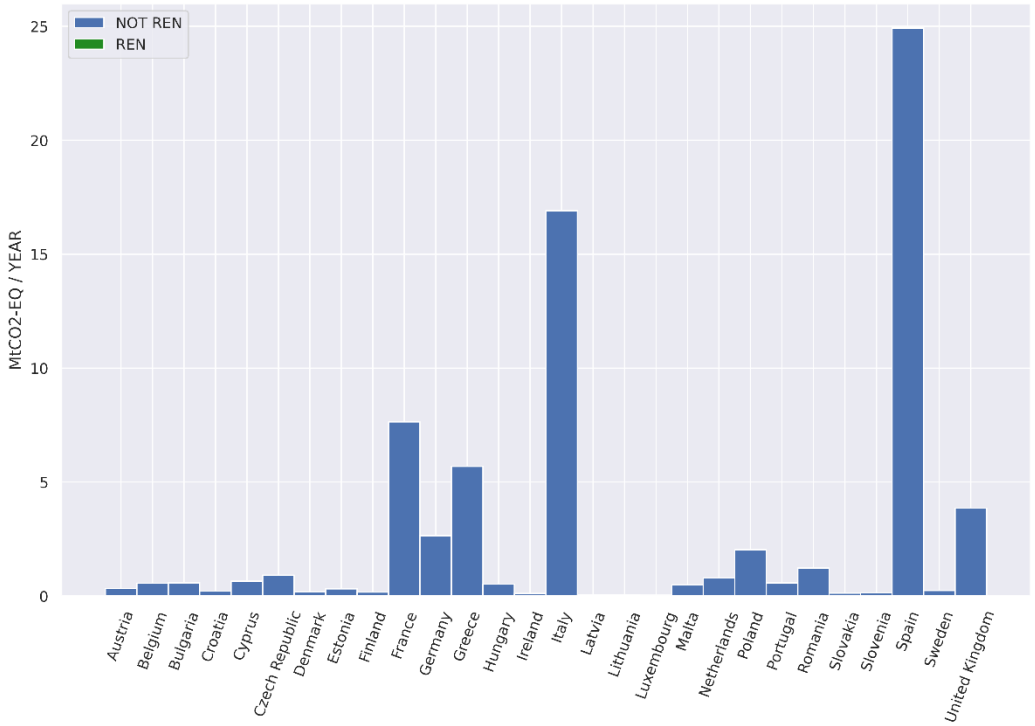

Figure 28: Total GHG emissions related to cooling in MtCO2-eq/year for the base year.

As mentioned above, Figure 29 below helps quantifying the limited amount of renewable cooling in the 27 EU Member States and the UK in the base year. Since the emissions relative

to renewable and non-renewable cooling are expressed in percentages and not in pure numbers, the graph also facilitates the comparison among different countries in the use of renewable technologies. It is important here to pay attention to the vertical axis of the graph, that spans only between 98% and 100%. We did this choice, indeed, to make more clearly visible the shares of emissions due to renewable cooling.

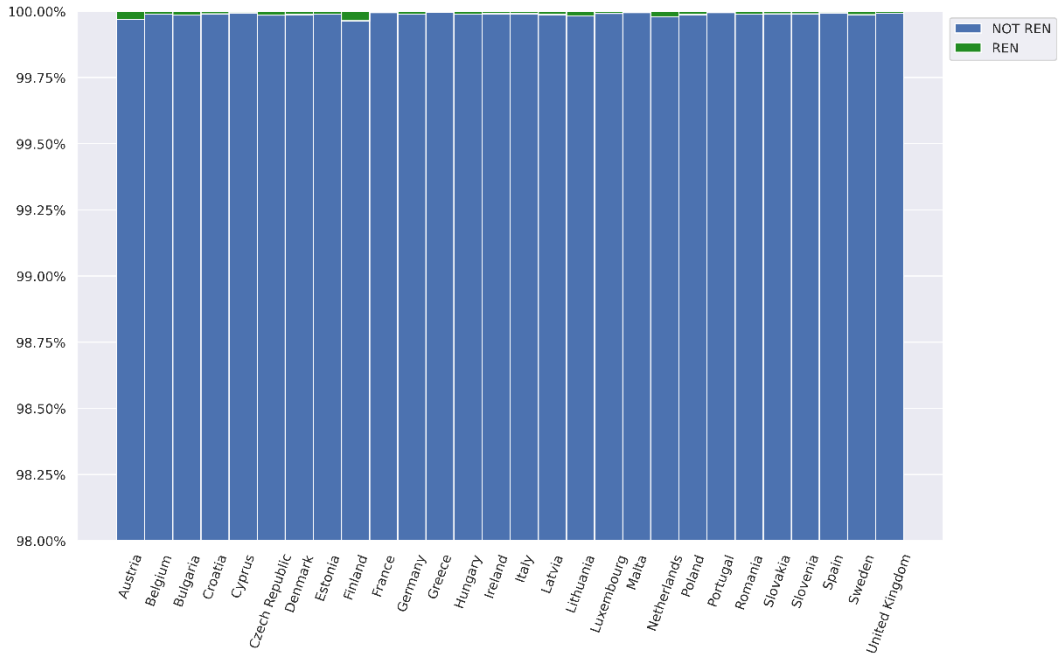

Figure 29: GHG emissions related to renewable and non-renewable cooling, in percentage of the total in the base year.

4.3.2. Low SPF_p thresholds for cooling technologies

If we consider instead low SPF_p thresholds for cooling technologies to count as renewables, we obtain the following two graphs. We provide them in comparison with the previous ones, showing the impact of different SPF_p thresholds in the definition of renewable cooling.

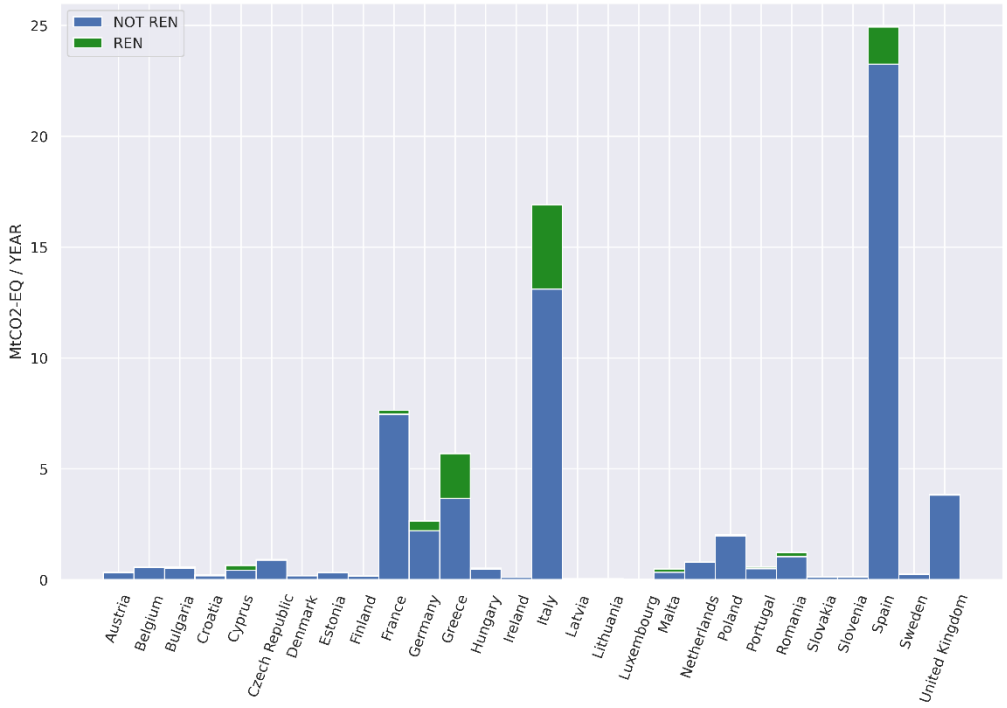

Figure 30: GHG emissions related to cooling in the base year - Low SPF_P thresholds

In the following Figure 31 the vertical axis spans between 60% and 100%. It is important to keep this in mind when comparing it with Figure 29. Using low SPF_P thresholds, an essential share of GHG-emissions from the cooling sector would result from systems classified as "renewable cooling" already in the base year. In the case of the high SPF_P thresholds proposed in this report, this would not be the case (see Figure 29 above).

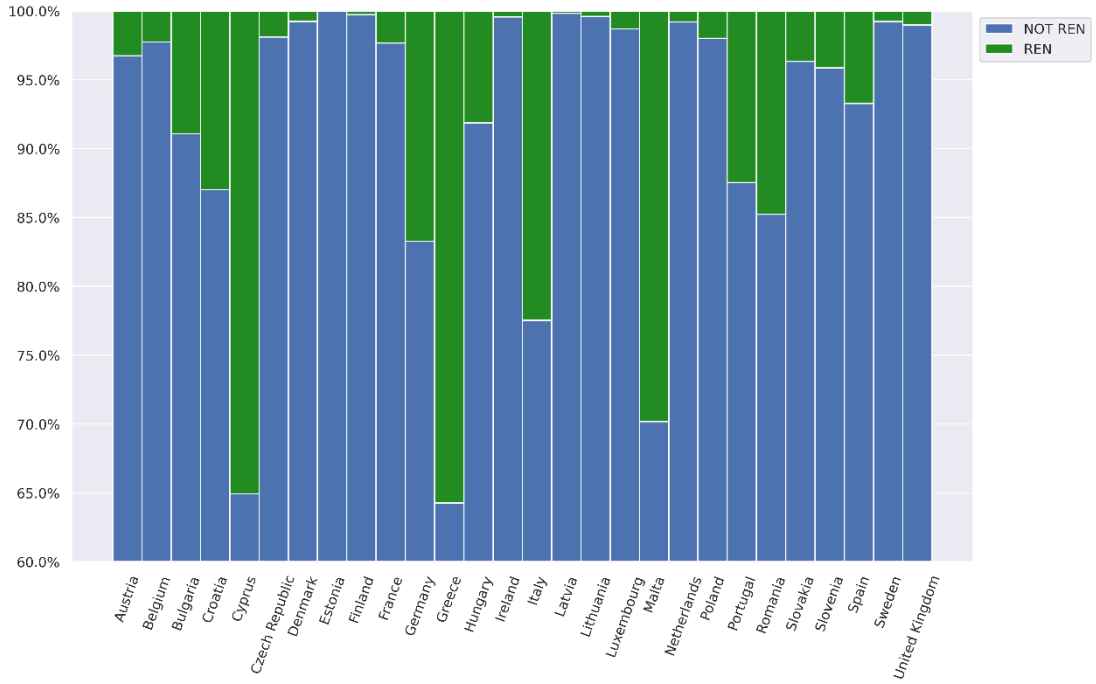

Figure 31: GHG emissions due to renewable and non-renewable cooling, in percentage of the total in the base year - low SPF_P thresholds

4.3.3. Economic impact

Figure 32 below displays the total costs of the cooling sector of the European Union Member States and in the United Kingdom, with 2016 as base year. The displayed costs include acquisition and installation costs of each cooling unit installed, a the overall investment, as explained in Section 4.1. Variable costs, such as operation and maintenance (O&M), and energy costs have computed as well and further detail in Section 4.4.3. The greatest expenditures are detained by Spain with around 3600 Mil. €, followed by Italy, and France with around 3500, and 2100 Mil. € respectively. Then, Greece, the United Kingdom, and Germany, follow the latter with around 800, 700, and 650 Mil. €. Minor values are shown by the remaining Member States. Overall, the total expenditure costs of the cooling sector of the European Union Member States and in the United Kingdom, with 2016 as base year resulted to be around 14000 Mil. €.

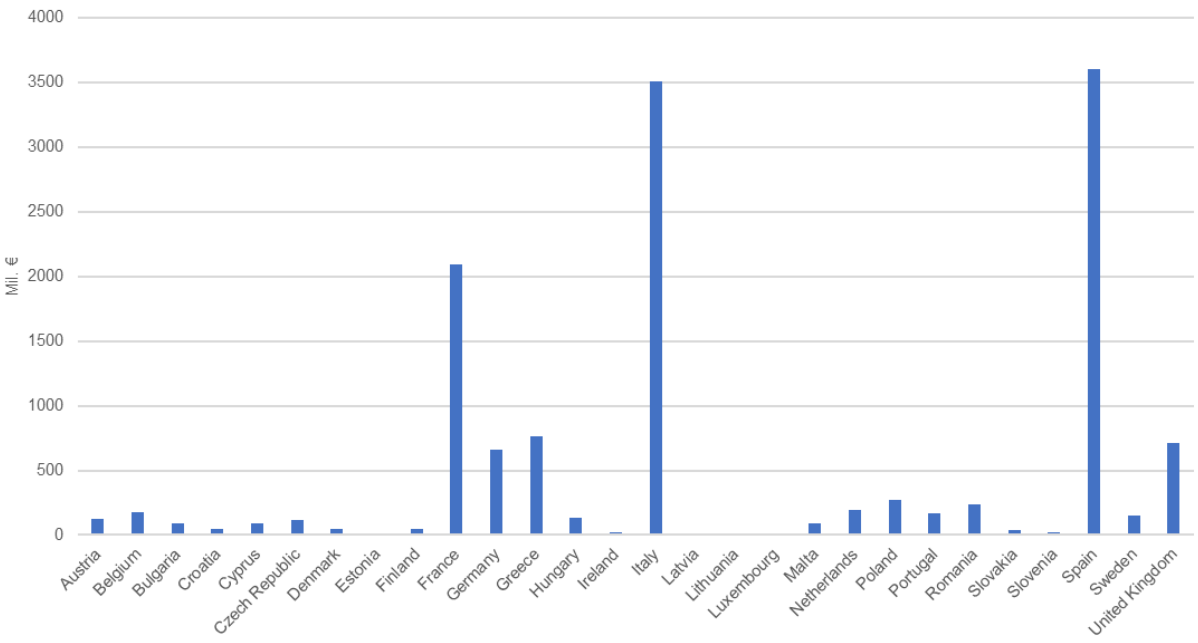

Figure 32: Total costs from the cooling sector in M€ for the base year

4.4. Results for the Baseline and the Ambitious scenarios in 2030 and 2050

In the following subsection, we expose the analogous results of the previous subsection for the years 2030 and 2050, according to the two different scenarios already outlined: a baseline one and an ambitious one. The main difference among these two scenarios lies in different shares for the diffusion of the various cooling technologies in the various Member States of the European Union and in the United Kingdom. The Ambitious scenario assumes a stronger distribution of the most innovative technologies in comparison to the Baseline scenario. The same types of results of the previous Subsection are presented for the environmental and for the socio-economic impact. In all these graphs, we compare the results for 2030 and 2050 not only with the base year, but also among them.

This section is concluded by an overall comparison of the two scenarios until 2050 with the baseline year, both for the greenhouse gases emissions and for the total revenues related to the cooling sector. Results for 2030 are also included.

4.4.1. Environmental impact

The following graph shows the total GHG emissions related to cooling in all the EU Member States and the United Kingdom for the 2030 and 2050 Baseline and Ambitious scenarios, in comparison with the base year. To have a clear picture of the share of emissions related to renewable cooling, we refer to the subsequent Figure 34. The difference among the future scenarios and the base year is more explicit and further commented in Figure 35, where the percentage variation of GHG emissions with respect to the base year is outlined. From the graph we can observe a substantial GHG emissions reduction, in particular in the ambitious scenario, for most of the countries with a high value of emissions from cooling. In some countries, though, e.g. France, the emissions in the base year are lower than in the 2050 scenarios. In these cases, this is due to an expected growth in the cooling demand which exceeds the emission reduction coming from new technologies and from the reduction of the national emission factor for electricity.

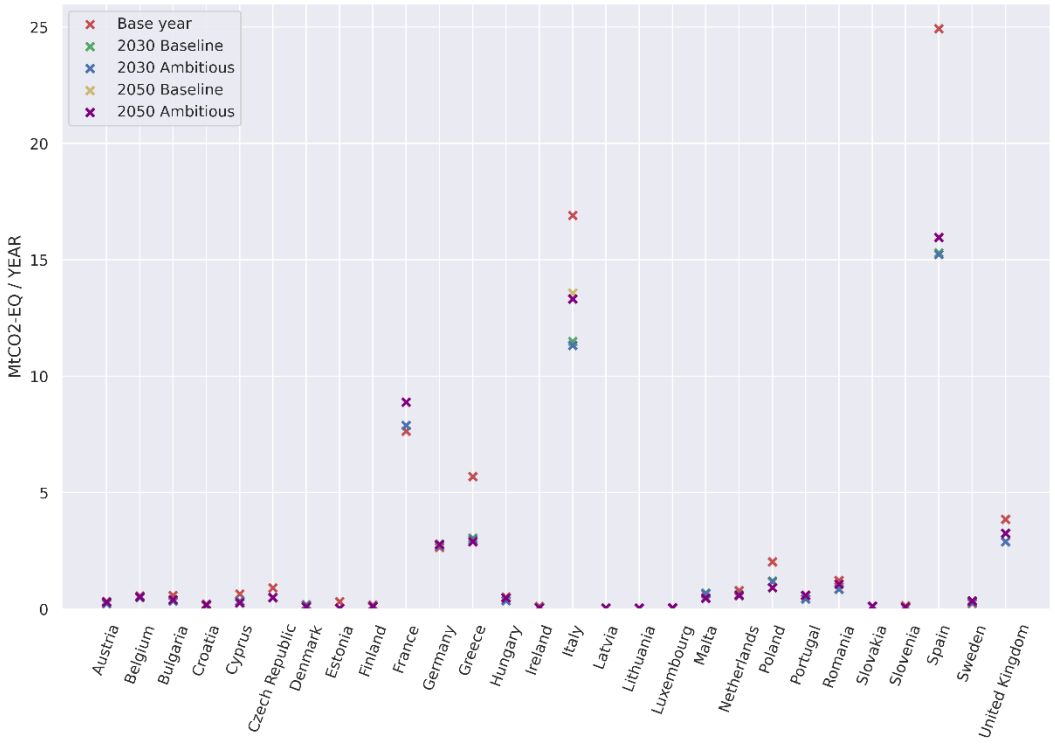

Figure 33: GHG emissions related to cooling for the 2030 and 2050 Baseline and Ambitious scenarios, compared to the base year (corresponding to main calculation according to Table 1).

The following graph quantifies the greenhouse gases emissions coming from cooling systems providing renewable cooling. As explained in Section 4.1, GHG-emissions coming from renewable cooling are calculated by multiplying the total GHG-emissions of cooling by the shares calculated in Chapter 2, which express the percentage of each technology cluster that is counted as renewable. The emissions relative to renewable cooling are expressed as percentages of the total GHG-emissions of cooling, to facilitate the comparison among different countries in the use of renewable technologies. It is important here to pay attention to the vertical axis, that spans between 0% and 50%.

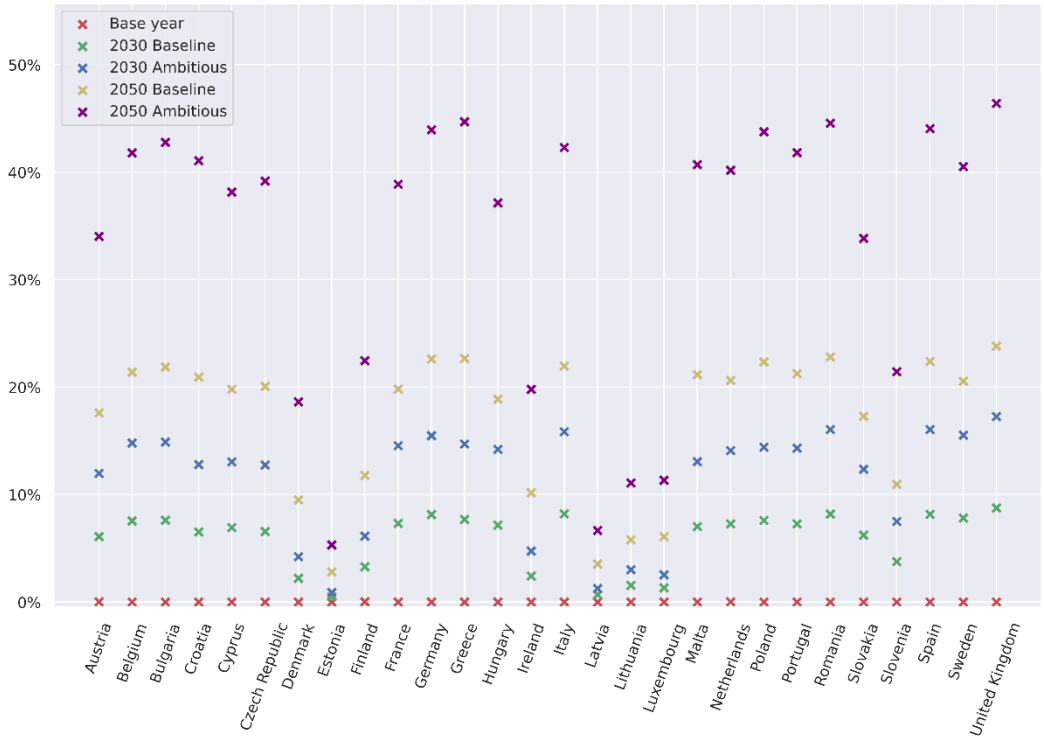

Figure 34: GHG emissions related to renewable cooling, in percentage of the total, for the 2030 and 2050 Baseline and Ambitious scenarios and for the base year (corresponding to main calculation according to Table 1).

