# Assessment of Member States' reports for the year 2020

Final report

**Guidehouse Germany GmbH**

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# Assessment of Member States' reports for the year 2020

## Final Report

**Prepared for:**

European Commission

## European Commission – DG ENER

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# Abbreviations

| | |
|---|---|
| CHP | Combined Heat and Power |
| CfD | Contract for Difference |
| DSO | Distributed System Operator |
| EC | European Commission |
| ETBE | Ethyl Tert-butyl Ether |
| EU | European Union |
| EV | Electric Vehicle(s) |
| FIP | Feed-in premium(s) |
| FIT | Feed-in tariff(s) |
| GHG | Greenhouse gas |
| Governance Regulation | Regulation (EU) 2018/1999 |
| ILUC Directive | DIRECTIVE (EU) 2015/1513 |
| MS | Member State(s) |
| NREAP | National Renewable Energy Action Plan |
| RES Directive | Renewable Energy Directive (DIRECTIVE 2009/28/EC) |
| REDII | Recast of the Renewable Energy Directive (DIRECTIVE (EU) 2018/2001) |
| RES | Renewable Energy Sources |
| RES-H&C | Renewable Energy Share in Heating and Cooling sector |
| RES-E | Renewable Energy Share in Electricity sector |
| RES-T | Renewable Energy Share in transport sector |
| TSO | Transmission System Operator |

# Executive Summary

In this final report, we present the main findings of the quantitative and qualitative analysis regarding the achieved shares of renewable energy sources (RES) in each Member State (MS) and in the European Union (EU) as a whole and the main policies and measures implemented.

For the quantitative analysis, based on the data provided by the MS and in the Eurostat SHARES database, we elaborated a set of graphs and tables to show the RES shares across different categories, mainly:

- Per sector: electricity, heating and cooling, and transport sectors (RES-E, RES-H&C, RES-T)
- Per technology
- For the year 2020, a comparison with the mandatory RES targets set in the Directive 2009/28/EC (RES Directive)
- Time evolution from 2011 to 2020
- In this context, we accounted for the use of statistical transfers between MS

As Figure 1 shows, all MS achieved the 2020 RES target set by the RES Directive, except France. This analysis is based on currently available data (as of September 2022) and may not reflect all statistical transfers agreed between MS.

The qualitative analysis of the reasons behind the observed results, implemented measures as well as best practices and recommendations is based on the information provided by the MS in their reports, in previous PREBS reports, and in specific sources as indicated where relevant.

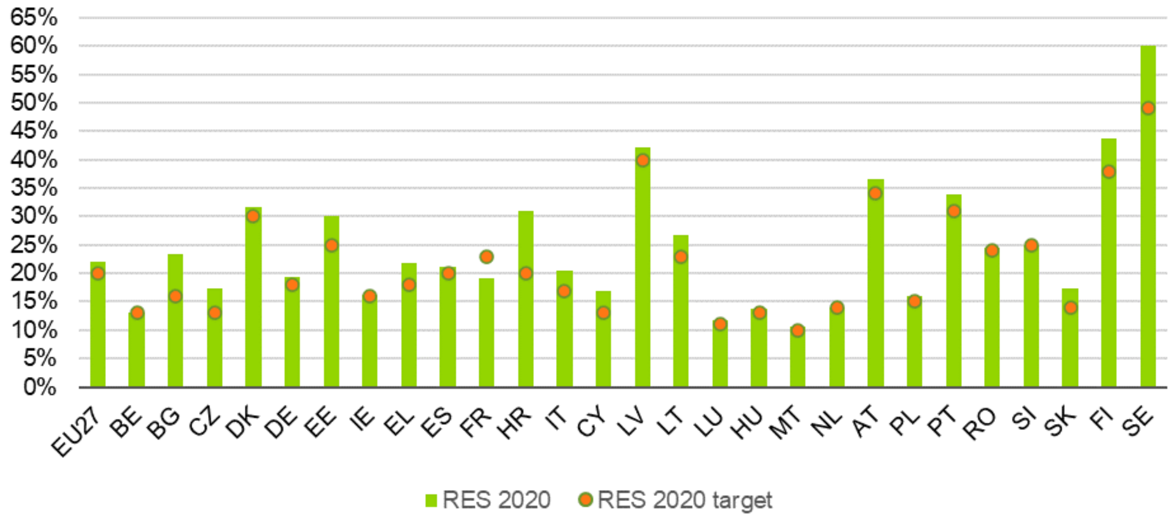


**Figure 1. Achieved 2020 RES share compared to 2020 RES target (Directive). Source: Eurostat SHARES; RES Directive. The numbers reflect statistical transfer use.**

# 1. Introduction

In 2009, the European Union (EU) adopted the first Renewable Energy Directive (the RES Directive, Directive 2009/28/EC). This Directive established an overall renewable energy target of at least 20% in final energy consumption for the EU (which is broken down in national targets) and a 10% target of renewable energy in transport for 2020 (which is the same for each Member State (MS)).