The following graph in addition shows the percentage variation of greenhouse gas emissions due to cooling in all the future scenarios with respect to the base year. Results include the Baseline and the Ambitious scenarios for 2030 and 2050. This graph should be consulted keeping in mind the total emissions due to cooling per country (Figure 33). In this way, it becomes evident that the graph shows a substantial GHG emissions reduction, in particular in the ambitious scenario, for most of the countries with a high value of emissions from cooling. The reduction of GHG emissions is consistent for many countries also in the Baseline scenarios with respect to the base year. This is mainly due to the assumption of decreasing CO2-emission factors for electricity from the grid, which has a high impact on the total GHG emissions for cooling. From this graph it can also be noticed that the Ambitious scenario leads to lower GHG emissions in all Member States, even if in some countries the difference in terms of resulting emissions among the two scenarios is subtle. Again, this is due to the fact that the national emission factors are foreseen to be very low in 2030 and 2050, and this has a high impact on the final outcome.

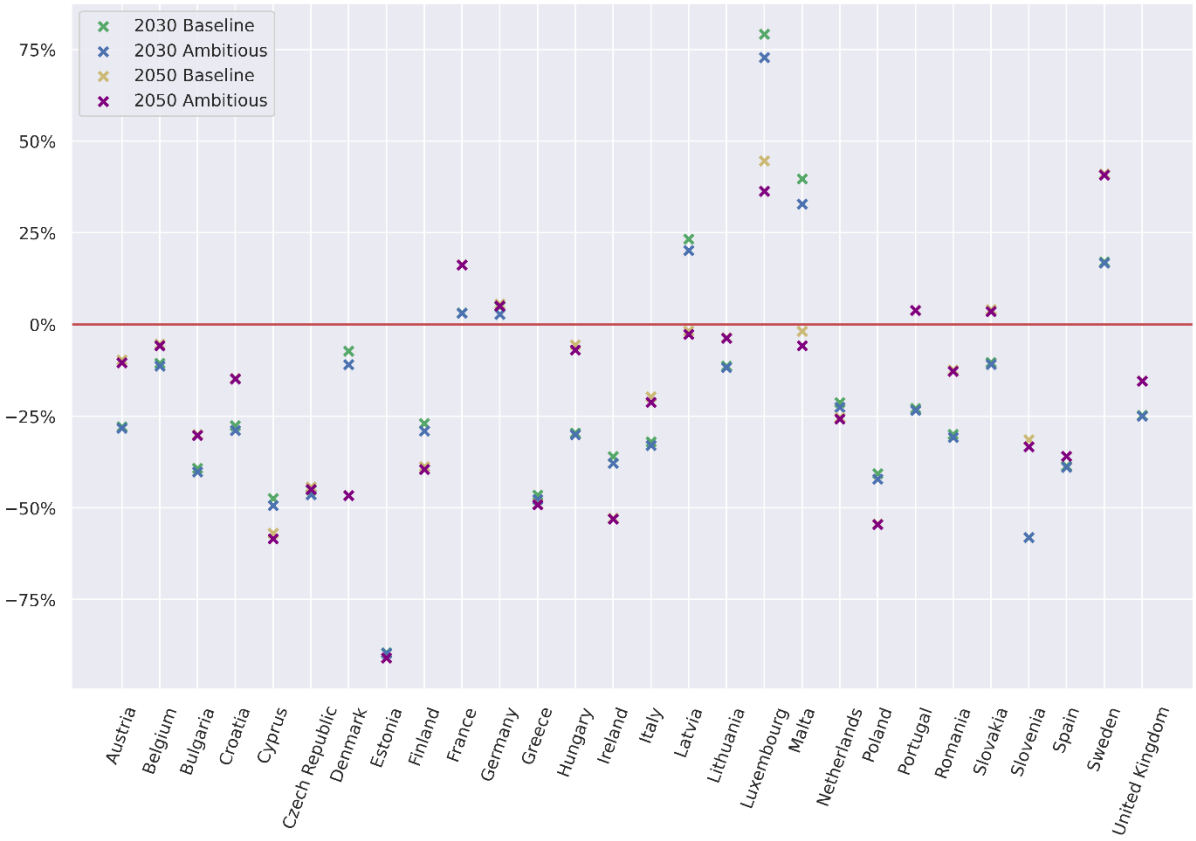

Figure 35: Percentage variations of GHG emissions related to cooling, with respect to the base year, for the 2030 and 2050 Baseline and Ambitious scenarios (corresponding to main calculation according to Table 1).

4.4.2. Low SPF_P thresholds for cooling technologies

If we consider instead low SPF_P thresholds of 2 (instead of 2.8) for cooling technologies to count as renewables, we obtain the following graph. We provide it in comparison with Figure 34, showing the impact of the SPF_P threshold in the definition of renewable cooling. Already in the base year an essential share of GHG-emissions from the sector would result from systems classified as “renewable cooling”. In the case of the SPF_P thresholds proposed in this study [3], this would not be the case (see Figure 34 above).

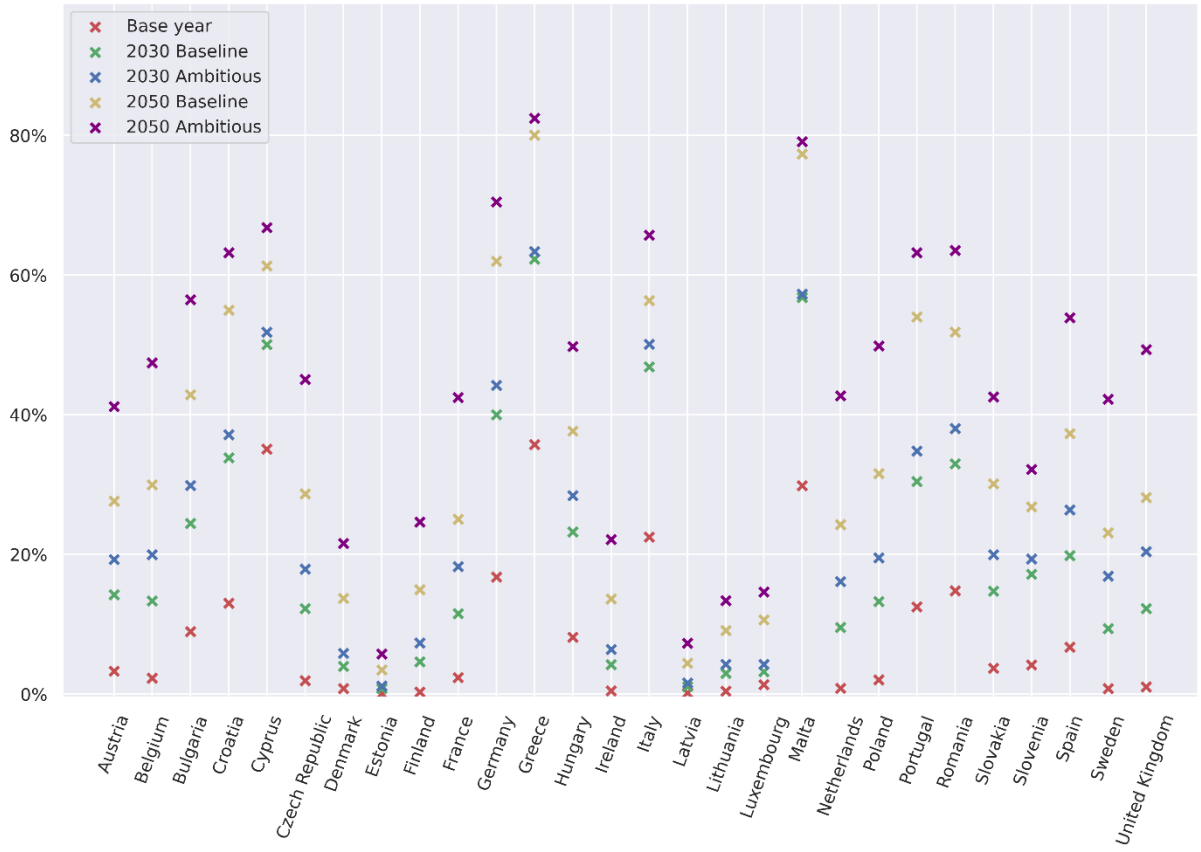

Figure 36: GHG emissions related to renewable cooling, in percentage of the total, for the 2030 and 2050 Baseline and Ambitious scenarios, compared to the base year - low SPF_P thresholds.

4.4.3. Economic impact

Overall, the total costs for the cooling sector, of the whole European Union Member States and the United Kingdom, per scenario is presented in Figure 37.

The operation and maintenance costs (O&M), have been computed by considering the values of Table 19 of the Part 1 “Cooling Technologies Overview and Market Shares” [2] of the current study, which present the mean operation and maintenance costs per air-conditioning type (€/unit/year). The latter have been multiplied with the number of units to retrieve the total O&M for the whole EU27+UK. Additionally, the energy costs have been calculated by considering energy prices (€/kWh) and are multiplied with the final energy consumption values presented in Section 3 of the Part 1 “Cooling Technologies Overview and Market Shares” for each scenario [9]. Installations linked to cooling, such as local PV installations, have not been included in the calculations.

We see that the ambitious scenario has slightly higher purchase and installation costs. However, the energy costs are strongly reduced in the ambitious scenario due to the increased input of local renewable energy. Under our current assumptions, the higher investment costs of the ambitious scenario are recovered by the lower energy costs.

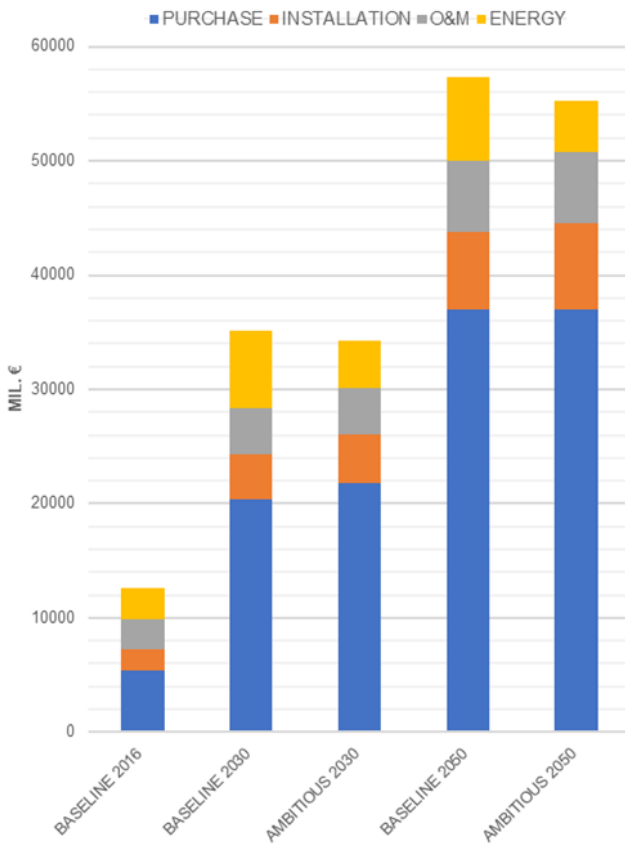

Figure 37: Total costs related to the cooling sector for the 2016 Baseline scenario, 2030 and 2050 Baseline and Ambitious scenarios.

5. Conclusion

The comparative analysis for the two scenarios (“ambitious” and “baseline”) and the 6 different RES-C definition options has shown following insights:

- The lower the SPF_P threshold, the lower is the incentive to use innovative cooling technologies.
- CYP, GRC, ITA, MLT and ESP are especially affected by the different renewable cooling definition options.
- Option (1) leads to higher RES and RES HC shares whereas option (2) lowers the resulting RES and RES HC shares.
- The largest difference between the baseline and the ambitious scenario was observed in option 2.A2. Thus, this option is considered to give the highest incentive to promote innovative cooling technologies in the future.

The following factors turn out to have a relevant impact on the results:

- The share of cooling energy consumption on total energy consumption and heating energy consumption, respectively.
- The “renewable” cooling definition itself. Depending on the calculation method, the results vary strongly.
- The share of technologies, which exceed the SPF_p threshold and are therefore counted as “renewable” influence all six different definition options.
- To some extent also the starting level of the renewable and renewable heating share has an impact, however only under some specific settings of the RES-C definition methodology.
- The amount of local, concomitant renewable energy input and the extent to which it will be measured and thus applied also has a significant impact on the results.
- The evolution of primary energy conversion factor of electricity generation $1/\eta$ and how it is considered in the calculation. In addition, the question whether national values of $1/\eta$ may be applied or not will have an impact.
- If a national values of $1/\eta$ are applied, it is in favor of countries with a high η-value whereas countries with a current low η-value will have increased RES and RES HC shares when using EU-wide η-values. These countries have typically a very high cooling consumption.

All these influencing variables are subject to uncertainty, not only with respect to the future development but also for the base year. In particular, there are significant uncertainties regarding cooling energy demand and the stock of cooling systems with their specific use of different cold sources and resulting SPF_P values. The results presented in this chapter thus are subject to these uncertainties and may vary with other input data. Some of these uncertainties have been studied by the means of parameter variations.

The analysis for the GHG emissions in the two scenarios “baseline” and “ambitious” has shown:

- A low SPF threshold will results in a significant increase of GHG emissions allocated to cooling classified as renewable
- With the SPF threshold proposed in this report there are almost no GHG emissions allocated to renewable cooling in the base year.

- The ambitious scenario results in lower GHG emissions for the EU27+UK in 2030 and 2050, however in the ambitious scenario renewable cooling accounts for a slightly higher share of GHG emissions compared to the baseline scenario as more technologies are considered renewable but still are powered partly by grid electricity.

The economic comparison of the ambitious scenario with the baseline scenario shows that higher investment costs are required in the ambitious scenario. However, due to the lower energy expenses, the higher investments pay off under our modelling assumptions.

6. References

[1] Carel, *Evaporative Cooling*. 2020 [Online]. Available: https://www.careluk.com/-evaporative-cooling-book. [Accessed: 24-Apr-2020]

[2] Pezutto S., Kranzl L., Mascherbauer P., Fallahnejad M., Novelli A., Zambito A., Miraglio P., Belleri A., Bottecchia L., Gantioler S., Riviere P., Etienne A., Stabat P., Berthou T., Viegand J., Jensen C., Hummel M., Müller A., Cooling Technologies Overview and Market Shares, Report 1 of the study Renewable Cooling under the Revised Renewable Energy Directive ENER/C1/2018-493, 2020

[3] Kranzl L., Mascherbauer P., Fallahnejad M., Pezutto S., Novelli A., Zambito A., Miraglio P., Belleri A., Bottecchia L., Gantioler S., Riviere P., Etienne A., Stabat P., Berthou T., Viegand J., Jensen C., Hummel M., Müller A. Renewable cooling definition options and calculation methodology, Report 2 of the study Renewable Cooling under the Revised Renewable Energy Directive ENER/C1/2018-493, 2020

[4] HRE4 project, 'Horizon 2020 Heat Roadmap Europe 4 - HRE4 - project'. 2016 [Online]. Available: https://heatroadmap.eu/. [Accessed: 28-Feb-2020]

[5] EUROVENT Market Intelligence, 'Statistics data on the HVAC&R market in Europe, Middle-East and Africa'. 25-Feb-2020 [Online]. Available: https://www.eurovent-marketintelligence.eu/. [Accessed: 25-Feb-2020]

[6] Hartner, M., Forthuber, S., Kranzl, L., Fritz, S., Müller, A., Bernath, C., Sensfuss, F., Maranon-Ledesma, H., 2018. Summary report on case study: Energy demand and supply in buildings and the role for RES market integration, A report compiled within the H2020 project SET-Nav.

[7] Results of the EUCO3232.5 scenario on Member States, Technical Note,https://ec.europa.eu/energy/sites/default/files/technical_note_on_the_euco3232_final_14062019.pdf, accessed 09.08.2021

[8] Koffi B., Cerutti A.K., Duerr M., Iancu A., Kona A., Janssens-Maenhout G., 2017. Covenant of Mayors for Climate and Energy: Default emission factors for local emission inventories– Version 2017, EUR 28718 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-71479-5, doi:10.2760/290197, JRC107518.

[9] Wierda L., Kemna R., 2019. Ecodesign Impact Accounting, Status Report 2018.

[10] Dittmann F., Rivière P., Stabat P., 2016. Heat Roadmap Europe: Building the knowledge, skills, and capacity required to enable new policies and encourage new investments in the heating and cooling sector., Deliverable 3.2: Cooling technology datasheets in the 14 MSs in the EU28.

[11] Schüppler S., Fleuchaus P., Blum P., 2019. Techno-economic and environmental analysis of an Aquifer Thermal Energy Storage (ATES) in Germany, Geotherm. Energy, 7 (2019).

[12] Casasso A., Sethi R., 2015. Territorial analysis for the implementation of Geothermal Heat Pumps in the Province of Cuneo (NW Italy), Energy Procedia, 78 (2015), 1159 – 1164.

[13] López-Aparicio S., Guevara M., Thunis P., Cuvelier K., Tarrasón L, 2017. Assessment of discrepancies between bottom-up and regional emission inventories in Norwegian urban areas, Atmospheric Environment,

Vol. 154 (2017), 285-296.

7. Annex

Table 6: Cooling technology shares for the different scenarios

Cooling distribution system	Energy input	Share of renewable energy input	Cold source	Share baseyear	Share 2030 ambitious	Share 2030 baseline	Share 2050 ambitious	Share 2050 baseline
Movables + Window units	ELEC_GRID	0%	AIR	100.0%	100.0%	100.0%	100.0%	100.0%
Small Split (<5 kW)	ELEC_GRID	0%	AIR	100.0%	51.4%	79.0%	0.0%	63.9%
Small Split (<5 kW)	ELEC_GRID	0%	Water	0.0%	0.0%	0.0%	0.0%	0.3%
Small Split (<5 kW)	ELEC_GRID	0%	GHE	0.0%	5.9%	9.0%	0.0%	24.0%
Small Split (<5 kW)	ELEC_GRID	0%	Aquifer	0.0%	1.8%	2.7%	0.0%	0.2%
Small Split (<5 kW)	ELEC_RE_local	20%	AIR	0.0%	20.5%	7.5%	50.0%	7.5%
Small Split (<5 kW)	ELEC_RE_local	20%	Water	0.0%	0.8%	0.0%	2.0%	0.5%
Small Split (<5 kW)	ELEC_RE_local	20%	GHE	0.0%	19.7%	1.4%	48.0%	3.6%
Small Split (<5 kW)	ELEC_RE_local	20%	Aquifer	0.0%	0.0%	0.4%	0.0%	0.0%
Big Split (>5 kW, inclusive ducted)	ELEC_GRID	0%	AIR	100.0%	51.4%	79.0%	0.0%	64.2%
Big Split (>5 kW, inclusive ducted)	ELEC_GRID	0%	Water	0.0%	0.0%	0.0%	0.0%	0.3%
Big Split (>5 kW, inclusive ducted)	ELEC_GRID	0%	GHE	0.0%	5.9%	9.0%	0.0%	24.0%
Big Split (>5 kW, inclusive ducted)	ELEC_GRID	0%	Aquifer	0.0%	1.8%	2.7%	0.0%	0.2%
Big Split (>5 kW, inclusive ducted)	ELEC_RE_local	20%	AIR	0.0%	26.7%	7.5%	65.1%	7.5%
Big Split (>5 kW, inclusive ducted)	ELEC_RE_local	20%	Water	0.0%	1.8%	0.0%	4.3%	0.3%
Big Split (>5 kW, inclusive ducted)	ELEC_RE_local	20%	GHE	0.0%	12.5%	1.4%	30.4%	3.6%
Big Split (>5 kW, inclusive ducted)	ELEC_RE_local	20%	Aquifer	0.0%	0.1%	0.4%	0.2%	0.0%
Variable refrigerant flow systems	ELEC_GRID	0%	AIR	100.0%	51.4%	79.0%	0.0%	64.2%
Variable refrigerant flow systems	ELEC_GRID	0%	Water	0.0%	0.0%	0.0%	0.0%	0.3%
Variable refrigerant flow systems	ELEC_GRID	0%	GHE	0.0%	5.9%	9.0%	0.0%	24.0%
Variable refrigerant flow systems	ELEC_GRID	0%	Aquifer	0.0%	1.8%	2.7%	0.0%	0.2%

Cooling distribution system	Energy input	Share of renewable energy input	Cold source	Share baseyear	Share 2030 ambitious	Share 2030 baseline	Share 2050 ambitious	Share 2050 baseline
Variable refrigerant flow systems	ELEC_RE_local	10%	AIR	0.0%	26.7%	7.5%	65.2%	7.5%
Variable refrigerant flow systems	ELEC_RE_local	10%	Water	0.0%	1.8%	0.0%	4.3%	0.3%
Variable refrigerant flow systems	ELEC_RE_local	10%	GHE	0.0%	12.5%	1.4%	30.4%	3.6%
Variable refrigerant flow systems	ELEC_RE_local	10%	Aquifer	0.0%	0.0%	0.4%	0.0%	0.0%
Rooftop + Packaged	ELEC_GRID	0%	AIR	100.0%	51.4%	79.0%	0.0%	64.2%
Rooftop + Packaged	ELEC_GRID	0%	Water	0.0%	0.0%	0.0%	0.0%	0.3%
Rooftop + Packaged	ELEC_GRID	0%	GHE	0.0%	5.9%	9.0%	0.0%	24.0%
Rooftop + Packaged	ELEC_GRID	0%	Aquifer	0.0%	1.8%	2.7%	0.0%	0.2%
Rooftop + Packaged	ELEC_RE_local	10%	AIR	0.0%	26.7%	7.5%	65.2%	7.5%
Rooftop + Packaged	ELEC_RE_local	10%	Water	0.0%	1.8%	0.0%	4.3%	0.3%
Rooftop + Packaged	ELEC_RE_local	10%	GHE	0.0%	12.5%	1.4%	30.4%	3.6%
Rooftop + Packaged	ELEC_RE_local	10%	Aquifer	0.0%	0.0%	0.4%	0.0%	0.0%
Chiller (air-to-water) < 400 kW	ELEC_GRID	0%	AIR	100.0%	60.1%	92.5%	0.0%	92.5%
Chiller (air-to-water) < 400 kW	ELEC_RE_local	20%	AIR	0.0%	39.9%	7.5%	100.0%	7.5%
Chiller (air-to-water) > 400 kW	ELEC_GRID	0%	AIR	100.0%	60.1%	92.5%	0.0%	92.5%
Chiller (air-to-water) > 400 kW	ELEC_RE_local	20%	AIR	0.0%	39.9%	7.5%	100.0%	7.5%
Chiller (water-to-water) < 400 kW	ELEC_GRID	0%	AIR	96.0%	50.8%	78.1%	0.0%	57.3%
Chiller (water-to-water) < 400 kW	ELEC_GRID	0%	Water	0.5%	0.3%	0.5%	0.0%	0.5%
Chiller (water-to-water) < 400 kW	ELEC_GRID	0%	GHE	2.0%	5.9%	9.0%	0.0%	24.0%
Chiller (water-to-water) < 400 kW	ELEC_GRID	0%	Aquifer	0.5%	0.0%	0.0%	0.0%	0.2%
Chiller (water-to-water) < 400 kW	ELEC_GRID	0%	waste cold	0.0%	0.0%	0.0%	0.0%	0.0%
Chiller (water-to-water) < 400 kW	ELEC_RE_local	20%	AIR	0.0%	17.9%	7.5%	41.7%	7.5%
Chiller (water-to-water) < 400 kW	ELEC_RE_local	20%	Water	0.0%	0.6%	0.1%	1.4%	0.1%
Chiller (water-to-water) < 400 kW	ELEC_RE_local	20%	GHE	0.0%	7.2%	1.4%	16.7%	3.6%
Chiller (water-to-water) < 400 kW	ELEC_RE_local	20%	Aquifer	0.0%	0.6%	0.0%	1.4%	0.0%

Cooling distribution system	Energy input	Share of renewable energy input	Cold source	Share baseyear	Share 2030 ambitious	Share 2030 baseline	Share 2050 ambitious	Share 2050 baseline
Chiller (water-to-water) < 400 kW	ELEC_RE_local	20%	waste cold	0.0%	0.0%	0.0%	0.0%	0.0%
Chiller (water-to-water) < 400 kW	HEAT _ RE	80%	AIR	0.0%	2.4%	0.8%	5.6%	0.8%
Chiller (water-to-water) < 400 kW	HEAT _ RE	80%	Water	0.0%	2.4%	0.8%	5.6%	0.8%
Chiller (water-to-water) < 400 kW	HEAT _ RE	80%	GHE	0.0%	7.2%	0.1%	16.7%	3.6%
Chiller (water-to-water) < 400 kW	HEAT _ RE	80%	Aquifer	0.0%	0.0%	0.0%	0.0%	0.0%
Chiller (water-to-water) < 400 kW	HEAT _ RE	80%	waste cold	0.0%	0.0%	0.0%	0.0%	0.0%
Chiller (water-to-water) < 400 kW	HEAT _ WH	80%	AIR	1.0%	1.2%	0.5%	2.8%	0.5%
Chiller (water-to-water) < 400 kW	HEAT _ WH	80%	Water	0.0%	1.2%	0.5%	2.8%	0.5%
Chiller (water-to-water) < 400 kW	HEAT _ WH	80%	GHE	0.0%	1.2%	0.5%	2.8%	0.5%
Chiller (water-to-water) < 400 kW	HEAT _ WH	80%	Aquifer	0.0%	1.2%	0.3%	2.8%	0.2%
Chiller (water-to-water) < 400 kW	HEAT _ WH	80%	waste cold	0.0%	0.0%	0.0%	0.0%	0.0%
Chiller (water-to-water) > 400 kW	ELEC_GRID	0%	AIR	96.0%	50.8%	78.1%	0.0%	57.3%
Chiller (water-to-water) > 400 kW	ELEC_GRID	0%	Water	0.5%	0.3%	0.5%	0.0%	0.5%
Chiller (water-to-water) > 400 kW	ELEC_GRID	0%	GHE	2.0%	5.9%	9.0%	0.0%	24.0%
Chiller (water-to-water) > 400 kW	ELEC_GRID	0%	Aquifer	0.5%	0.0%	0.0%	0.0%	0.2%
Chiller (water-to-water) > 400 kW	ELEC_GRID	0%	waste cold	0.0%	0.0%	0.0%	0.0%	0.0%
Chiller (water-to-water) > 400 kW	ELEC_RE_local	20%	AIR	0.0%	17.4%	7.5%	40.5%	7.5%
Chiller (water-to-water) > 400 kW	ELEC_RE_local	20%	Water	0.0%	0.6%	0.1%	1.4%	0.1%
Chiller (water-to-water) > 400 kW	ELEC_RE_local	20%	GHE	0.0%	8.1%	1.4%	18.9%	3.6%
Chiller (water-to-water) > 400 kW	ELEC_RE_local	20%	Aquifer	0.0%	0.6%	0.0%	1.4%	0.0%
Chiller (water-to-water) > 400 kW	ELEC_RE_local	20%	waste cold	0.0%	0.0%	0.0%	0.0%	0.0%
Chiller (water-to-water) > 400 kW	HEAT _ RE	80%	AIR	0.0%	1.7%	0.8%	4.1%	0.8%
Chiller (water-to-water) > 400 kW	HEAT _ RE	80%	Water	0.0%	1.7%	0.8%	4.1%	0.8%
Chiller (water-to-water) > 400 kW	HEAT _ RE	80%	GHE	0.0%	8.1%	0.1%	18.9%	3.6%
Chiller (water-to-water) > 400 kW	HEAT _ RE	80%	Aquifer	0.0%	0.0%	0.0%	0.0%	0.0%
Chiller (water-to-water) > 400 kW	HEAT _ RE	80%	waste cold	0.0%	0.0%	0.0%	0.0%	0.0%
Chiller (water-to-water) > 400 kW	HEAT _ WH	80%	AIR	1.0%	1.2%	0.5%	2.7%	0.5%

Cooling distribution system	Energy input	Share of renewable energy input	Cold source	Share baseyear	Share 2030 ambitious	Share 2030 baseline	Share 2050 ambitious	Share 2050 baseline
Chiller (water-to-water) > 400 kW	HEAT _ WH	80%	Water	0.0%	1.2%	0.5%	2.7%	0.5%
Chiller (water-to-water) > 400 kW	HEAT _ WH	80%	GHE	0.0%	1.2%	0.5%	2.7%	0.5%
Chiller (water-to-water) > 400 kW	HEAT _ WH	80%	Aquifer	0.0%	1.2%	0.3%	2.7%	0.2%
Chiller (water-to-water) > 400 kW	HEAT _ WH	80%	waste cold	0.0%	0.0%	0.0%	0.0%	0.0%

Table 7: Estimated SEER distribution in the EU27 + UK for the year 2030

Distributions	Mobile	Small Split	Big Split	VRF	Rooftop+ Packaged	Chillers (A/W) < 400 kW	Chillers (A/W) > 400 kW	Chillers (W/W) < 400 kW	Chillers (W/W) > 400 kW	Overall
SEER<2		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0%
2<=SEER<3	100.0%	0.0%	0.0%	0.0%	3.8%	0.0%	0.8%	0.0%	0.0%	2%
3<=SEER<4		0.0%	0.0%	0.4%	49.9%	11.4%	17.0%	0.0%	0.7%	4%
4<=SEER<5		0.7%	2.6%	7.2%	37.6%	77.9%	63.5%	3.2%	4.7%	17%
5<=SEER<6		3.6%	32.2%	20.3%	7.8%	10.4%	18.1%	59.0%	10.8%	19%
6<=SEER<7		42.0%	44.3%	35.5%	0.9%	0.3%	0.6%	30.0%	42.8%	31%
7<=SEER<8		39.4%	17.5%	26.6%	0.0%	0.0%	0.0%	6.7%	26.1%	20%
8<=SEER<9		12.2%	2.9%	8.2%	0.0%	0.0%	0.0%	1.0%	11.0%	6%
9<=SEER<10		1.9%	0.4%	1.6%	0.0%	0.0%	0.0%	0.2%	3.0%	1%
10<=SEER<11		0.3%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.9%	
SEER>=11		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0%
									SEER AVE	6.1

Table 8: Estimated SEER distribution in the EU27 + UK for the year 2050.

Distributions	Mobile	Small Split	Big Split	VRF	Rooftop+ Packaged	Chillers (A/W) < 400 kW	Chillers (A/W) > 400 kW	Chillers (W/W) < 400 kW	Chillers (W/W) > 400 kW	Overall
SEER<2		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2<=SEER<3		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
3<=SEER<4	100.0%	0.0%	0.0%	0.0%	26.9%	0.0%	0.0%	0.0%	0.0%	2.1%
4<=SEER<5		0.0%	0.0%	0.0%	51.7%	57.4%	28.1%	0.0%	0.0%	8.9%
5<=SEER<6		0.0%	3.1%	1.3%	18.8%	40.9%	64.6%	29.7%	0.0%	11.8%
6<=SEER<7		3.3%	16.2%	5.7%	2.4%	1.7%	7.1%	45.3%	24.9%	9.9%
7<=SEER<8		16.8%	43.6%	22.0%	0.3%	0.0%	0.2%	20.6%	33.8%	22.7%
8<=SEER<9		43.0%	29.7%	38.1%	0.0%	0.0%	0.0%	3.8%	27.3%	27.1%
9<=SEER<10		29.4%	6.4%	24.6%	0.0%	0.0%	0.0%	0.6%	10.4%	13.8%
10<=SEER<11		6.5%	1.0%	6.8%	0.0%	0.0%	0.0%	0.0%	3.2%	3.2%
SEER>=11		1.0%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%	0.3%	0.5%
									SEER AVE	7.5

Table 9: Useful cooling energy demand for all EU member states from different studies provided in TWh/year.

UED	HRE			PRIMES			SET NAV			RES-C		
country	2016	2030	2050	2015	2030	2050	2015	2030	2050	2018	2030	2050
Austria	5.5	10.4	23.8	4.6	8.0	12.5	0.0	0.0	0.0	3.3	4.8	6.4
Belgium	9.1	17.8	27.0	5.9	8.1	12.4	1.9	6.0	15.8	3.8	4.3	5.0
Bulgaria	6.5	19.0	45.6	0.9	2.4	4.0	4.3	10.7	22.9	1.9	4.0	5.7
Croatia	3.3	10.5	29.2	1.3	2.4	5.4	6.0	11.1	19.4	1.8	2.6	4.2
Cyprus	11.3	24.6	41.1	0.9	1.5	2.3	2.3	4.3	6.2	2.8	4.8	7.1
Czech Republic	4.0	9.3	27.6	2.4	4.6	6.7	1.3	5.1	15.0	2.9	4.7	6.6
Denmark	0.8	2.9	10.4	1.7	2.4	3.0	0.8	2.2	5.1	1.6	2.0	2.4
Estonia	0.1	0.2	0.8	0.2	0.4	0.5	0.1	0.5	1.1	0.7	1.0	0.9
Finland	1.7	2.0	3.1	1.7	2.1	2.4	1.9	5.7	12.9	2.0	2.4	2.8
France	65.6	138.8	303.4	107.6	160.7	225.7	51.6	111.0	231.2	64.0	83.4	94.8
Germany	34.5	81.1	209.6	61.9	102.7	126.8	14.6	73.5	175.5	9.6	14.3	20.4
Greece	44.5	76.3	136.7	11.5	16.6	20.2	19.3	41.4	72.6	23.7	33.2	52.5
Hungary	5.0	10.2	34.2	1.9	3.8	5.4	2.6	9.2	21.9	3.8	6.3	8.6
Ireland	0.3	0.7	1.2	1.4	2.2	2.7	0.9	2.3	4.9	0.7	1.0	1.2
Italy	146.5	259.2	543.6	92.0	119.2	184.8	66.5	186.5	374.3	98.4	129.3	197.3
Latvia	0.1	0.6	2.1	0.3	0.7	0.8	0.1	0.5	1.3	0.7	1.3	1.3
Lithuania	0.5	1.8	6.5	0.4	0.7	0.7	0.3	2.0	4.4	0.8	1.2	1.2
Luxembourg	0.2	0.6	1.7	0.8	1.3	1.5	0.4	1.2	2.3	0.8	1.1	1.1
Malta	3.9	8.6	15.0	0.2	0.7	1.3	1.0	1.8	2.6	1.8	5.4	10.6
Netherlands	9.3	18.6	36.6	21.2	31.3	35.4	4.7	19.5	58.8	4.1	5.6	6.3
Poland	12.8	37.4	104.5	5.0	7.9	10.1	8.4	28.0	54.2	5.9	7.9	8.6
Portugal	9.5	14.5	39.1	8.8	13.7	17.9	9.0	21.9	44.8	3.9	5.8	9.8
Romania	10.3	26.2	61.3	1.2	2.7	3.5	2.8	7.5	16.9	5.9	10.6	16.2
Slovakia	2.2	7.9	25.8	1.4	2.8	3.1	1.1	3.6	9.7	1.3	2.2	2.4
Slovenia	0.7	2.6	8.0	0.5	1.0	1.7	1.2	3.1	7.1	1.0	1.8	2.4
Spain	113.7	190.5	396.1	60.3	78.4	88.7	58.2	135.7	247.6	146.9	181.7	212.5
Sweden	5.7	10.4	16.6	2.8	4.2	6.5	1.3	4.3	12.1	3.1	4.0	5.1
United Kingdom	34.3	62.3	91.0	47.7	69.1	83.4	22.2	58.6	135.7	13.7	18.0	21.2
EU28	541.9	1044.8	2241.5	446.2	651.5	869.6	284.6	757.3	1576.4	410.9	544.6	714.6
EU27	507.6	982.5	2150.4	398.5	582.4	786.1	262.5	698.7	1440.7	397.3	526.6	693.4

Table 10: Resulting shares for RES ambitious and baseline scenarios applying method 1.A.1 for all EU member states under the assumption of UED development from the HRE project [4]

HRE	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.4%	45.7%	72.2%	33.4%	45.6%	71.8%
BEL	9.4%	22.9%	50.6%	9.4%	22.7%	50.1%
BGR	20.5%	34.6%	60.7%	20.5%	34.0%	58.7%
HRV	28.0%	35.5%	66.5%	28.0%	35.0%	64.9%
CYP	13.9%	40.5%	88.7%	13.9%	36.0%	86.6%
CZE	15.2%	21.6%	39.9%	15.2%	21.5%	39.2%
DNK	35.7%	48.2%	80.0%	35.7%	48.1%	79.8%
EST	30.0%	37.2%	74.6%	30.0%	37.2%	74.5%
FIN	41.2%	52.5%	56.4%	41.2%	52.4%	56.3%
FRA	16.6%	30.2%	66.0%	16.6%	29.9%	65.2%
DEU	16.5%	30.4%	71.2%	16.5%	30.2%	70.8%
GRC	18.0%	43.9%	83.4%	18.0%	42.5%	81.8%
HUN	12.5%	20.2%	44.6%	12.5%	20.0%	43.4%
IRL	11.1%	32.7%	77.7%	11.1%	32.7%	77.7%
ITA	17.8%	34.2%	67.3%	17.8%	33.4%	65.5%
LVA	40.3%	47.9%	75.5%	40.3%	47.9%	75.3%
LTU	24.4%	32.5%	63.7%	24.4%	32.4%	63.2%
LUX	9.1%	12.4%	42.5%	9.1%	12.4%	42.2%
MLT	8.0%	36.5%	72.5%	8.0%	32.1%	67.3%
NLD	7.4%	22.2%	53.8%	7.4%	22.0%	53.2%
POL	11.3%	27.3%	51.7%	11.3%	27.1%	50.9%
PRT	30.3%	43.5%	79.5%	30.3%	43.3%	78.9%
ROU	23.9%	36.6%	65.8%	23.9%	36.3%	64.8%
SVK	11.9%	19.5%	45.2%	11.9%	19.3%	43.7%
SVN	21.1%	35.4%	67.4%	21.1%	35.2%	66.8%
ESP	17.5%	38.1%	80.8%	17.5%	37.4%	79.8%
SWE	54.6%	68.0%	77.5%	54.6%	68.0%	77.3%
GBR	11.0%	28.2%	61.7%	11.0%	28.0%	61.3%
EU27	18.9%	33.4%	66.2%	18.9%	33.1%	65.3%
EU28	18.0%	32.9%	65.7%	18.0%	32.5%	64.8%

Table 11: Resulting shares for RES HC ambitious and baseline scenarios applying method 1.A.1 for all EU member states under the assumption of UED development from the HRE project [4]

HRE	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	34.0%	41.7%	60.6%	34.0%	41.4%	59.2%
BEL	8.2%	21.8%	43.7%	8.2%	21.4%	42.4%
BGR	33.3%	44.9%	70.2%	33.3%	43.5%	65.9%
HRV	36.5%	35.4%	67.9%	36.5%	34.2%	64.3%
CYP	36.8%	72.7%	89.5%	36.8%	67.1%	85.8%
CZE	20.7%	27.3%	46.1%	20.7%	27.1%	44.4%
DNK	46.7%	56.4%	68.3%	46.7%	56.3%	67.7%
EST	53.7%	60.8%	69.4%	53.7%	60.8%	69.2%
FIN	54.6%	71.3%	71.2%	54.6%	71.3%	71.1%
FRA	21.8%	37.9%	66.3%	21.8%	37.0%	63.9%
DEU	13.6%	28.8%	54.0%	13.6%	28.4%	52.2%
GRC	30.2%	61.8%	86.1%	30.2%	58.7%	83.0%
HUN	18.1%	29.2%	56.0%	18.1%	28.8%	53.8%
IRL	6.5%	34.4%	63.7%	6.5%	34.4%	63.5%
ITA	19.2%	40.7%	69.6%	19.2%	39.1%	65.9%
LVA	55.9%	64.7%	78.5%	55.9%	64.7%	78.2%
LTU	45.6%	48.3%	66.4%	45.6%	48.1%	65.1%
LUX	8.8%	28.5%	45.4%	8.8%	28.3%	44.3%
MLT	23.5%	85.8%	97.7%	23.5%	81.7%	96.8%
NLD	6.1%	15.5%	40.5%	6.1%	15.1%	39.0%
POL	14.8%	35.2%	56.9%	14.8%	34.9%	54.9%
PRT	41.2%	47.1%	71.4%	41.2%	46.5%	69.3%
ROU	25.4%	35.4%	59.9%	25.4%	34.7%	57.4%
SVK	10.6%	23.1%	53.5%	10.6%	22.6%	50.6%
SVN	31.6%	47.3%	67.5%	31.6%	46.9%	65.6%
ESP	17.5%	38.2%	76.8%	17.5%	35.8%	73.4%
SWE	65.4%	79.9%	81.3%	65.4%	79.8%	80.9%
GBR	7.5%	19.0%	49.7%	7.5%	18.3%	48.1%
EU27	21.1%	36.9%	62.5%	21.1%	36.0%	59.9%
EU28	19.7%	35.1%	61.5%	19.7%	34.3%	58.9%