In December 2018, the EU adopted the Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action (Governance Regulation). This Regulation aims at setting out the necessary legislative foundation for a reliable, inclusive, cost-efficient, transparent and predictable Governance of the Energy Union and Climate Action.

The governance mechanism established with the Governance Regulation aims at ensuring the achievement of the 2030 and long-term objectives and targets of the Energy Union, i.e. by implementing strategies and measures designed to meet the objectives and targets of the Energy Union and by stimulating cooperation between MS. Another key element of the mechanism is to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of reporting by the Union and its MS.

In this context, Article 27 of the Governance Regulation requires MS, amongst other things, to report to the Commission on the achievement of the national overall targets for the share of renewable energy sources (RES) in 2020 as set out in Annex I to the RES Directive by providing the following information:

- The sectoral (electricity, heating and cooling, and transport) and overall shares of energy from renewable sources in 2020
- The measures taken to achieve the 2020 national renewable energy targets, including measures related to support schemes, guarantees of origin and simplification of administrative procedures
- The share of energy from biofuels and bioliquids produced from cereal and other starch-rich crops, sugars and oil crops in energy consumption in transport
- The share of energy from biofuels and biogas for transport produced from feedstocks and of other fuels listed in Part A of Annex IX to RES Directive in the version in force on 31 December 2020 in energy consumption in transport

The goal of this report is to provide the European Commission (EC) with technical assistance in preparation of the EC's evaluation and summary report on MS's national overall targets for the share of energy from renewable sources in 2020 and the other information requested in Article 27 of the Governance Regulation in the framework of the 2022 State of the Energy Union report. Our report provides the results from data collection, analysis and assessment of the progress in deployment of renewable energy, and national measures promoting such deployment, in the 27 EU MS.

In Chapter 2, we present a **quantitative** overview of the information required under Article 27 of the Governance Regulation related to the share of energy from:

- **Renewable sources** for specific sectors (electricity, H&C, transport) and technologies
- **Biofuels and bioliquids** produced from cereal and other starch-rich crops, sugar and oil crops in energy consumption in transport (since 2016)
- **Biofuels and biogas** for transport produced from feedstock and other fuels (Part A Annex IX RES Directive)

The quantitative overview covers the year 2020 and the preceding 10 years, each MS as well as the EU as a whole. The use of statistical transfers is also identified.

In order to take advantage of areas with greater potential for RES, the EU RES Directive has introduced three cooperation mechanisms that can be used by MS to tap into RE opportunities and meet their national RES targets: statistical transfers, joint projects between EU countries or EU countries and third countries and joint support schemes[1]. Statistical transfers between two MS occur when an amount of renewable energy is deducted from one country's progress towards its target and added to another's. This is simply an accounting procedure, as no actual energy changes hands[2]. Under joint projects, two or more MS can co-fund a RE project in electricity or heating and cooling, and share the resulting renewable energy for the purpose of meeting their targets. These projects can but do not have to involve the physical transfer of energy from one country to another[3]. Finally, under joint support schemes, two or more EU countries can co-fund a joint support scheme to spur renewable energy production in one or both of their territories. This form of cooperation can involve measures such as a common feed-in tariff (FIT), a common feed-in premium (FIP), or a common quota and certificate trading regime[4].

In Chapter 3, we provide a **qualitative analysis** of the information provided by the MS progress reports regarding the achievement or non-achievement of overall RES targets in 2020, and the reasons behind the observed results. We also provide an overview of the policies and measures taken to achieve the targets, as well as market developments behind them. A separate analysis is provided for support schemes, guarantees of origin, and simplification of administrative procedures. Chapter 3 also includes an analysis of policies and measures that have proven to be particularly successful in triggering further renewables development and policy recommendations which could be replicated in other MS.

In the Appendixes A, B, and C, we additionally present detailed information on the quantitative progress of all MS per sector and per technology (2011-2020).