Table 12: Resulting shares for RES ambitious and baseline scenarios applying method 1.A.1 for all EU member states under the assumption of UED development from the SET NAV project [6]

SET NAV	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.4%	45.5%	71.4%	33.4%	45.5%	71.4%
BEL	9.4%	22.5%	50.1%	9.4%	22.5%	49.8%
BGR	20.5%	33.9%	58.2%	20.5%	33.6%	57.0%
HRV	28.0%	35.8%	65.2%	28.0%	35.2%	64.0%
CYP	13.9%	25.7%	79.6%	13.9%	24.9%	78.7%
CZE	15.2%	21.5%	39.2%	15.2%	21.4%	38.7%
DNK	35.7%	48.2%	79.8%	35.7%	48.1%	79.7%
EST	30.0%	37.2%	74.6%	30.0%	37.2%	74.5%
FIN	41.2%	52.5%	56.8%	41.2%	52.5%	56.5%
FRA	16.6%	30.0%	65.4%	16.6%	29.7%	64.8%
DEU	16.5%	30.4%	71.0%	16.5%	30.2%	70.6%
GRC	18.0%	41.7%	80.7%	18.0%	40.9%	79.7%
HUN	12.5%	20.1%	43.4%	12.5%	19.9%	42.6%
IRL	11.1%	32.7%	77.8%	11.1%	32.7%	77.7%
ITA	17.8%	33.4%	65.2%	17.8%	32.9%	63.9%
LVA	40.3%	47.9%	75.4%	40.3%	47.9%	75.3%
LTU	24.4%	32.5%	63.5%	24.4%	32.4%	63.1%
LUX	9.1%	12.5%	42.6%	9.1%	12.4%	42.2%
MLT	8.0%	23.5%	52.8%	8.0%	22.3%	50.4%
NLD	7.4%	22.2%	54.6%	7.4%	22.0%	53.7%
POL	11.3%	27.2%	50.6%	11.3%	27.0%	50.1%
PRT	30.3%	43.8%	79.7%	30.3%	43.5%	79.1%
ROU	23.9%	35.9%	63.5%	23.9%	35.8%	63.2%
SVK	11.9%	19.2%	42.9%	11.9%	19.1%	42.3%
SVN	21.2%	35.5%	67.1%	21.2%	35.3%	66.6%
ESP	17.5%	37.5%	79.6%	17.5%	37.0%	78.9%
SWE	54.6%	68.0%	77.4%	54.6%	67.9%	77.3%
GBR	11.0%	28.1%	62.2%	11.0%	27.9%	61.7%
EU27	18.9%	33.1%	65.2%	18.9%	32.9%	64.6%
EU28	18.0%	32.6%	64.9%	18.0%	32.3%	64.3%

Table 13: Resulting shares for RES HC ambitious and baseline scenarios applying method 1.A.1 for all EU member states under the assumption of UED development from the SET NAV project [6]

SET NAV	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	34.0%	41.1%	57.5%	34.0%	41.1%	57.5%
BEL	8.2%	21.1%	42.2%	8.2%	20.9%	41.4%
BGR	33.3%	43.4%	64.5%	33.3%	42.5%	61.5%
HRV	36.5%	36.1%	64.9%	36.5%	34.7%	62.2%
CYP	36.8%	47.5%	61.0%	36.8%	45.1%	55.2%
CZE	20.7%	27.1%	44.4%	20.7%	26.9%	43.5%
DNK	46.7%	56.4%	67.7%	46.7%	56.3%	67.3%
EST	53.7%	60.8%	69.5%	53.7%	60.8%	69.3%
FIN	54.6%	71.4%	72.0%	54.6%	71.3%	71.4%
FRA	21.8%	37.3%	64.6%	21.8%	36.6%	62.5%
DEU	13.6%	28.6%	53.0%	13.6%	28.2%	51.5%
GRC	30.2%	56.7%	80.0%	30.2%	54.8%	77.0%
HUN	18.1%	29.1%	53.8%	18.1%	28.7%	52.3%
IRL	6.5%	34.6%	64.4%	6.5%	34.4%	63.8%
ITA	19.2%	39.1%	65.4%	19.2%	38.0%	62.3%
LVA	55.9%	64.7%	78.3%	55.9%	64.7%	78.2%
LTU	45.6%	48.3%	65.7%	45.6%	48.2%	64.8%
LUX	8.8%	28.6%	45.8%	8.8%	28.3%	44.4%
MLT	23.4%	66.8%	89.7%	23.4%	63.1%	86.6%
NLD	6.1%	15.5%	42.7%	6.1%	15.1%	40.4%
POL	14.8%	35.0%	54.2%	14.8%	34.7%	53.0%
PRT	41.2%	48.1%	72.1%	41.2%	47.2%	69.8%
ROU	25.4%	34.0%	54.1%	25.4%	33.8%	53.2%
SVK	10.6%	22.5%	49.1%	10.6%	22.3%	47.9%
SVN	31.6%	47.4%	66.8%	31.6%	47.0%	65.0%
ESP	17.5%	36.4%	72.5%	17.5%	34.5%	69.7%
SWE	65.4%	79.8%	81.0%	65.4%	79.7%	80.7%
GBR	7.5%	18.9%	52.0%	7.5%	18.3%	49.8%
EU27	21.1%	36.1%	59.8%	21.1%	35.5%	57.8%
EU28	19.7%	34.4%	59.0%	19.7%	33.8%	57.1%

Table 14: Calculation Method 1A1 resulting shares for RES ambitious and baseline for all EU member states

1A1	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.4%	45.5%	71.6%	33.4%	45.5%	71.5%
BEL	9.4%	22.5%	49.6%	9.4%	22.4%	49.5%
BGR	20.5%	33.1%	55.4%	20.5%	33.0%	55.1%
HRV	28.0%	40.7%	62.1%	28.0%	40.6%	61.8%
CYP	13.9%	27.9%	79.9%	13.9%	27.0%	79.0%
CZE	15.2%	21.4%	38.5%	15.2%	21.3%	38.3%
DNK	35.7%	48.7%	79.7%	35.7%	48.7%	79.7%
EST	30.0%	39.0%	74.6%	30.0%	38.9%	74.5%
FIN	41.2%	52.5%	56.3%	41.2%	52.4%	56.3%
FRA	16.6%	29.7%	64.2%	16.6%	29.6%	63.9%
DEU	16.5%	29.9%	69.9%	16.5%	29.9%	69.8%
GRC	18.0%	41.1%	80.0%	18.0%	40.5%	79.3%
HUN	12.5%	19.9%	42.1%	12.5%	19.8%	41.8%
IRL	11.1%	32.7%	77.7%	11.1%	32.7%	77.7%
ITA	17.8%	32.8%	63.1%	17.8%	32.5%	62.4%
LVA	40.3%	47.9%	75.4%	40.3%	47.9%	75.3%
LTU	24.4%	35.7%	63.0%	24.4%	35.7%	62.9%
LUX	9.1%	12.4%	42.2%	9.1%	12.4%	42.1%
MLT	8.0%	28.8%	65.3%	8.0%	26.1%	60.4%
NLD	7.4%	21.8%	52.6%	7.4%	21.8%	52.5%
POL	11.3%	26.9%	49.5%	11.3%	26.8%	49.4%
PRT	30.3%	43.0%	78.2%	30.3%	43.0%	78.1%
ROU	23.9%	35.9%	63.3%	23.9%	35.8%	63.1%
SVK	11.9%	19.1%	41.9%	11.9%	19.1%	41.8%
SVN	21.2%	35.1%	66.0%	21.2%	35.0%	65.8%
ESP	17.5%	37.6%	79.0%	17.5%	37.0%	78.5%
SWE	54.6%	67.9%	77.2%	54.6%	67.9%	77.2%
GBR	11.0%	27.8%	60.8%	11.0%	27.7%	60.7%
EU27	18.9%	32.9%	64.1%	18.9%	32.7%	63.8%
EU28	18.0%	32.3%	63.8%	18.0%	32.2%	63.5%

Table 15: Calculation Method 1A1 resulting shares for RES HC ambitious and baseline for all EU member states

1A1	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	34.0%	41.3%	58.2%	34.0%	41.2%	57.9%
BEL	8.2%	20.9%	40.6%	8.2%	20.8%	40.4%
BGR	33.3%	41.3%	56.4%	33.3%	41.1%	55.5%
HRV	36.5%	47.9%	56.8%	36.5%	47.8%	56.1%
CYP	36.8%	54.6%	63.0%	36.8%	52.5%	57.4%
CZE	20.7%	27.0%	42.9%	20.7%	26.8%	42.5%
DNK	46.7%	57.7%	67.3%	46.7%	57.7%	67.1%
EST	53.7%	64.8%	69.4%	53.7%	64.7%	69.2%
FIN	54.6%	71.3%	71.1%	54.6%	71.3%	71.0%
FRA	21.8%	36.6%	60.2%	21.8%	36.1%	59.4%
DEU	13.6%	27.7%	48.5%	13.6%	27.6%	48.3%
GRC	30.2%	55.2%	77.9%	30.2%	53.8%	75.4%
HUN	18.1%	28.6%	51.2%	18.1%	28.4%	50.6%
IRL	6.5%	34.4%	63.6%	6.5%	34.4%	63.5%
ITA	19.2%	37.9%	60.2%	19.2%	37.2%	58.5%
LVA	55.9%	64.8%	78.3%	55.9%	64.7%	78.1%
LTU	45.6%	56.7%	64.6%	45.6%	56.7%	64.3%
LUX	8.8%	28.4%	44.3%	8.8%	28.3%	43.7%
MLT	23.4%	77.5%	96.3%	23.4%	73.0%	94.7%
NLD	6.1%	14.7%	37.1%	6.1%	14.6%	36.8%
POL	14.8%	34.4%	51.3%	14.8%	34.3%	51.1%
PRT	41.2%	45.9%	66.2%	41.2%	45.7%	65.6%
ROU	25.4%	34.0%	53.4%	25.4%	33.8%	52.7%
SVK	10.6%	22.2%	46.9%	10.6%	22.1%	46.6%
SVN	31.6%	46.4%	62.9%	31.6%	46.3%	62.3%
ESP	17.5%	36.6%	70.2%	17.5%	34.7%	67.7%
SWE	65.4%	79.8%	80.6%	65.4%	79.7%	80.5%
GBR	7.5%	17.7%	45.5%	7.5%	17.5%	45.1%
EU27	21.1%	35.5%	56.3%	21.1%	35.2%	55.4%
EU28	19.7%	33.8%	55.4%	19.7%	33.4%	54.5%

Table 16: Calculation Method 1A2 resulting shares for RES ambitious and baseline for all EU member states

1A2	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.4%	45.6%	71.6%	33.4%	45.5%	71.5%
BEL	9.4%	22.5%	49.6%	9.4%	22.4%	49.5%
BGR	20.5%	33.1%	55.4%	20.5%	33.0%	55.1%
HRV	28.0%	40.7%	62.1%	28.0%	40.6%	61.8%
CYP	13.9%	28.1%	80.1%	13.9%	27.0%	79.1%
CZE	15.2%	21.4%	38.5%	15.2%	21.3%	38.3%
DNK	35.7%	48.7%	79.7%	35.7%	48.7%	79.7%
EST	30.0%	39.0%	74.6%	30.0%	38.9%	74.5%
FIN	41.2%	52.5%	56.3%	41.2%	52.4%	56.3%
FRA	16.6%	29.8%	64.2%	16.6%	29.6%	64.0%
DEU	16.5%	29.9%	69.9%	16.5%	29.9%	69.8%
GRC	18.0%	41.2%	80.2%	18.0%	40.6%	79.3%
HUN	12.5%	19.9%	42.1%	12.5%	19.8%	41.8%
IRL	11.1%	32.7%	77.7%	11.1%	32.7%	77.7%
ITA	17.8%	32.9%	63.2%	17.8%	32.5%	62.4%
LVA	40.3%	48.0%	75.4%	40.3%	47.9%	75.3%
LTU	24.4%	35.8%	63.1%	24.4%	35.7%	62.9%
LUX	9.1%	12.5%	42.3%	9.1%	12.4%	42.1%
MLT	8.0%	29.5%	66.3%	8.0%	26.3%	60.6%
NLD	7.4%	21.8%	52.6%	7.4%	21.8%	52.5%
POL	11.3%	26.9%	49.5%	11.3%	26.8%	49.4%
PRT	30.3%	43.1%	78.2%	30.3%	43.0%	78.1%
ROU	23.9%	35.9%	63.4%	23.9%	35.8%	63.1%
SVK	11.9%	19.1%	41.9%	11.9%	19.1%	41.8%
SVN	21.2%	35.1%	66.0%	21.2%	35.0%	65.8%
ESP	17.5%	37.8%	79.1%	17.5%	37.1%	78.5%
SWE	54.6%	67.9%	77.2%	54.6%	67.9%	77.2%
GBR	11.0%	27.8%	60.8%	11.0%	27.7%	60.7%
EU27	18.9%	32.9%	64.2%	18.9%	32.7%	63.8%
EU28	18.0%	32.3%	63.8%	18.0%	32.2%	63.5%

Table 17: Calculation Method 1A2 resulting shares for RES HC ambitious and baseline for all EU member states

1A2	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	34.0%	41.4%	58.3%	34.0%	41.2%	57.9%
BEL	8.2%	20.9%	40.7%	8.2%	20.8%	40.4%
BGR	33.3%	41.4%	56.6%	33.3%	41.1%	55.5%
HRV	36.5%	48.0%	57.0%	36.5%	47.8%	56.1%
CYP	36.8%	55.2%	64.3%	36.8%	52.7%	57.6%
CZE	20.7%	27.0%	43.0%	20.7%	26.9%	42.5%
DNK	46.7%	57.7%	67.3%	46.7%	57.7%	67.1%
EST	53.7%	64.8%	69.5%	53.7%	64.7%	69.2%
FIN	54.6%	71.3%	71.2%	54.6%	71.3%	71.1%
FRA	21.8%	36.7%	60.5%	21.8%	36.2%	59.4%
DEU	13.6%	27.7%	48.5%	13.6%	27.6%	48.3%
GRC	30.2%	55.6%	78.4%	30.2%	53.9%	75.4%
HUN	18.1%	28.7%	51.3%	18.1%	28.4%	50.6%
IRL	6.5%	34.5%	63.7%	6.5%	34.4%	63.5%
ITA	19.2%	38.1%	60.6%	19.2%	37.2%	58.5%
LVA	55.9%	64.8%	78.4%	55.9%	64.7%	78.2%
LTU	45.6%	56.8%	64.7%	45.6%	56.7%	64.4%
LUX	8.8%	28.6%	44.6%	8.8%	28.3%	43.8%
MLT	23.5%	78.5%	96.5%	23.5%	73.3%	94.8%
NLD	6.1%	14.7%	37.1%	6.1%	14.6%	36.8%
POL	14.8%	34.4%	51.4%	14.8%	34.3%	51.1%
PRT	41.2%	46.0%	66.3%	41.2%	45.7%	65.6%
ROU	25.4%	34.0%	53.6%	25.4%	33.8%	52.7%
SVK	10.6%	22.3%	47.0%	10.6%	22.1%	46.6%
SVN	31.6%	46.5%	63.1%	31.6%	46.3%	62.3%
ESP	17.5%	37.1%	70.7%	17.5%	34.8%	67.8%
SWE	65.4%	79.8%	80.6%	65.4%	79.7%	80.5%
GBR	7.5%	17.7%	45.6%	7.5%	17.5%	45.1%
EU27	21.1%	35.6%	56.5%	21.1%	35.2%	55.4%
EU28	19.7%	33.9%	55.6%	19.7%	33.4%	54.5%

Table 18: Calculation Method 1B resulting shares for RES ambitious and baseline for all EU member states

1B	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.5%	45.7%	71.7%	33.5%	45.7%	71.6%
BEL	9.5%	22.5%	49.6%	9.5%	22.5%	49.5%
BGR	20.6%	33.3%	55.6%	20.6%	33.2%	55.3%
HRV	28.2%	41.0%	62.3%	28.2%	40.9%	62.1%
CYP	14.2%	28.8%	80.5%	14.2%	27.8%	79.6%
CZE	15.2%	21.5%	38.5%	15.2%	21.4%	38.3%
DNK	35.8%	48.9%	79.8%	35.8%	48.8%	79.8%
EST	30.1%	39.1%	74.7%	30.1%	39.0%	74.6%
FIN	41.2%	52.5%	56.4%	41.2%	52.5%	56.3%
FRA	16.8%	30.0%	64.4%	16.8%	29.8%	64.2%
DEU	16.5%	30.0%	69.9%	16.5%	30.0%	69.9%
GRC	18.7%	42.3%	80.7%	18.7%	41.7%	80.0%
HUN	12.5%	20.0%	42.2%	12.5%	19.9%	41.9%
IRL	11.1%	32.7%	77.8%	11.1%	32.7%	77.7%
ITA	18.3%	33.4%	63.7%	18.3%	33.0%	63.0%
LVA	40.4%	48.1%	75.5%	40.4%	48.1%	75.4%
LTU	24.5%	35.9%	63.1%	24.5%	35.8%	63.0%
LUX	9.1%	12.5%	42.4%	9.1%	12.5%	42.2%
MLT	8.5%	31.2%	67.5%	8.5%	28.3%	62.5%
NLD	7.4%	21.9%	52.6%	7.4%	21.8%	52.5%
POL	11.3%	26.9%	49.5%	11.3%	26.9%	49.4%
PRT	30.5%	43.3%	78.4%	30.5%	43.2%	78.3%
ROU	24.0%	36.2%	63.5%	24.0%	36.1%	63.3%
SVK	11.9%	19.2%	42.0%	11.9%	19.1%	41.8%
SVN	21.3%	35.3%	66.2%	21.3%	35.2%	66.0%
ESP	18.5%	38.9%	79.5%	18.5%	38.3%	79.0%
SWE	54.7%	68.0%	77.2%	54.7%	68.0%	77.2%
GBR	11.1%	27.9%	60.9%	11.1%	27.8%	60.8%
EU27	19.1%	33.2%	64.4%	19.1%	33.0%	64.1%
EU28	18.2%	32.6%	64.0%	18.2%	32.5%	63.8%

Table 19: Calculation Method 1B resulting shares for RES HC ambitious and baseline for all EU member states

1B	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	34.2%	41.7%	58.6%	34.2%	41.6%	58.3%
BEL	8.3%	21.1%	40.8%	8.3%	21.0%	40.5%
BGR	33.4%	41.8%	57.1%	33.4%	41.6%	56.2%
HRV	36.9%	48.5%	57.5%	36.9%	48.4%	56.8%
CYP	37.5%	56.7%	66.5%	37.5%	54.4%	61.4%
CZE	20.7%	27.1%	43.1%	20.7%	27.0%	42.6%
DNK	46.8%	58.0%	67.6%	46.8%	58.0%	67.4%
EST	53.8%	64.9%	69.8%	53.8%	64.8%	69.7%
FIN	54.7%	71.3%	71.2%	54.7%	71.3%	71.1%
FRA	22.2%	37.4%	61.1%	22.2%	36.9%	60.3%
DEU	13.7%	27.8%	48.7%	13.7%	27.7%	48.6%
GRC	32.0%	58.2%	79.9%	32.0%	56.9%	77.8%
HUN	18.2%	28.8%	51.5%	18.2%	28.6%	50.8%
IRL	6.6%	34.7%	63.8%	6.6%	34.6%	63.7%
ITA	20.3%	39.1%	61.7%	20.3%	38.3%	59.9%
LVA	56.1%	65.0%	78.6%	56.1%	65.0%	78.4%
LTU	45.7%	56.9%	64.9%	45.7%	56.9%	64.6%
LUX	8.9%	28.8%	44.9%	8.9%	28.6%	44.1%
MLT	26.4%	80.7%	96.8%	26.4%	76.8%	95.5%
NLD	6.2%	14.8%	37.2%	6.2%	14.7%	37.0%
POL	14.8%	34.5%	51.4%	14.8%	34.4%	51.2%
PRT	41.6%	46.7%	67.0%	41.6%	46.5%	66.4%
ROU	25.7%	34.5%	54.1%	25.7%	34.3%	53.4%
SVK	10.7%	22.4%	47.1%	10.7%	22.3%	46.8%
SVN	31.9%	47.0%	63.5%	31.9%	46.8%	62.9%
ESP	20.6%	40.6%	72.3%	20.6%	38.7%	70.1%
SWE	65.5%	79.8%	80.7%	65.5%	79.8%	80.6%
GBR	7.7%	18.1%	45.9%	7.7%	17.9%	45.5%
EU27	21.6%	36.3%	57.2%	21.6%	35.9%	56.3%
EU28	20.1%	34.5%	56.3%	20.1%	34.2%	55.4%

Table 20: Calculation Method 2A1 resulting shares for RES ambitious and baseline for all EU member states

2A1	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.1%	44.9%	70.4%	33.1%	44.8%	70.1%
BEL	9.3%	22.3%	49.1%	9.3%	22.2%	48.9%
BGR	20.2%	32.1%	53.4%	20.2%	32.0%	52.8%
HRV	27.4%	39.5%	59.7%	27.4%	39.4%	59.1%
CYP	12.1%	22.7%	64.0%	12.1%	21.7%	60.7%
CZE	15.0%	21.1%	37.8%	15.0%	21.0%	37.5%
DNK	35.4%	48.2%	78.7%	35.4%	48.1%	78.5%
EST	29.5%	37.9%	72.7%	29.5%	37.9%	72.4%
FIN	40.9%	52.0%	55.9%	40.9%	52.0%	55.7%
FRA	16.0%	28.4%	61.1%	16.0%	28.2%	60.5%
DEU	16.4%	29.8%	69.4%	16.4%	29.7%	69.2%
GRC	16.0%	35.2%	66.6%	16.0%	34.4%	63.7%
HUN	12.3%	19.3%	40.8%	12.3%	19.2%	40.4%
IRL	11.0%	32.4%	77.1%	11.0%	32.4%	77.0%
ITA	16.6%	30.3%	57.1%	16.6%	29.9%	55.4%
LVA	39.7%	46.8%	73.4%	39.7%	46.7%	73.1%
LTU	24.2%	35.0%	61.8%	24.2%	35.0%	61.6%
LUX	8.9%	12.1%	41.3%	8.9%	12.1%	41.1%
MLT	6.3%	17.4%	38.1%	6.3%	15.2%	30.9%
NLD	7.3%	21.6%	52.1%	7.3%	21.5%	51.9%
POL	11.2%	26.7%	49.1%	11.2%	26.6%	49.0%
PRT	29.8%	41.9%	75.1%	29.8%	41.7%	74.5%
ROU	23.4%	34.8%	60.8%	23.4%	34.6%	60.1%
SVK	11.8%	18.8%	41.2%	11.8%	18.8%	41.0%
SVN	20.8%	34.0%	63.6%	20.8%	33.9%	63.2%
ESP	15.3%	32.3%	68.6%	15.3%	31.5%	66.5%
SWE	54.2%	67.3%	76.5%	54.2%	67.3%	76.3%
GBR	10.9%	27.4%	60.1%	10.9%	27.4%	59.9%
EU27	18.3%	31.5%	61.2%	18.3%	31.3%	60.5%
EU28	17.5%	31.1%	61.1%	17.5%	30.9%	60.4%

Table 21: Calculation Method 2A1 resulting shares for RES HC ambitious and baseline for all EU member states

2A1	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.3%	40.0%	55.7%	33.3%	39.8%	54.9%
BEL	8.1%	20.5%	39.7%	8.1%	20.4%	39.3%
BGR	32.0%	38.0%	50.0%	32.0%	37.6%	48.2%
HRV	34.8%	44.7%	51.5%	34.8%	44.4%	50.0%
CYP	24.8%	29.7%	35.1%	24.8%	27.3%	27.7%
CZE	20.3%	26.1%	41.1%	20.3%	26.0%	40.5%
DNK	45.8%	56.2%	64.9%	45.8%	56.1%	64.5%
EST	51.7%	61.1%	65.5%	51.7%	61.0%	64.9%
FIN	54.0%	70.1%	69.7%	54.0%	70.0%	69.3%
FRA	20.0%	31.9%	51.5%	20.0%	31.3%	49.7%
DEU	13.5%	27.3%	47.6%	13.5%	27.3%	47.3%
GRC	21.5%	35.2%	49.0%	21.5%	33.2%	42.4%
HUN	17.6%	27.0%	47.7%	17.6%	26.8%	46.7%
IRL	6.4%	33.7%	61.8%	6.4%	33.6%	61.5%
ITA	16.7%	32.2%	48.1%	16.7%	31.2%	44.6%
LVA	54.5%	61.8%	74.0%	54.5%	61.6%	73.4%
LTU	44.5%	54.0%	61.2%	44.5%	53.8%	60.6%
LUX	8.3%	25.8%	40.3%	8.3%	25.6%	39.3%
MLT	7.9%	19.0%	35.4%	7.9%	14.9%	24.5%
NLD	6.1%	14.4%	36.3%	6.1%	14.3%	35.9%
POL	14.6%	33.8%	50.3%	14.6%	33.7%	49.9%
PRT	39.1%	42.2%	58.9%	39.1%	41.9%	57.3%
ROU	24.5%	31.9%	48.9%	24.5%	31.6%	47.5%
SVK	10.4%	21.5%	45.1%	10.4%	21.4%	44.6%
SVN	30.2%	42.1%	55.8%	30.2%	41.8%	54.5%
ESP	12.3%	23.9%	47.7%	12.3%	21.9%	42.6%
SWE	64.2%	77.9%	78.2%	64.2%	77.7%	77.6%
GBR	7.4%	17.1%	43.7%	7.4%	17.0%	43.0%
EU27	19.7%	32.2%	49.8%	19.7%	31.7%	48.0%
EU28	18.4%	30.8%	49.4%	18.4%	30.3%	47.6%

Table 22: Calculation Method 2A2 resulting shares for RES ambitious and baseline for all EU member states

2A2	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.1%	44.9%	70.5%	33.1%	44.8%	70.1%
BEL	9.3%	22.3%	49.1%	9.3%	22.2%	48.9%
BGR	20.2%	32.2%	53.5%	20.2%	32.0%	52.8%
HRV	27.4%	39.5%	59.8%	27.4%	39.4%	59.1%
CYP	12.1%	23.0%	64.8%	12.1%	21.7%	60.8%
CZE	15.0%	21.1%	37.9%	15.0%	21.0%	37.5%
DNK	35.4%	48.2%	78.7%	35.4%	48.1%	78.5%
EST	29.5%	38.0%	72.8%	29.5%	37.9%	72.4%
FIN	40.9%	52.1%	55.9%	40.9%	52.0%	55.7%
FRA	16.0%	28.4%	61.2%	16.0%	28.2%	60.5%
DEU	16.4%	29.8%	69.4%	16.4%	29.7%	69.2%
GRC	16.0%	35.4%	67.3%	16.0%	34.5%	63.8%
HUN	12.3%	19.4%	40.9%	12.3%	19.2%	40.4%
IRL	11.0%	32.4%	77.1%	11.0%	32.4%	77.0%
ITA	16.6%	30.5%	57.4%	16.6%	29.9%	55.5%
LVA	39.7%	46.8%	73.5%	39.7%	46.7%	73.1%
LTU	24.2%	35.1%	61.9%	24.2%	35.0%	61.6%
LUX	8.9%	12.2%	41.4%	8.9%	12.1%	41.1%
MLT	6.3%	18.0%	39.8%	6.3%	15.4%	31.1%
NLD	7.3%	21.6%	52.1%	7.3%	21.5%	51.9%
POL	11.2%	26.7%	49.1%	11.2%	26.6%	49.0%
PRT	29.8%	41.9%	75.2%	29.8%	41.7%	74.5%
ROU	23.4%	34.8%	60.9%	23.4%	34.6%	60.1%
SVK	11.8%	18.8%	41.3%	11.8%	18.8%	41.0%
SVN	20.8%	34.1%	63.8%	20.8%	34.0%	63.2%
ESP	15.3%	32.5%	69.1%	15.3%	31.5%	66.6%
SWE	54.2%	67.3%	76.5%	54.2%	67.3%	76.3%
GBR	10.9%	27.5%	60.1%	10.9%	27.4%	59.9%
EU27	18.3%	31.6%	61.4%	18.3%	31.3%	60.5%
EU28	17.5%	31.2%	61.2%	17.5%	30.9%	60.4%

Table 23: Calculation Method 2A2 resulting shares for RES HC ambitious and baseline for all EU member states

2A2	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.3%	40.0%	55.9%	33.3%	39.8%	54.9%
BEL	8.1%	20.5%	39.8%	8.1%	20.4%	39.3%
BGR	32.0%	38.1%	50.5%	32.0%	37.6%	48.3%
HRV	34.8%	44.8%	51.9%	34.8%	44.4%	50.1%
CYP	24.8%	30.5%	37.0%	24.8%	27.5%	28.0%
CZE	20.3%	26.2%	41.3%	20.3%	26.0%	40.5%
DNK	45.8%	56.2%	65.1%	45.8%	56.1%	64.5%
EST	51.7%	61.2%	65.8%	51.7%	61.0%	64.9%
FIN	54.0%	70.1%	69.8%	54.0%	70.0%	69.3%
FRA	20.0%	32.0%	52.0%	20.0%	31.3%	49.8%
DEU	13.5%	27.4%	47.7%	13.5%	27.3%	47.3%
GRC	21.5%	35.7%	50.4%	21.5%	33.4%	42.6%
HUN	17.6%	27.1%	48.0%	17.6%	26.8%	46.7%
IRL	6.4%	33.7%	61.9%	6.4%	33.6%	61.5%
ITA	16.7%	32.4%	48.8%	16.7%	31.3%	44.7%
LVA	54.5%	61.8%	74.3%	54.5%	61.7%	73.4%
LTU	44.5%	54.1%	61.5%	44.5%	53.9%	60.6%
LUX	8.3%	26.0%	40.8%	8.3%	25.6%	39.4%
MLT	7.9%	20.2%	38.0%	7.9%	15.1%	24.8%
NLD	6.1%	14.4%	36.4%	6.1%	14.3%	35.9%
POL	14.6%	33.8%	50.3%	14.6%	33.7%	49.9%
PRT	39.1%	42.4%	59.3%	39.1%	41.9%	57.4%
ROU	24.5%	32.0%	49.3%	24.5%	31.6%	47.5%
SVK	10.4%	21.5%	45.3%	10.4%	21.4%	44.6%
SVN	30.2%	42.2%	56.4%	30.2%	41.9%	54.5%
ESP	12.3%	24.4%	48.9%	12.3%	22.0%	42.7%
SWE	64.2%	77.9%	78.3%	64.2%	77.7%	77.6%
GBR	7.4%	17.2%	43.9%	7.4%	17.0%	43.0%
EU27	19.7%	32.4%	50.3%	19.7%	31.7%	48.0%
EU28	18.4%	31.0%	49.8%	18.4%	30.4%	47.7%

Table 24: Calculation Method 2B resulting shares for RES ambitious and baseline for all EU member states

2B	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.3%	45.2%	70.7%	33.3%	45.1%	70.4%
BEL	9.4%	22.3%	49.2%	9.4%	22.3%	49.0%
BGR	20.3%	32.4%	53.9%	20.3%	32.3%	53.2%
HRV	27.7%	39.9%	60.3%	27.7%	39.8%	59.7%
CYP	12.4%	23.7%	66.6%	12.4%	22.6%	62.9%
CZE	15.0%	21.2%	37.9%	15.0%	21.1%	37.6%
DNK	35.5%	48.4%	79.0%	35.5%	48.4%	78.8%
EST	29.6%	38.1%	73.3%	29.6%	38.0%	73.0%
FIN	41.0%	52.1%	56.0%	41.0%	52.1%	55.8%
FRA	16.2%	28.8%	61.7%	16.2%	28.5%	61.1%
DEU	16.5%	29.8%	69.5%	16.5%	29.8%	69.4%
GRC	16.8%	37.0%	69.5%	16.8%	36.2%	66.4%
HUN	12.3%	19.5%	41.1%	12.3%	19.3%	40.5%
IRL	11.1%	32.5%	77.2%	11.1%	32.5%	77.1%
ITA	17.2%	31.2%	58.5%	17.2%	30.6%	56.8%
LVA	39.9%	47.1%	73.9%	39.9%	47.1%	73.6%
LTU	24.2%	35.2%	62.1%	24.2%	35.2%	61.8%
LUX	9.0%	12.3%	41.5%	9.0%	12.2%	41.3%
MLT	6.7%	19.5%	42.0%	6.7%	17.0%	33.8%
NLD	7.4%	21.7%	52.2%	7.4%	21.6%	52.0%
POL	11.2%	26.7%	49.2%	11.2%	26.7%	49.0%
PRT	30.0%	42.3%	75.8%	30.0%	42.2%	75.3%
ROU	23.6%	35.2%	61.4%	23.6%	35.0%	60.7%
SVK	11.8%	18.9%	41.3%	11.8%	18.8%	41.1%
SVN	21.0%	34.4%	64.1%	21.0%	34.3%	63.6%
ESP	16.4%	34.0%	70.8%	16.4%	33.2%	68.6%
SWE	54.4%	67.5%	76.6%	54.4%	67.4%	76.5%
GBR	11.0%	27.6%	60.3%	11.0%	27.5%	60.0%
EU27	18.5%	32.0%	61.9%	18.5%	31.8%	61.2%
EU28	17.7%	31.5%	61.8%	17.7%	31.3%	61.1%

Table 25: Calculation Method 2B resulting shares for RES HC ambitious and baseline for all EU member states

2B	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.7%	40.6%	56.6%	33.7%	40.4%	55.8%
BEL	8.1%	20.7%	40.0%	8.1%	20.5%	39.5%
BGR	32.2%	38.8%	51.6%	32.2%	38.4%	49.6%
HRV	35.4%	45.7%	53.1%	35.4%	45.4%	51.5%
CYP	25.6%	32.3%	40.9%	25.6%	29.5%	32.8%
CZE	20.4%	26.3%	41.5%	20.4%	26.2%	40.7%
DNK	46.1%	56.8%	65.7%	46.1%	56.7%	65.3%
EST	51.9%	61.5%	66.9%	51.9%	61.3%	66.3%
FIN	54.1%	70.3%	69.9%	54.1%	70.2%	69.5%
FRA	20.4%	33.0%	53.4%	20.4%	32.3%	51.5%
DEU	13.6%	27.5%	48.0%	13.6%	27.4%	47.7%
GRC	23.4%	39.8%	55.3%	23.4%	37.7%	48.5%
HUN	17.6%	27.3%	48.3%	17.6%	27.0%	47.1%
IRL	6.5%	34.0%	62.4%	6.5%	34.0%	62.0%
ITA	17.8%	33.8%	51.1%	17.8%	32.8%	47.4%
LVA	54.9%	62.5%	75.2%	54.9%	62.3%	74.5%
LTU	44.6%	54.4%	62.0%	44.6%	54.2%	61.3%
LUX	8.4%	26.3%	41.2%	8.4%	26.0%	39.9%
MLT	9.2%	23.1%	41.3%	9.2%	18.3%	28.8%
NLD	6.1%	14.6%	36.5%	6.1%	14.4%	36.1%
POL	14.6%	33.9%	50.5%	14.6%	33.8%	50.0%
PRT	39.8%	43.6%	61.1%	39.8%	43.3%	59.4%
ROU	24.9%	32.7%	50.2%	24.9%	32.3%	48.7%
SVK	10.5%	21.7%	45.4%	10.5%	21.5%	44.8%
SVN	30.6%	43.1%	57.5%	30.6%	42.8%	55.9%
ESP	15.1%	28.2%	52.9%	15.1%	26.1%	47.5%
SWE	64.5%	78.3%	78.7%	64.5%	78.1%	78.1%
GBR	7.5%	17.6%	44.4%	7.5%	17.4%	43.6%
EU27	20.3%	33.3%	51.7%	20.3%	32.7%	49.8%
EU28	19.0%	31.9%	51.2%	19.0%	31.3%	49.3%

Table 26: Calculation Method 1A1 resulting shares for RES ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

1A1	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.4%	45.6%	71.7%	33.4%	45.6%	71.6%
BEL	9.4%	22.6%	49.7%	9.4%	22.5%	49.6%
BGR	20.5%	33.3%	55.7%	20.5%	33.2%	55.4%
HRV	28.0%	40.9%	62.4%	28.0%	40.8%	62.1%
CYP	13.9%	29.9%	81.0%	13.9%	29.0%	80.2%
CZE	15.2%	21.5%	38.7%	15.2%	21.5%	38.5%
DNK	35.7%	48.8%	79.8%	35.7%	48.7%	79.7%
EST	30.0%	39.1%	74.7%	30.0%	39.0%	74.6%
FIN	41.2%	52.5%	56.4%	41.2%	52.5%	56.3%
FRA	16.6%	30.1%	64.5%	16.6%	29.9%	64.3%
DEU	16.5%	30.0%	69.9%	16.5%	30.0%	69.9%
GRC	18.0%	42.3%	80.9%	18.0%	41.9%	80.3%
HUN	12.5%	20.1%	42.5%	12.5%	20.0%	42.1%
IRL	11.1%	32.7%	77.8%	11.1%	32.7%	77.7%
ITA	17.8%	33.6%	63.9%	17.8%	33.3%	63.3%
LVA	40.3%	48.0%	75.5%	40.3%	48.0%	75.4%
LTU	24.4%	35.8%	63.2%	24.4%	35.8%	63.1%
LUX	9.1%	12.6%	42.5%	9.1%	12.5%	42.3%
MLT	8.0%	34.4%	70.2%	8.0%	32.1%	66.7%
NLD	7.4%	21.9%	52.7%	7.4%	21.9%	52.6%
POL	11.3%	27.0%	49.6%	11.3%	26.9%	49.5%
PRT	30.3%	43.2%	78.4%	30.3%	43.1%	78.3%
ROU	23.9%	36.2%	63.7%	23.9%	36.0%	63.4%
SVK	11.9%	19.2%	42.1%	11.9%	19.2%	41.9%
SVN	21.2%	35.2%	66.3%	21.2%	35.1%	66.0%
ESP	17.5%	39.0%	79.7%	17.5%	38.5%	79.2%
SWE	54.6%	68.0%	77.2%	54.6%	68.0%	77.2%
GBR	11.0%	27.9%	60.9%	11.0%	27.8%	60.8%
EU27	18.9%	33.3%	64.5%	18.9%	33.2%	64.2%
EU28	18.0%	32.7%	64.1%	18.0%	32.6%	63.9%

Table 27: Calculation Method 1A1 resulting shares for RES HC ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

1A1	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	34.0%	41.5%	58.7%	34.0%	41.4%	58.3%
BEL	8.2%	21.1%	41.0%	8.2%	21.0%	40.7%
BGR	33.3%	41.9%	57.6%	33.3%	41.6%	56.6%
HRV	36.5%	48.3%	57.9%	36.5%	48.1%	57.0%
CYP	36.8%	59.0%	68.9%	36.8%	57.1%	64.7%
CZE	20.7%	27.2%	43.4%	20.7%	27.1%	43.0%
DNK	46.7%	57.8%	67.6%	46.7%	57.8%	67.3%
EST	53.7%	64.9%	69.9%	53.7%	64.8%	69.5%
FIN	54.6%	71.3%	71.3%	54.6%	71.3%	71.2%
FRA	21.8%	37.6%	61.5%	21.8%	37.2%	60.6%
DEU	13.6%	27.8%	48.7%	13.6%	27.7%	48.5%
GRC	30.2%	58.3%	80.5%	30.2%	57.1%	78.7%
HUN	18.1%	29.1%	52.0%	18.1%	28.8%	51.3%
IRL	6.5%	34.5%	63.9%	6.5%	34.5%	63.7%
ITA	19.2%	39.4%	62.3%	19.2%	38.9%	60.8%
LVA	55.9%	64.9%	78.6%	55.9%	64.8%	78.4%
LTU	45.6%	56.9%	65.1%	45.6%	56.8%	64.7%
LUX	8.8%	28.9%	45.7%	8.8%	28.5%	44.6%
MLT	23.4%	84.0%	97.4%	23.4%	81.7%	96.6%
NLD	6.1%	14.9%	37.4%	6.1%	14.8%	37.1%
POL	14.8%	34.5%	51.6%	14.8%	34.5%	51.4%
PRT	41.2%	46.4%	67.1%	41.2%	46.2%	66.4%
ROU	25.4%	34.5%	54.5%	25.4%	34.3%	53.7%
SVK	10.6%	22.5%	47.4%	10.6%	22.3%	47.0%
SVN	31.6%	46.8%	64.0%	31.6%	46.5%	63.1%
ESP	17.5%	40.9%	72.9%	17.5%	39.4%	71.1%
SWE	65.4%	79.8%	80.7%	65.4%	79.8%	80.6%
GBR	7.5%	18.1%	46.1%	7.5%	18.0%	45.7%
EU27	21.1%	36.6%	57.5%	21.1%	36.2%	56.6%
EU28	19.7%	34.8%	56.6%	19.7%	34.4%	55.7%

Table 28: Calculation Method 1A2 resulting shares for RES ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

1A2	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.4%	45.5%	71.7%	33.4%	45.5%	71.6%
BEL	9.4%	22.4%	49.7%	9.4%	22.4%	49.6%
BGR	20.5%	33.0%	55.8%	20.5%	32.9%	55.4%
HRV	28.0%	40.6%	62.5%	28.0%	40.5%	62.1%
CYP	13.9%	26.4%	81.2%	13.9%	25.5%	80.2%
CZE	15.2%	21.3%	38.8%	15.2%	21.3%	38.5%
DNK	35.7%	48.7%	79.8%	35.7%	48.7%	79.7%
EST	30.0%	39.0%	74.7%	30.0%	38.9%	74.6%
FIN	41.2%	52.4%	56.4%	41.2%	52.4%	56.3%
FRA	16.6%	29.5%	64.6%	16.6%	29.3%	64.3%
DEU	16.5%	29.9%	69.9%	16.5%	29.9%	69.9%
GRC	18.0%	40.1%	81.0%	18.0%	39.5%	80.3%
HUN	12.5%	19.8%	42.5%	12.5%	19.7%	42.2%
IRL	11.1%	32.7%	77.8%	11.1%	32.7%	77.7%
ITA	17.8%	32.2%	64.0%	17.8%	31.9%	63.3%
LVA	40.3%	47.9%	75.6%	40.3%	47.9%	75.4%
LTU	24.4%	35.7%	63.2%	24.4%	35.7%	63.1%
LUX	9.1%	12.4%	42.6%	9.1%	12.4%	42.3%
MLT	8.0%	24.0%	70.9%	8.0%	20.9%	66.8%
NLD	7.4%	21.7%	52.7%	7.4%	21.7%	52.6%
POL	11.3%	26.8%	49.6%	11.3%	26.8%	49.5%
PRT	30.3%	42.9%	78.4%	30.3%	42.9%	78.3%
ROU	23.9%	35.7%	63.7%	23.9%	35.6%	63.4%
SVK	11.9%	19.1%	42.2%	11.9%	19.0%	41.9%
SVN	21.2%	35.1%	66.3%	21.2%	35.0%	66.0%
ESP	17.5%	36.6%	79.8%	17.5%	36.1%	79.2%
SWE	54.6%	67.9%	77.3%	54.6%	67.9%	77.2%
GBR	11.0%	27.7%	60.9%	11.0%	27.6%	60.8%
EU27	18.9%	32.7%	64.5%	18.9%	32.5%	64.2%
EU28	18.0%	32.1%	64.2%	18.0%	32.0%	63.9%

Table 29: Calculation Method 1A2 resulting shares for RES HC ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

1A2	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	34.0%	41.2%	58.8%	34.0%	41.1%	58.3%
BEL	8.2%	20.8%	41.0%	8.2%	20.7%	40.7%
BGR	33.3%	41.0%	57.9%	33.3%	40.7%	56.7%
HRV	36.5%	47.7%	58.0%	36.5%	47.6%	57.1%
CYP	36.8%	51.1%	69.8%	36.8%	48.7%	64.8%
CZE	20.7%	26.8%	43.5%	20.7%	26.7%	43.0%
DNK	46.7%	57.7%	67.6%	46.7%	57.7%	67.3%
EST	53.7%	64.8%	69.9%	53.7%	64.7%	69.5%
FIN	54.6%	71.3%	71.3%	54.6%	71.2%	71.2%
FRA	21.8%	35.9%	61.7%	21.8%	35.5%	60.6%
DEU	13.6%	27.6%	48.7%	13.6%	27.5%	48.6%
GRC	30.2%	52.5%	80.9%	30.2%	51.0%	78.8%
HUN	18.1%	28.4%	52.1%	18.1%	28.2%	51.4%
IRL	6.5%	34.4%	63.9%	6.5%	34.4%	63.7%
ITA	19.2%	36.6%	62.6%	19.2%	35.9%	60.8%
LVA	55.9%	64.8%	78.7%	55.9%	64.7%	78.4%
LTU	45.6%	56.7%	65.1%	45.6%	56.7%	64.7%
LUX	8.8%	28.5%	45.9%	8.8%	28.2%	44.7%
MLT	23.4%	68.0%	97.5%	23.4%	57.7%	96.7%
NLD	6.1%	14.6%	37.5%	6.1%	14.5%	37.1%
POL	14.8%	34.3%	51.6%	14.8%	34.2%	51.4%
PRT	41.2%	45.6%	67.2%	41.2%	45.4%	66.4%
ROU	25.4%	33.6%	54.6%	25.4%	33.4%	53.7%
SVK	10.6%	22.1%	47.5%	10.6%	22.0%	47.0%
SVN	31.6%	46.4%	64.2%	31.6%	46.2%	63.1%
ESP	17.5%	33.1%	73.4%	17.5%	31.4%	71.1%
SWE	65.4%	79.7%	80.7%	65.4%	79.7%	80.6%
GBR	7.5%	17.4%	46.2%	7.5%	17.3%	45.7%
EU27	21.1%	35.0%	57.7%	21.1%	34.7%	56.6%
EU28	19.7%	33.3%	56.8%	19.7%	33.0%	55.7%

Table 30: Calculation Method 1B resulting shares for RES ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

1B	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.5%	45.7%	71.8%	33.5%	45.6%	71.7%
BEL	9.5%	22.5%	49.7%	9.5%	22.4%	49.6%
BGR	20.6%	33.1%	56.0%	20.6%	33.1%	55.6%
HRV	28.2%	40.8%	62.7%	28.2%	40.8%	62.4%
CYP	14.2%	27.1%	81.6%	14.2%	26.3%	80.7%
CZE	15.2%	21.4%	38.8%	15.2%	21.3%	38.6%
DNK	35.8%	48.8%	79.9%	35.8%	48.8%	79.8%
EST	30.1%	39.1%	74.9%	30.1%	39.0%	74.7%
FIN	41.2%	52.5%	56.5%	41.2%	52.5%	56.4%
FRA	16.8%	29.7%	64.7%	16.8%	29.6%	64.5%
DEU	16.5%	29.9%	70.0%	16.5%	29.9%	69.9%
GRC	18.7%	41.2%	81.5%	18.7%	40.7%	80.9%
HUN	12.5%	19.8%	42.6%	12.5%	19.7%	42.2%
IRL	11.1%	32.7%	77.8%	11.1%	32.7%	77.8%
ITA	18.3%	32.7%	64.5%	18.3%	32.4%	63.8%
LVA	40.4%	48.1%	75.7%	40.4%	48.1%	75.5%
LTU	24.5%	35.8%	63.3%	24.5%	35.8%	63.2%
LUX	9.1%	12.5%	42.7%	9.1%	12.5%	42.4%
MLT	8.5%	26.0%	71.8%	8.5%	23.2%	68.2%
NLD	7.4%	21.8%	52.7%	7.4%	21.8%	52.6%
POL	11.3%	26.9%	49.6%	11.3%	26.8%	49.5%
PRT	30.5%	43.2%	78.6%	30.5%	43.1%	78.4%
ROU	24.0%	36.0%	63.9%	24.0%	35.9%	63.6%
SVK	11.9%	19.1%	42.2%	11.9%	19.1%	42.0%
SVN	21.3%	35.3%	66.5%	21.3%	35.2%	66.2%
ESP	18.5%	37.7%	80.1%	18.5%	37.4%	79.7%
SWE	54.7%	68.0%	77.3%	54.7%	67.9%	77.2%
GBR	11.1%	27.8%	61.0%	11.1%	27.7%	60.9%
EU27	19.1%	32.9%	64.8%	19.1%	32.8%	64.5%
EU28	18.2%	32.4%	64.4%	18.2%	32.3%	64.1%

Table 31: Calculation Method 1B resulting shares for RES HC ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

1B	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	34.2%	41.6%	59.1%	34.2%	41.5%	58.6%
BEL	8.3%	20.9%	41.1%	8.3%	20.8%	40.9%
BGR	33.4%	41.4%	58.4%	33.4%	41.2%	57.3%
HRV	36.9%	48.3%	58.6%	36.9%	48.1%	57.7%
CYP	37.5%	52.9%	71.4%	37.5%	50.7%	67.5%
CZE	20.7%	26.9%	43.7%	20.7%	26.8%	43.1%
DNK	46.8%	58.0%	67.8%	46.8%	57.9%	67.6%
EST	53.8%	64.9%	70.3%	53.8%	64.8%	69.9%
FIN	54.7%	71.3%	71.4%	54.7%	71.3%	71.2%
FRA	22.2%	36.6%	62.3%	22.2%	36.3%	61.4%
DEU	13.7%	27.7%	48.9%	13.7%	27.6%	48.8%
GRC	32.0%	55.5%	82.1%	32.0%	54.3%	80.5%
HUN	18.2%	28.5%	52.3%	18.2%	28.3%	51.5%
IRL	6.6%	34.6%	64.1%	6.6%	34.6%	63.9%
ITA	20.3%	37.6%	63.6%	20.3%	37.1%	62.1%
LVA	56.1%	65.0%	78.9%	56.1%	64.9%	78.6%
LTU	45.7%	56.9%	65.3%	45.7%	56.8%	64.9%
LUX	8.9%	28.7%	46.2%	8.9%	28.5%	45.0%
MLT	26.4%	72.6%	97.6%	26.4%	65.9%	97.0%
NLD	6.2%	14.7%	37.6%	6.2%	14.6%	37.3%
POL	14.8%	34.3%	51.7%	14.8%	34.3%	51.5%
PRT	41.6%	46.3%	67.8%	41.6%	46.2%	67.2%
ROU	25.7%	34.1%	55.1%	25.7%	33.9%	54.3%
SVK	10.7%	22.3%	47.6%	10.7%	22.2%	47.2%
SVN	31.9%	46.9%	64.6%	31.9%	46.8%	63.7%
ESP	20.6%	37.1%	74.7%	20.6%	35.8%	73.0%
SWE	65.5%	79.8%	80.8%	65.5%	79.8%	80.7%
GBR	7.7%	17.7%	46.4%	7.7%	17.6%	46.1%
EU27	21.6%	35.7%	58.4%	21.6%	35.5%	57.5%
EU28	20.1%	34.0%	57.4%	20.1%	33.7%	56.6%

Table 32: Calculation Method 2A1 resulting shares for RES ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

2A1	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.1%	44.8%	70.8%	33.1%	44.8%	70.4%
BEL	9.3%	22.2%	49.3%	9.3%	22.1%	49.1%
BGR	20.2%	31.9%	54.2%	20.2%	31.8%	53.5%
HRV	27.4%	39.3%	60.6%	27.4%	39.2%	59.9%
CYP	12.1%	20.8%	68.7%	12.1%	20.0%	65.1%
CZE	15.0%	21.0%	38.2%	15.0%	20.9%	37.9%
DNK	35.4%	48.1%	79.0%	35.4%	48.1%	78.7%
EST	29.5%	37.9%	73.3%	29.5%	37.9%	72.8%
FIN	40.9%	52.0%	56.1%	40.9%	52.0%	55.9%
FRA	16.0%	28.0%	62.0%	16.0%	27.8%	61.3%
DEU	16.4%	29.7%	69.5%	16.4%	29.7%	69.4%
GRC	16.0%	33.5%	70.4%	16.0%	33.0%	67.7%
HUN	12.3%	19.2%	41.5%	12.3%	19.1%	41.0%
IRL	11.0%	32.4%	77.3%	11.0%	32.4%	77.1%
ITA	16.6%	29.4%	59.1%	16.6%	29.0%	57.6%
LVA	39.7%	46.7%	74.0%	39.7%	46.7%	73.5%
LTU	24.2%	35.0%	62.3%	24.2%	35.0%	61.9%
LUX	8.9%	12.1%	41.9%	8.9%	12.1%	41.5%
MLT	6.3%	13.0%	47.8%	6.3%	11.3%	40.5%
NLD	7.3%	21.5%	52.3%	7.3%	21.5%	52.1%
POL	11.2%	26.6%	49.3%	11.2%	26.5%	49.1%
PRT	29.8%	41.6%	75.9%	29.8%	41.6%	75.3%
ROU	23.4%	34.4%	61.7%	23.4%	34.3%	61.0%
SVK	11.8%	18.7%	41.6%	11.8%	18.7%	41.3%
SVN	20.8%	33.9%	64.5%	20.8%	33.9%	63.8%
ESP	15.3%	30.7%	71.5%	15.3%	30.2%	69.5%
SWE	54.2%	67.2%	76.7%	54.2%	67.2%	76.5%
GBR	10.9%	27.3%	60.3%	10.9%	27.3%	60.2%
EU27	18.3%	31.1%	62.2%	18.3%	31.0%	61.4%
EU28	17.5%	30.7%	62.0%	17.5%	30.6%	61.3%

Table 33: Calculation Method 2A1 resulting shares for RES HC ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

2A1	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.3%	39.8%	56.7%	33.3%	39.6%	55.8%
BEL	8.1%	20.3%	40.2%	8.1%	20.2%	39.8%
BGR	32.0%	37.3%	52.7%	32.0%	37.0%	50.6%
HRV	34.8%	44.2%	53.8%	34.8%	44.0%	52.0%
CYP	24.8%	25.1%	45.6%	24.8%	23.3%	37.6%
CZE	20.3%	25.9%	42.1%	20.3%	25.8%	41.3%
DNK	45.8%	56.1%	65.8%	45.8%	56.0%	65.1%
EST	51.7%	61.0%	66.9%	51.7%	60.9%	65.8%
FIN	54.0%	70.0%	70.2%	54.0%	70.0%	69.7%
FRA	20.0%	30.8%	54.3%	20.0%	30.4%	52.3%
DEU	13.5%	27.2%	48.0%	13.5%	27.1%	47.7%
GRC	21.5%	31.0%	57.3%	21.5%	29.6%	51.2%
HUN	17.6%	26.6%	49.3%	17.6%	26.4%	48.0%
IRL	6.4%	33.6%	62.5%	6.4%	33.6%	61.9%
ITA	16.7%	30.2%	52.4%	16.7%	29.5%	49.2%
LVA	54.5%	61.7%	75.4%	54.5%	61.6%	74.3%
LTU	44.5%	53.9%	62.5%	44.5%	53.8%	61.5%
LUX	8.3%	25.7%	42.6%	8.3%	25.5%	40.8%
MLT	7.9%	10.5%	50.1%	7.9%	7.3%	39.0%
NLD	6.0%	14.2%	36.8%	6.0%	14.1%	36.4%
POL	14.6%	33.6%	50.7%	14.6%	33.5%	50.4%
PRT	39.1%	41.6%	61.3%	39.1%	41.4%	59.6%
ROU	24.5%	31.3%	50.9%	24.5%	31.1%	49.4%
SVK	10.4%	21.3%	46.0%	10.4%	21.3%	45.3%
SVN	30.2%	41.8%	58.6%	30.2%	41.7%	56.4%
ESP	12.3%	20.0%	54.7%	12.3%	18.8%	49.8%
SWE	64.2%	77.6%	78.9%	64.2%	77.5%	78.3%
GBR	7.4%	16.8%	44.6%	7.4%	16.7%	44.0%
EU27	19.7%	31.3%	52.3%	19.7%	31.0%	50.5%
EU28	18.4%	30.0%	51.7%	18.4%	29.7%	50.0%

Table 34: Calculation Method 2A2 resulting shares for RES ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

2A2	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.1%	44.9%	70.9%	33.1%	44.8%	70.4%
BEL	9.3%	22.2%	49.4%	9.3%	22.1%	49.2%
BGR	20.2%	32.0%	54.4%	20.2%	31.8%	53.6%
HRV	27.4%	39.3%	60.8%	27.4%	39.2%	59.9%
CYP	12.1%	21.1%	69.5%	12.1%	20.1%	65.2%
CZE	15.0%	21.0%	38.3%	15.0%	20.9%	37.9%
DNK	35.4%	48.1%	79.0%	35.4%	48.1%	78.7%
EST	29.5%	38.0%	73.4%	29.5%	37.9%	72.8%
FIN	40.9%	52.0%	56.1%	40.9%	52.0%	55.9%
FRA	16.0%	28.0%	62.2%	16.0%	27.9%	61.4%
DEU	16.4%	29.7%	69.5%	16.4%	29.7%	69.4%
GRC	16.0%	33.7%	71.0%	16.0%	33.0%	67.7%
HUN	12.3%	19.2%	41.6%	12.3%	19.1%	41.0%
IRL	11.0%	32.4%	77.3%	11.0%	32.4%	77.1%
ITA	16.6%	29.5%	59.4%	16.6%	29.0%	57.6%
LVA	39.7%	46.8%	74.2%	39.7%	46.7%	73.5%
LTU	24.2%	35.0%	62.4%	24.2%	35.0%	61.9%
LUX	8.9%	12.2%	42.0%	8.9%	12.1%	41.5%
MLT	6.3%	13.6%	49.5%	6.3%	11.4%	40.7%
NLD	7.3%	21.5%	52.3%	7.3%	21.5%	52.1%
POL	11.2%	26.6%	49.3%	11.2%	26.6%	49.2%
PRT	29.8%	41.7%	76.1%	29.8%	41.6%	75.3%
ROU	23.4%	34.5%	61.9%	23.4%	34.3%	61.0%
SVK	11.8%	18.8%	41.7%	11.8%	18.7%	41.3%
SVN	20.8%	34.0%	64.6%	20.8%	33.9%	63.8%
ESP	15.3%	30.9%	72.0%	15.3%	30.3%	69.5%
SWE	54.2%	67.3%	76.7%	54.2%	67.2%	76.5%
GBR	10.9%	27.3%	60.4%	10.9%	27.3%	60.2%
EU27	18.3%	31.2%	62.3%	18.3%	31.0%	61.5%
EU28	17.5%	30.8%	62.1%	17.5%	30.6%	61.3%

Table 35: Calculation Method 2A2 resulting shares for RES HC ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

2A2	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.3%	39.8%	56.9%	33.3%	39.6%	55.8%
BEL	8.1%	20.3%	40.3%	8.1%	20.2%	39.8%
BGR	32.0%	37.5%	53.2%	32.0%	37.1%	50.7%
HRV	34.8%	44.3%	54.2%	34.8%	44.0%	52.0%
CYP	24.8%	25.8%	47.5%	24.8%	23.4%	37.8%
CZE	20.3%	26.0%	42.3%	20.3%	25.9%	41.3%
DNK	45.8%	56.1%	65.9%	45.8%	56.0%	65.1%
EST	51.7%	61.1%	67.2%	51.7%	61.0%	65.8%
FIN	54.0%	70.1%	70.3%	54.0%	70.0%	69.7%
FRA	20.0%	30.9%	54.8%	20.0%	30.4%	52.3%
DEU	13.5%	27.2%	48.1%	13.5%	27.1%	47.7%
GRC	21.5%	31.5%	58.7%	21.5%	29.7%	51.4%
HUN	17.6%	26.7%	49.6%	17.6%	26.5%	48.1%
IRL	6.4%	33.7%	62.6%	6.4%	33.6%	62.0%
ITA	16.7%	30.4%	53.1%	16.7%	29.5%	49.3%
LVA	54.5%	61.8%	75.6%	54.5%	61.6%	74.3%
LTU	44.5%	54.0%	62.7%	44.5%	53.8%	61.5%
LUX	8.3%	25.8%	43.0%	8.3%	25.5%	40.9%
MLT	7.9%	11.7%	52.7%	7.9%	7.5%	39.3%
NLD	6.1%	14.3%	36.9%	6.1%	14.1%	36.4%
POL	14.6%	33.6%	50.8%	14.6%	33.5%	50.4%
PRT	39.1%	41.7%	61.7%	39.1%	41.4%	59.6%
ROU	24.5%	31.4%	51.3%	24.5%	31.1%	49.4%
SVK	10.4%	21.4%	46.2%	10.4%	21.3%	45.3%
SVN	30.2%	42.0%	59.1%	30.2%	41.7%	56.5%
ESP	12.3%	20.5%	55.9%	12.3%	18.9%	49.9%
SWE	64.2%	77.7%	79.0%	64.2%	77.5%	78.3%
GBR	7.4%	16.8%	44.8%	7.4%	16.7%	44.0%
EU27	19.7%	31.4%	52.8%	19.7%	31.0%	50.5%
EU28	18.4%	30.1%	52.1%	18.4%	29.7%	50.0%

Table 36: Calculation Method 2B resulting shares for RES ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

2B	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.3%	45.1%	71.1%	33.3%	45.0%	70.7%
BEL	9.4%	22.2%	49.4%	9.4%	22.2%	49.2%
BGR	20.3%	32.2%	54.7%	20.3%	32.1%	54.0%
HRV	27.7%	39.7%	61.3%	27.7%	39.6%	60.5%
CYP	12.4%	21.8%	71.3%	12.4%	20.9%	67.4%
CZE	15.0%	21.1%	38.4%	15.0%	21.0%	38.0%
DNK	35.5%	48.4%	79.3%	35.5%	48.4%	79.0%
EST	29.6%	38.1%	73.9%	29.6%	38.0%	73.4%
FIN	41.0%	52.1%	56.2%	41.0%	52.1%	56.0%
FRA	16.2%	28.4%	62.6%	16.2%	28.2%	61.9%
DEU	16.5%	29.8%	69.7%	16.5%	29.7%	69.6%
GRC	16.8%	35.3%	73.2%	16.8%	34.7%	70.4%
HUN	12.3%	19.3%	41.8%	12.3%	19.2%	41.1%
IRL	11.1%	32.5%	77.4%	11.1%	32.5%	77.3%
ITA	17.2%	30.2%	60.5%	17.2%	29.8%	58.9%
LVA	39.9%	47.1%	74.6%	39.9%	47.0%	74.1%
LTU	24.2%	35.2%	62.6%	24.2%	35.1%	62.1%
LUX	9.0%	12.2%	42.1%	9.0%	12.2%	41.6%
MLT	6.7%	15.1%	51.6%	6.7%	13.0%	43.4%
NLD	7.4%	21.6%	52.4%	7.4%	21.5%	52.2%
POL	11.2%	26.6%	49.4%	11.2%	26.6%	49.2%
PRT	30.0%	42.1%	76.7%	30.0%	42.0%	76.1%
ROU	23.6%	34.8%	62.4%	23.6%	34.7%	61.6%
SVK	11.8%	18.8%	41.7%	11.8%	18.8%	41.4%
SVN	21.0%	34.3%	65.0%	21.0%	34.2%	64.2%
ESP	16.4%	32.5%	73.6%	16.4%	31.9%	71.5%
SWE	54.4%	67.4%	76.9%	54.4%	67.3%	76.7%
GBR	11.0%	27.5%	60.5%	11.0%	27.4%	60.3%
EU27	18.5%	31.6%	62.9%	18.5%	31.4%	62.2%
EU28	17.7%	31.2%	62.7%	17.7%	31.0%	62.0%

Table 37: Calculation Method 2B resulting shares for RES HC ambitious and baseline for all EU member states with 1/η equals to 1.77 and 1.05 for 2030 and 2050 respectively.

2B	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	34.13%	41.96%	59.50%	33.98%	41.38%	58.87%
BEL	8.19%	20.89%	41.27%	8.19%	21.02%	41.14%
BGR	33.30%	41.01%	58.42%	33.30%	41.59%	58.29%
HRV	36.81%	49.17%	59.68%	36.51%	48.12%	58.37%
CYP	36.77%	52.00%	72.00%	36.77%	57.12%	71.46%
CZE	20.65%	27.10%	44.13%	20.65%	27.06%	43.72%
DNK	46.79%	58.17%	68.12%	46.66%	57.75%	67.70%
EST	53.69%	64.74%	70.09%	53.69%	64.78%	70.06%
FIN	54.65%	71.32%	71.49%	54.64%	71.29%	71.36%
FRA	21.78%	35.91%	62.42%	21.79%	37.17%	62.57%
DEU	13.63%	27.73%	48.94%	13.63%	27.74%	48.81%
GRC	30.19%	55.70%	82.82%	30.19%	57.12%	81.91%
HUN	18.12%	28.40%	52.51%	18.12%	28.81%	52.41%
IRL	6.47%	34.55%	64.24%	6.47%	34.45%	64.01%
ITA	19.26%	39.24%	65.05%	19.24%	38.84%	63.58%
LVA	55.96%	65.31%	79.16%	55.90%	64.77%	78.75%
LTU	45.69%	57.25%	65.83%	45.64%	56.77%	65.27%
LUX	8.93%	30.00%	47.78%	8.79%	28.53%	46.30%
MLT	23.46%	82.61%	98.07%	23.44%	81.68%	97.71%
NLD	6.15%	14.93%	37.85%	6.13%	14.80%	37.55%
POL	14.80%	34.45%	51.86%	14.80%	34.47%	51.70%
PRT	41.22%	46.50%	68.42%	41.21%	46.17%	67.63%
ROU	25.44%	34.29%	55.64%	25.44%	34.26%	54.99%
SVK	10.60%	22.22%	47.92%	10.60%	22.31%	47.69%
SVN	31.61%	46.51%	65.13%	31.61%	46.52%	64.49%
ESP	17.50%	37.85%	75.75%	17.50%	39.41%	74.64%
SWE	65.38%	79.81%	80.89%	65.38%	79.79%	80.77%
GBR	7.52%	17.91%	46.72%	7.52%	17.95%	46.40%
EU27	21.14%	36.00%	58.93%	21.13%	36.22%	58.29%
EU28	19.68%	34.25%	57.96%	19.68%	34.44%	57.32%

Table 38: Calculation Method 1A1 resulting shares for RES HC ambitious and baseline for all EU member states with EU-wide η-values.

	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.98%	41.51%	59.13%	33.98%	41.38%	58.87%
BEL	8.19%	21.12%	41.31%	8.19%	21.02%	41.14%
BGR	33.30%	41.89%	58.92%	33.30%	41.59%	58.29%
HRV	36.51%	48.34%	58.88%	36.51%	48.12%	58.37%
CYP	36.77%	58.99%	73.43%	36.77%	57.12%	71.46%
CZE	20.65%	27.20%	44.02%	20.65%	27.06%	43.72%
DNK	46.66%	57.82%	67.85%	46.66%	57.75%	67.70%
EST	53.69%	64.90%	70.29%	53.69%	64.78%	70.06%
FIN	54.64%	71.32%	71.45%	54.64%	71.29%	71.36%
FRA	21.79%	37.55%	63.13%	21.79%	37.17%	62.57%
DEU	13.63%	27.79%	48.90%	13.63%	27.74%	48.81%
GRC	30.19%	58.25%	82.82%	30.19%	57.12%	81.91%
HUN	18.12%	29.05%	52.82%	18.12%	28.81%	52.41%
IRL	6.47%	34.53%	64.15%	6.47%	34.45%	64.01%
ITA	19.24%	39.42%	64.46%	19.24%	38.84%	63.58%
LVA	55.90%	64.87%	78.90%	55.90%	64.77%	78.75%
LTU	45.64%	56.90%	65.52%	45.64%	56.77%	65.27%
LUX	8.79%	28.93%	46.95%	8.79%	28.53%	46.30%
MLT	23.44%	84.02%	97.97%	23.44%	81.68%	97.71%
NLD	6.13%	14.91%	37.72%	6.13%	14.80%	37.55%
POL	14.80%	34.54%	51.82%	14.80%	34.47%	51.70%
PRT	41.21%	46.39%	68.03%	41.21%	46.17%	67.63%
ROU	25.44%	34.51%	55.47%	25.44%	34.26%	54.99%
SVK	10.60%	22.46%	47.95%	10.60%	22.31%	47.69%
SVN	31.61%	46.83%	65.02%	31.61%	46.52%	64.49%
ESP	17.50%	40.91%	75.64%	17.50%	39.41%	74.64%
SWE	65.38%	79.82%	80.85%	65.38%	79.79%	80.77%
GBR	7.52%	18.10%	46.63%	7.52%	17.95%	46.40%
EU27	21.13%	36.56%	58.84%	21.13%	36.22%	58.29%
EU28	19.68%	34.76%	57.85%	19.68%	34.44%	57.32%

Table 39: Calculation Method 1A1 resulting shares for RES ambitious and baseline for all EU member states with EU-wide η-values.

	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.43%	45.63%	71.80%	33.43%	45.58%	71.74%
BEL	9.42%	22.57%	49.78%	9.42%	22.52%	49.72%
BGR	20.53%	33.32%	56.16%	20.53%	33.20%	55.95%
HRV	28.03%	40.87%	62.79%	28.03%	40.77%	62.61%
CYP	13.89%	29.91%	82.08%	13.89%	29.00%	81.59%
CZE	15.15%	21.52%	38.98%	15.15%	21.45%	38.84%
DNK	35.71%	48.78%	79.86%	35.71%	48.74%	79.82%
EST	30.00%	39.08%	74.87%	30.00%	38.99%	74.79%
FIN	41.16%	52.49%	56.50%	41.16%	52.46%	56.45%
FRA	16.59%	30.08%	64.97%	16.59%	29.94%	64.81%
DEU	16.48%	29.99%	69.96%	16.48%	29.97%	69.94%
GRC	18.00%	42.32%	81.77%	18.00%	41.85%	81.40%
HUN	12.49%	20.11%	42.91%	12.49%	19.98%	42.69%
IRL	11.06%	32.71%	77.81%	11.06%	32.68%	77.79%
ITA	17.78%	33.59%	64.84%	17.78%	33.30%	64.46%
LVA	40.29%	48.03%	75.69%	40.29%	47.95%	75.60%
LTU	24.45%	35.83%	63.38%	24.45%	35.76%	63.29%
LUX	9.06%	12.56%	42.86%	9.06%	12.45%	42.70%
MLT	7.99%	34.42%	74.09%	7.99%	32.04%	72.38%
NLD	7.39%	21.90%	52.81%	7.39%	21.85%	52.75%
POL	11.28%	26.96%	49.67%	11.28%	26.93%	49.62%
PRT	30.32%	43.21%	78.63%	30.32%	43.13%	78.54%
ROU	23.88%	36.16%	64.04%	23.88%	36.04%	63.87%
SVK	11.90%	19.23%	42.37%	11.90%	19.16%	42.25%
SVN	21.15%	35.23%	66.59%	21.15%	35.12%	66.43%
ESP	17.46%	38.99%	80.41%	17.46%	38.49%	80.12%
SWE	54.65%	67.98%	77.30%	54.65%	67.96%	77.27%
GBR	11.02%	27.89%	61.01%	11.02%	27.84%	60.96%
EU27	18.89%	33.30%	64.91%	18.89%	33.16%	64.73%
EU28	17.98%	32.71%	64.50%	17.98%	32.58%	64.34%

Table 40: Calculation Method 1A1 resulting shares for RES ambitious and baseline for all EU member states with national η-values.

	RES ambitious			RES baseline		
	2018	2030	2050	2018	2030	2050
AUT	33.50%	45.95%	71.80%	33.50%	45.92%	71.74%
BEL	9.42%	22.53%	49.78%	9.42%	22.49%	49.72%
BGR	20.53%	33.08%	56.16%	20.53%	32.99%	55.95%
HRV	28.18%	41.60%	62.79%	28.18%	41.53%	62.61%
CYP	13.89%	27.98%	82.08%	13.89%	27.11%	81.59%
CZE	15.15%	21.61%	38.98%	15.15%	21.53%	38.84%
DNK	35.78%	49.08%	79.86%	35.78%	49.06%	79.82%
EST	30.00%	38.96%	74.87%	30.00%	38.93%	74.79%
FIN	41.17%	52.54%	56.50%	41.17%	52.51%	56.45%
FRA	16.59%	29.66%	64.97%	16.59%	29.50%	64.81%
DEU	16.48%	30.02%	69.96%	16.48%	29.99%	69.94%
GRC	18.00%	42.32%	81.77%	18.00%	41.84%	81.40%
HUN	12.49%	19.88%	42.91%	12.49%	19.78%	42.69%
IRL	11.06%	32.79%	77.81%	11.06%	32.76%	77.79%
ITA	17.79%	34.22%	64.84%	17.79%	33.94%	64.46%
LVA	40.34%	48.63%	75.69%	40.34%	48.58%	75.60%
LTU	24.48%	36.28%	63.38%	24.48%	36.22%	63.29%
LUX	9.10%	13.26%	42.86%	9.10%	13.17%	42.70%
MLT	7.99%	38.00%	74.09%	7.99%	35.88%	72.38%
NLD	7.40%	22.03%	52.81%	7.40%	21.98%	52.75%
POL	11.28%	26.99%	49.67%	11.28%	26.95%	49.62%
PRT	30.33%	43.50%	78.63%	30.33%	43.42%	78.54%
ROU	23.88%	36.31%	64.04%	23.88%	36.18%	63.87%
SVK	11.90%	19.21%	42.37%	11.90%	19.14%	42.25%
SVN	21.15%	35.28%	66.59%	21.15%	35.15%	66.43%
ESP	17.46%	39.16%	80.41%	17.46%	38.67%	80.12%
SWE	54.65%	68.02%	77.30%	54.65%	68.00%	77.27%
GBR	11.02%	27.94%	61.01%	11.02%	27.90%	60.96%
EU27	18.89%	33.37%	64.91%	18.89%	33.23%	64.73%
EU28	17.98%	32.79%	64.50%	17.98%	32.65%	64.34%

Table 41: Calculation Method 1A1 resulting shares for RES HC ambitious and baseline for all EU member states with national η-values.

	RES HC ambitious			RES HC baseline		
	2018	2030	2050	2018	2030	2050
AUT	34.13%	42.32%	59.13%	34.13%	42.24%	58.87%
BEL	8.19%	21.05%	41.31%	8.19%	20.96%	41.14%
BGR	33.30%	41.28%	58.92%	33.30%	41.04%	58.29%
HRV	36.81%	49.84%	58.88%	36.81%	49.71%	58.37%
CYP	36.77%	54.89%	73.43%	36.77%	52.84%	71.46%
CZE	20.65%	27.36%	44.02%	20.65%	27.22%	43.72%
DNK	46.79%	58.40%	67.85%	46.79%	58.36%	67.70%
EST	53.69%	64.75%	70.29%	53.69%	64.71%	70.06%
FIN	54.65%	71.39%	71.45%	54.65%	71.36%	71.36%
FRA	21.78%	36.39%	63.13%	21.78%	35.95%	62.57%
DEU	13.63%	27.85%	48.90%	13.63%	27.80%	48.81%
GRC	30.19%	58.24%	82.82%	30.19%	57.11%	81.91%
HUN	18.12%	28.61%	52.82%	18.12%	28.42%	52.41%
IRL	6.47%	34.78%	64.15%	6.47%	34.69%	64.01%
ITA	19.26%	40.65%	64.46%	19.26%	40.11%	63.58%
LVA	55.96%	65.64%	78.90%	55.96%	65.58%	78.75%
LTU	45.69%	57.67%	65.52%	45.69%	57.57%	65.27%
LUX	8.93%	31.37%	46.95%	8.93%	31.06%	46.30%
MLT	23.46%	86.80%	97.97%	23.46%	85.25%	97.71%
NLD	6.15%	15.21%	37.72%	6.15%	15.10%	37.55%
POL	14.80%	34.60%	51.82%	14.80%	34.52%	51.70%
PRT	41.22%	47.21%	68.03%	41.22%	46.99%	67.63%
ROU	25.44%	34.81%	55.47%	25.44%	34.55%	54.99%
SVK	10.60%	22.42%	47.95%	10.60%	22.28%	47.69%
SVN	31.61%	46.97%	65.02%	31.61%	46.60%	64.49%
ESP	17.50%	41.43%	75.64%	17.50%	39.96%	74.64%
SWE	65.38%	79.88%	80.85%	65.38%	79.85%	80.77%
GBR	7.52%	18.26%	46.63%	7.52%	18.12%	46.40%
EU27	21.14%	36.71%	58.84%	21.14%	36.38%	58.29%
EU28	19.68%	34.94%	57.85%	19.68%	34.62%	57.32%

Table 42: RES HC and RES with RENEWABLE BONUS in the ambitious scenario with progressive method 1 (low SPF 2.8, high SPF 9.5)

	RES HC			RES		
	2018	2030	2050	2018	2030	2050
AUT	33.98%	41.26%	58.11%	33.43%	45.53%	71.54%
BEL	8.19%	20.84%	40.49%	9.42%	22.43%	49.51%
BGR	33.30%	41.11%	55.89%	20.53%	33.02%	55.21%
HRV	36.51%	47.80%	56.43%	28.03%	40.62%	61.93%
CYP	36.77%	52.32%	59.80%	13.89%	26.90%	79.37%
CZE	20.65%	26.88%	42.67%	15.15%	21.36%	38.37%
DNK	46.66%	57.71%	67.23%	35.71%	48.72%	79.71%
EST	53.69%	64.76%	69.35%	30.00%	38.97%	74.53%
FIN	54.64%	71.27%	71.12%	41.16%	52.45%	56.31%
FRA	21.79%	36.12%	59.67%	16.60%	29.56%	64.01%
DEU	13.63%	27.60%	48.40%	16.48%	29.91%	69.84%
GRC	30.19%	53.43%	76.15%	18.00%	40.41%	79.50%
HUN	18.12%	28.45%	50.90%	12.49%	19.80%	41.93%
IRL	6.47%	34.42%	63.58%	11.06%	32.67%	77.71%
ITA	19.24%	37.07%	59.06%	17.78%	32.42%	62.64%
LVA	55.90%	64.75%	78.25%	40.29%	47.93%	75.34%
LTU	45.64%	56.73%	64.51%	24.45%	35.73%	63.00%
LUX	8.79%	28.41%	44.13%	9.06%	12.42%	42.20%
MLT	23.47%	71.88%	95.42%	7.99%	25.61%	62.31%
NLD	6.13%	14.62%	36.95%	7.39%	21.77%	52.55%
POL	14.80%	34.31%	51.21%	11.28%	26.85%	49.44%
PRT	41.21%	45.68%	65.77%	30.32%	42.97%	78.12%
ROU	25.44%	33.75%	52.99%	23.88%	35.79%	63.15%
SVK	10.60%	22.16%	46.79%	11.90%	19.08%	41.83%
SVN	31.61%	46.36%	62.64%	21.15%	35.06%	65.91%
ESP	17.50%	34.43%	68.35%	17.46%	36.96%	78.61%
SWE	65.38%	79.73%	80.51%	54.65%	67.93%	77.17%
GBR	7.52%	17.52%	45.23%	11.02%	27.71%	60.72%
EU27	21.14%	35.30%	55.67%	18.89%	32.76%	63.92%
EU28	19.68%	33.56%	54.79%	17.98%	32.21%	63.58%

Table 43: RES HC and RES without RENEWABLE BONUS in the ambitious scenario with progressive method 1 (low SPF 2.8, high SPF 9.5)

	RES HC			RES		
	2018	2030	2050	2018	2030	2050
AUT	33.98%	41.23%	57.95%	33.43%	45.52%	71.50%
BEL	8.19%	20.79%	40.31%	9.42%	22.41%	49.45%
BGR	33.30%	40.98%	55.24%	20.53%	32.97%	55.02%
HRV	36.51%	47.72%	55.89%	28.03%	40.58%	61.75%
CYP	36.77%	50.77%	53.93%	13.89%	26.28%	78.57%
CZE	20.65%	26.83%	42.43%	15.15%	21.33%	38.26%
DNK	46.66%	57.70%	67.16%	35.71%	48.72%	79.69%
EST	53.69%	64.75%	69.27%	30.00%	38.96%	74.50%
FIN	54.64%	71.27%	71.08%	41.16%	52.44%	56.29%
FRA	21.79%	35.86%	58.94%	16.60%	29.47%	63.82%
DEU	13.63%	27.56%	48.25%	16.48%	29.89%	69.81%
GRC	30.19%	52.28%	72.85%	18.00%	40.00%	78.66%
HUN	18.12%	28.35%	50.49%	12.49%	19.74%	41.73%
IRL	6.47%	34.41%	63.52%	11.06%	32.66%	77.70%
ITA	19.24%	36.57%	57.20%	17.78%	32.18%	61.96%
LVA	55.90%	64.74%	78.19%	40.29%	47.93%	75.31%
LTU	45.64%	56.72%	64.42%	24.45%	35.72%	62.97%
LUX	8.79%	28.37%	43.88%	9.06%	12.41%	42.14%
MLT	23.47%	66.83%	92.81%	7.99%	23.55%	56.57%
NLD	6.13%	14.57%	36.79%	7.39%	21.75%	52.49%
POL	14.80%	34.27%	51.07%	11.28%	26.83%	49.39%
PRT	41.21%	45.55%	65.17%	30.32%	42.92%	78.00%
ROU	25.44%	33.62%	52.35%	23.88%	35.72%	62.93%
SVK	10.60%	22.12%	46.63%	11.90%	19.06%	41.75%
SVN	31.61%	46.31%	62.35%	21.15%	35.04%	65.83%
ESP	17.50%	33.02%	65.66%	17.46%	36.56%	78.08%
SWE	65.38%	79.72%	80.43%	54.65%	67.92%	77.15%
GBR	7.52%	17.42%	44.88%	11.02%	27.67%	60.65%
EU27	21.14%	35.07%	54.79%	18.89%	32.66%	63.67%
EU28	19.68%	33.33%	53.95%	17.98%	32.12%	63.34%

Table 44: RES HC and RES with RENEWABLE BONUS in the ambitious scenario with progressive method 2 (low SPF 2.8)

	RES HC			RES		
	2018	2030	2050	2018	2030	2050
AUT	33.98%	41.31%	58.22%	33.43%	45.55%	71.57%
BEL	8.19%	20.91%	40.63%	9.42%	22.47%	49.55%
BGR	33.30%	41.31%	56.37%	20.53%	33.10%	55.35%
HRV	36.51%	47.94%	56.81%	28.03%	40.68%	62.06%
CYP	36.77%	54.64%	63.08%	13.89%	27.87%	79.90%
CZE	20.65%	26.95%	42.86%	15.15%	21.40%	38.45%
DNK	46.66%	57.73%	67.28%	35.71%	48.73%	79.72%
EST	53.69%	64.76%	69.42%	30.00%	38.97%	74.55%
FIN	54.64%	71.28%	71.15%	41.16%	52.45%	56.33%
FRA	21.79%	36.56%	60.24%	16.59%	29.72%	64.16%
DEU	13.63%	27.66%	48.51%	16.48%	29.94%	69.87%
GRC	30.19%	55.23%	77.94%	18.00%	41.09%	80.02%
HUN	18.12%	28.61%	51.17%	12.49%	19.88%	42.06%
IRL	6.47%	34.43%	63.62%	11.06%	32.67%	77.72%
ITA	19.24%	37.91%	60.26%	17.78%	32.83%	63.10%
LVA	55.90%	64.75%	78.30%	40.29%	47.94%	75.36%
LTU	45.64%	56.74%	64.59%	24.45%	35.74%	63.03%
LUX	8.79%	28.42%	44.36%	9.06%	12.42%	42.25%
MLT	23.44%	77.55%	96.31%	7.99%	28.79%	65.33%
NLD	6.13%	14.70%	37.07%	7.39%	21.81%	52.59%
POL	14.80%	34.38%	51.32%	11.28%	26.88%	49.48%
PRT	41.21%	45.89%	66.19%	30.32%	43.04%	78.21%
ROU	25.44%	33.98%	53.45%	23.88%	35.90%	63.31%
SVK	10.60%	22.22%	46.93%	11.90%	19.11%	41.89%
SVN	31.61%	46.41%	62.87%	21.15%	35.08%	65.97%
ESP	17.50%	36.64%	70.19%	17.46%	37.62%	79.01%
SWE	65.38%	79.76%	80.57%	54.65%	67.94%	77.19%
GBR	7.52%	17.70%	45.54%	11.02%	27.76%	60.78%
EU27	21.13%	35.73%	56.31%	18.89%	32.95%	64.12%
EU28	19.68%	33.97%	55.41%	17.98%	32.38%	63.76%

Table 45: RES HC and RES without RENEWABLE BONUS in the ambitious scenario with progressive method 2 (low SPF 2.8)

	RES HC			RES		
	2018	2030	2050	2018	2030	2050
AUT	33.98%	41.19%	57.83%	33.43%	45.50%	71.47%
BEL	8.19%	20.81%	40.36%	9.42%	22.42%	49.46%
BGR	33.30%	41.03%	55.37%	20.53%	32.99%	55.06%
HRV	36.51%	47.76%	56.03%	28.02%	40.60%	61.80%
CYP	36.76%	52.32%	57.02%	13.88%	26.90%	78.97%
CZE	20.65%	26.83%	42.42%	15.15%	21.34%	38.26%
DNK	46.66%	57.69%	67.12%	35.71%	48.71%	79.68%
EST	53.69%	64.70%	69.19%	30.00%	38.93%	74.47%
FIN	54.64%	71.25%	71.04%	41.16%	52.43%	56.26%
FRA	21.78%	36.08%	59.33%	16.59%	29.55%	63.92%
DEU	13.63%	27.60%	48.33%	16.48%	29.91%	69.83%
GRC	30.18%	53.67%	75.24%	18.00%	40.50%	79.25%
HUN	18.12%	28.39%	50.57%	12.49%	19.77%	41.76%
IRL	6.47%	34.39%	63.49%	11.06%	32.66%	77.69%
ITA	19.23%	37.14%	58.34%	17.78%	32.45%	62.38%
LVA	55.89%	64.70%	78.13%	40.29%	47.90%	75.28%
LTU	45.63%	56.67%	64.32%	24.45%	35.70%	62.93%
LUX	8.78%	28.24%	43.66%	9.06%	12.37%	42.09%
MLT	23.37%	72.57%	94.63%	7.98%	25.94%	60.18%
NLD	6.13%	14.58%	36.78%	7.38%	21.75%	52.49%
POL	14.79%	34.30%	51.13%	11.28%	26.84%	49.41%
PRT	41.21%	45.67%	65.52%	30.32%	42.96%	78.07%
ROU	25.43%	33.74%	52.66%	23.87%	35.78%	63.03%
SVK	10.60%	22.11%	46.60%	11.90%	19.06%	41.74%
SVN	31.61%	46.24%	62.23%	21.15%	35.02%	65.80%
ESP	17.48%	34.43%	67.52%	17.45%	36.96%	78.44%
SWE	65.38%	79.72%	80.44%	54.65%	67.92%	77.15%
GBR	7.52%	17.51%	45.10%	11.02%	27.70%	60.69%
EU27	21.13%	35.32%	55.32%	18.88%	32.77%	63.82%
EU28	19.68%	33.57%	54.45%	17.98%	32.22%	63.49%

Complete results for the economic impact assessment

Results for the base year

Table 46: Revenues and jobs in the base year associated to cooling

	Retail		Wholesale		Industry		Installation		Total	
	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs
AUT	4,53	70	4,53	17	36,21	670	29,96	277	75,23	1034
BEL	8,46	130	8,46	31	67,67	1253	54,46	504	139,05	1918
BGR	3,81	59	3,81	14	30,46	564	25,28	234	63,36	871
HRV	2,47	38	2,47	9	19,73	365	16,36	151	41,03	563
CYP	2,76	42	2,76	10	22,08	409	18,4	170	46	631
CZE	5,47	84	5,47	20	43,77	811	36,17	335	90,88	1250
DNK	2,5	39	2,5	9	20,03	371	15,82	147	40,85	566
EST	0,93	14	0,93	3	7,41	137	6,18	57	15,45	211
FIN	2,54	39	2,54	9	20,33	376	17,05	158	42,46	582
FRA	118,12	1817	118,12	437	944,92	17499	782,04	7241	1963,2	26994
DEU	32,46	499	32,46	120	259,69	4809	184,86	1712	509,47	7140
GRC	35,5	546	35,5	131	283,98	5259	236,29	2188	591,27	8124
HUN	5,89	91	5,89	22	47,11	872	38,57	357	97,46	1342
IRL	1,11	17	1,11	4	8,84	164	7,36	68	18,42	253
ITA	160,2	2465	160,2	593	1281,6	23733	1046,8	9693	2648,8	36484
LVA	0,95	15	0,95	4	7,58	140	6,29	58	15,77	217
LTU	1,02	16	1,02	4	8,16	151	6,67	62	16,87	233
LUX	1,03	16	1,03	4	8,23	152	6,87	64	17,16	236
MLT	2,19	34	2,19	8	17,54	325	14,08	130	36	497
NLD	8,58	132	8,58	32	68,67	1272	54,83	508	140,66	1944
POL	12,85	198	12,85	48	102,78	1903	85,65	793	214,13	2942
PRT	6,24	96	6,24	23	49,91	924	40,93	379	103,32	1422
ROU	10,97	169	10,97	41	87,74	1625	72,44	671	182,12	2506
SVK	1,86	29	1,86	7	14,88	276	12,15	112	30,75	424
SVN	1,27	20	1,27	5	10,14	188	8,36	77	21,04	290
ESP	204,54	3147	204,54	758	1636,3	30302	1362,5	12616	3407,9	46823
SWE	5,81	89	5,81	22	46,45	860	37,6	348	95,67	1319
GBR	37,74	581	37,74	140	301,9	5591	250,09	2316	627,47	8628
EU+UK	681,8	10492	681,8	2525	5454,1	101001	4474,09	41426	11291,8	155444

Results for 2030

Table 47: revenues and jobs in 2030 (baseline scenario) associated to cooling

	Retail		Wholesale		Industry		Installation		Total	
	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs
AUT	8,92	137	8,92	33	71,33	1321	81,4	754	170,57	2245
BEL	12,2	188	12,2	45	97,56	1807	140,97	1305	262,93	3345
BGR	10,45	161	10,45	39	83,62	1549	126,03	1167	230,55	2916
HRV	4,69	72	4,69	17	37,53	695	58,23	539	105,14	1323
CYP	6,03	93	6,03	22	48,22	893	83,78	776	144,06	1784
CZE	11,68	180	11,68	43	93,44	1730	123,91	1147	240,71	3100
DNK	4,46	69	4,46	17	35,67	661	38,62	358	83,21	1105
EST	1,86	29	1,86	7	14,88	276	13,17	122	31,77	434
FIN	4,13	63	4,13	15	33	611	33,4	309	74,66	998
FRA	183,69	2826	183,69	680	1469,55	27214	2133,33	19753	3970,26	50473
DEU	60,09	925	60,09	223	480,74	8903	710,98	6583	1311,9	16634
GRC	63	969	63	233	504,04	9334	983,56	9107	1613,6	19643
HUN	13,04	201	13,04	48	104,35	1932	166,95	1546	297,38	3727
IRL	2,15	33	2,15	8	17,17	318	16,53	153	38	512
ITA	266,25	4096	266,25	986	2130	39444	3985,52	36903	6648,02	81429
LVA	2,41	37	2,41	9	19,26	357	17,15	159	41,23	562
LTU	2,35	36	2,35	9	18,83	349	17,03	158	40,56	552
LUX	2,02	31	2,02	7	16,16	299	15,36	142	35,56	479
MLT	9,39	144	9,39	35	75,1	1391	141,27	1308	235,15	2878
NLD	14,52	223	14,52	54	116,14	2151	158,79	1470	303,97	3898
POL	21,65	333	21,65	80	173,18	3207	274,68	2543	491,16	6163
PRT	11,71	180	11,71	43	93,68	1735	143,92	1333	261,02	3291
ROU	25,17	387	25,17	93	201,39	3730	326,86	3027	578,59	7237
SVK	4,27	66	4,27	16	34,17	633	41,59	385	84,3	1100
SVN	3,32	51	3,32	12	26,58	492	30,25	280	63,47	835
ESP	297,7	4580	297,7	1103	2381,64	44104	3874,75	35877	6851,79	85664
SWE	9,82	151	9,82	36	78,56	1455	131,19	1215	229,39	2857
GBR	59,36	913	59,36	220	474,87	8794	667,3	6179	1260,89	16106
EU+UK	1116,33	17174	1116,33	4133	8930,66	165385	14536,5	134598	25699,8	321290

Table 48: revenues and jobs in 2030 (ambitious scenario) associated to cooling

	Retail		Wholesale		Industry		Installation		Total	
	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs
AUT	8,94	137	8,94	33	71,48	1324	105,05	973	194,41	2467
BEL	12,2	188	12,2	45	97,64	1808	204,74	1896	326,78	3937
BGR	10,46	161	10,46	39	83,69	1550	182,96	1694	287,57	3444
HRV	4,69	72	4,69	17	37,56	696	85,57	792	132,51	1577
CYP	6,03	93	6,03	22	48,25	893	127,5	1181	187,81	2189
CZE	11,69	180	11,69	43	93,56	1733	171,28	1586	288,22	3542
DNK	4,47	69	4,47	17	35,73	662	49,33	457	94	1205
EST	1,86	29	1,86	7	14,91	276	14,1	131	32,73	443
FIN	4,14	64	4,14	15	33,08	613	40,36	374	81,72	1066
FRA	183,76	2827	183,76	681	1470,08	27224	3055,76	28294	4893,36	59026
DEU	60,12	925	60,12	223	480,97	8907	1073,53	9940	1674,74	19995
GRC	63,02	969	63,02	233	504,12	9336	1548,25	14336	2178,41	24874
HUN	13,06	201	13,06	48	104,45	1934	248,68	2303	379,25	4486
IRL	2,15	33	2,15	8	17,2	319	18,9	175	40,4	535
ITA	266,31	4097	266,31	986	2130,46	39453	6237,94	57759	8901,02	102295
LVA	2,41	37	2,41	9	19,29	357	18,5	171	42,61	574
LTU	2,36	36	2,36	9	18,87	349	18,9	175	42,49	569
LUX	2,02	31	2,02	7	16,18	300	17,39	161	37,61	499
MLT	9,39	144	9,39	35	75,13	1391	221,99	2055	315,9	3625
NLD	14,53	224	14,53	54	116,27	2153	226,03	2093	371,36	4524
POL	21,66	333	21,66	80	173,29	3209	406,16	3761	622,77	7383
PRT	11,72	180	11,72	43	93,72	1736	211,28	1956	328,44	3915
ROU	25,19	387	25,19	93	201,49	3731	487,85	4517	739,72	8728
SVK	4,28	66	4,28	16	34,21	634	55,4	513	98,17	1229
SVN	3,33	51	3,33	12	26,62	493	38,68	358	71,96	914
ESP	297,77	4581	297,77	1103	2382,17	44114	5773,97	53463	8751,68	103261
SWE	9,83	151	9,83	36	78,64	1456	199,73	1849	298,03	3492
GBR	59,38	914	59,38	220	475,03	8797	943,24	8734	1537,03	18665
EU+UK	1116,77	17180	1116,77	4134	8934,09	165448	21783,1	201697	32950,7	388459

Results for 2050

Table 49: revenues and jobs in 2050 (baseline scenario) associated to cooling

	Retail		Wholesale		Industry		Installation		Total	
	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs
AUT	12,56	193	12,56	47	100,46	1860	145	1343	270,58	3443
BEL	17,25	265	17,25	64	137,99	2555	257,37	2383	429,86	5267
BGR	16,93	260	16,93	63	135,46	2508	280,69	2599	450,01	5430
HRV	8,96	138	8,96	33	71,66	1327	153,03	1417	242,61	2915
CYP	9,89	152	9,89	37	79,09	1465	179,15	1659	278,02	3313
CZE	17,41	268	17,41	64	139,32	2580	239,93	2222	414,07	5134
DNK	5,95	92	5,95	22	47,63	882	63,09	584	122,62	1580
EST	1,85	28	1,85	7	14,77	273	14,4	133	32,87	441
FIN	5,47	84	5,47	20	43,74	810	52,65	488	107,33	1402
FRA	258,14	3971	258,14	956	2065,09	38242	3742,8	34656	6324,17	77825
DEU	97,39	1498	97,39	361	779,15	14429	1471,05	13621	2444,98	29909
GRC	121	1862	121	448	968,01	17926	2488,88	23045	3698,89	43281
HUN	21,3	328	21,3	79	170,39	3155	365,54	3385	578,53	6947
IRL	2,61	40	2,61	10	20,87	386	23,1	214	49,19	650
ITA	471,91	7260	471,91	1748	3775,31	69913	8908,11	82483	13627,2	161404
LVA	2,56	39	2,56	9	20,51	380	20,24	187	45,87	615
LTU	2,56	39	2,56	9	20,46	379	20,41	189	45,99	616
LUX	2,28	35	2,28	8	18,25	338	20,68	191	43,49	572
MLT	19,88	306	19,88	74	159,05	2945	394,33	3651	593,14	6976
NLD	19,15	295	19,15	71	153,17	2836	266,38	2467	457,85	5669
POL	28,9	445	28,9	107	231,17	4281	484,62	4487	773,59	9320
PRT	22,75	350	22,75	84	182,03	3371	388,27	3595	615,8	7400
ROU	44,46	684	44,46	165	355,67	6587	794,41	7356	1239	14792
SVK	5,39	83	5,39	20	43,12	799	68,91	638	122,81	1540
SVN	4,87	75	4,87	18	38,93	721	60,49	560	109,16	1374
ESP	414,36	6375	414,36	1535	3314,84	61386	7146,93	66175	11290,5	135471
SWE	15,05	232	15,05	56	120,4	2230	257,19	2381	407,69	4899
GBR	77,74	1196	77,74	288	621,95	11518	1121,54	10385	1898,97	23387
EU+UK	1728,57	26593	1728,57	6403	13828,5	256082	29429,2	272494	46714,8	561572

Table 50: revenues and jobs in 2050 (ambitious scenario) associated to cooling

	Retail		Wholesale		Industry		Installation		Total	
	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs	Rev. [M€]	Jobs
AUT	12,62	194	12,62	47	100,97	1870	209,76	1942	335,97	4053
BEL	17,28	266	17,28	64	138,24	2560	408,14	3779	580,94	6669
BGR	16,96	261	16,96	63	135,71	2513	449,9	4166	619,53	7003
HRV	8,98	138	8,98	33	71,83	1330	247,3	2290	337,09	3791
CYP	9,9	152	9,9	37	79,21	1467	292,75	2711	391,76	4367
CZE	17,48	269	17,48	65	139,83	2590	366,95	3398	541,74	6322
DNK	5,99	92	5,99	22	47,89	887	90,01	833	149,88	1834
EST	1,86	29	1,86	7	14,88	276	16,91	157	35,51	469
FIN	5,5	85	5,5	20	43,98	814	71,41	661	126,39	1580
FRA	258,27	3973	258,27	957	2066,14	38262	5788,67	53599	8371,35	96791
DEU	97,5	1500	97,5	361	779,97	14444	2386,16	22094	3361,13	38399
GRC	121,05	1862	121,05	448	968,38	17933	4173,52	38644	5384	58887
HUN	21,35	328	21,35	79	170,8	3163	592,93	5490	806,43	9060
IRL	2,63	40	2,63	10	21	389	29,21	270	55,47	709
ITA	471,99	7261	471,99	1748	3775,92	69924	14733,6	136422	19453,5	215355
LVA	2,58	40	2,58	10	20,67	383	24,02	222	49,85	655
LTU	2,57	40	2,57	10	20,59	381	25,32	234	51,05	665
LUX	2,3	35	2,3	9	18,37	340	26,52	246	49,49	630
MLT	19,9	306	19,9	74	159,21	2948	660,43	6115	859,44	9443
NLD	19,18	295	19,18	71	153,44	2842	415,25	3845	607,05	7053
POL	28,93	445	28,93	107	231,47	4287	778,83	7211	1068,16	12050
PRT	22,78	350	22,78	84	182,22	3374	628,86	5823	856,64	9631
ROU	44,5	685	44,5	165	355,98	6592	1296,62	12006	1741,6	19448
SVK	5,41	83	5,41	20	43,3	802	103,48	958	157,6	1863
SVN	4,89	75	4,89	18	39,13	725	89,48	829	138,39	1647
ESP	414,44	6376	414,44	1535	3315,49	61398	11548,3	106929	15692,7	176238
SWE	15,08	232	15,08	56	120,65	2234	420,89	3897	571,7	6419
GBR	77,78	1197	77,78	288	622,23	11523	1732,46	16041	2510,25	29049
EU+UK	1729,7	26609	1729,7	6408	13837,5	256251	47607,7	440812	64904,6	730080

HOW TO OBTAIN EU PUBLICATIONS

Free publications:

- one copy:
  via EU Bookshop (http://bookshop.europa.eu);

- more than one copy or posters/maps:
  from the European Union's representations (http://ec.europa.eu/represent_en.htm);
  from the delegations in non-EU countries
  (http://eeas.europa.eu/delegations/index_en.htm);
  by contacting the Europe Direct service (http://europa.eu/europedirect/index_en.htm)
  or calling 00 800 6 7 8 9 10 11 (freephone number from anywhere in the EU) (*).

  (*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

Priced publications:

- via EU Bookshop (http://bookshop.europa.eu).

Priced subscriptions:

- via one of the sales agents of the Publications Office of the European Union
  (http://publications.europa.eu/others/agents/index_en.htm).

MJ-07-22-385-EN-N

Publications Office
of the European Union

ISBN 978-92-76-53164-7