[1] https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/cooperation-mechanisms_en

[2] Ibid.

[3] Ibid.

[4] Ibid.

# 2. Quantitative analysis of the national and EU overall targets for the share of renewable energy in 2020

## 2.1 Introduction

In this chapter, we present a **quantitative** overview of the information required under Article 27 of the Governance Regulation related to the share of energy from:

- Renewable sources for specific sectors (electricity, H&C, transport) and technologies
- Biofuels and bioliquids produced from cereal and other starch-rich crops, sugar and oil crops in energy consumption in transport (since 2016)
- Biofuels and biogas for transport produced from feedstock and other fuels (Part A Annex IX Directive RES Directive) (since 2016)

In the following sections we present the main findings for the three aspects of Article 27 Governance Regulation differentiating between technologies, sectors, EU and MS levels, as well as the achieved shares in 2020 and the historic development in the last 10 years. The use of statistical transfers is also considered.

In Appendix A, we provide detailed descriptions of each MS and their progress, split over quantitative growth in sectors and technologies (2011-2020).

### 2.1.1 Approach and data sources

The quantitative analysis presented in this chapter is based on the data available in Eurostat Shares and submitted by MS for the year 2020. The data also covers the last 10 years to analyse the trends and evolutions.

To provide the required quantitative overview, we first updated our statistical data until 2020. Statistical data for the years 2010 to 2019 is part of our database and has been updated in the context of previous projects (Technical assistance in realisation of the 5th report on progress of renewable energy in the EU (2021); Technical assistance in realisation of the 4th report on progress of renewable energy in the EU (2019)). Based on the update of the database we developed tables and graphs on the share of RES in the different categories, for instance, per sector and per technology.

Historical trends and RES shares reached in 2020 were analysed based on the following data sources:

- The targets are derived from the RES Directive.
- Eurostat shares: RES shares published by Eurostat for those graphs displaying RES overall shares or RES sector shares. The Eurostat shares are available for the EU-27. The latest shares are of 2020. Both "SHARES summary results" and "SHARES detailed results" databases were used.
- MS Reports from Article 27 Governance Regulation: Used for comparison and verification purposes only. MS submitted their Reports to the Commission between April and June 2022. As of 15th August, not all MS had submitted their reports[5].

Any gaps or serious discrepancies between data sources are mentioned either in the analysis text or in a footnote below the respective figure.

[5] Missing MS reports: Croatia and Lithuania.

## 2.2 Shares of renewable energy: overall, per sectors and technology-specific findings

In this section we present the share of energy from renewable sources:

- Per sector: RES-E, RES-H&C and RES-T in 2020 as well as the development in the last ten years
- Per technology: technology-specific within each sector as well as the development in the last ten years (technologies indicated in Table 1)

The analysis covers both EU and MS level and it also takes into account whether statistical transfers were used.

The following graphs and tables were created for this subtask:

- One overview graph indicating the time evolution in overall EU RES shares overall and per sector
- One graph on the overall RES share in the 27 MS with and without considering statistical transfers
- MS-specific overview of the RES-E, RES-H&C and RES-T share in 2020
- Overview of the historical development 2011-2020 of the technologies in RES-E, RES-H&C and RES-T in the EU as a whole
- A table on the historical development 2011-2020 of the technologies in RES-E, RES-H&C and RES-T in each MS (in Appendix A)

**Table 1. RES technologies per sector**

| **Renewable electricity (RES-E)** | **Renewable heating and cooling (RES-H&C)** | **Renewable energy in transport (RES-T)** |
|---|---|---|
| Offshore wind | Solar thermal | Bioethanol/Bio- Ethyl Tert-butyl Ether (ETBE) |
| Onshore wind | Solid biomass | Biodiesel |
| Solid biomass | Biogas | Electricity in transport |
| Biogas | Heat pumps | Other biofuels |
| Photovoltaics | Geothermal | Hydrogen |
| Geothermal | Bioliquids | |
| Bioliquids | | |
| Concentrated solar power | | |
| Tide, wave and ocean energy | | |

### 2.2.1 Overall RES shares in the EU

For the EU as a whole, Figure 2 shows the historic development 2011-2020 of overall RES shares, renewable electricity (RES-E), renewables for heating and cooling (RES-H&C) and renewables in the transport sector (RES-T). At the EU level, the shares of RES overall, RES-E, RES-H&C and RES-T have increased steadily over the last decade. In 2020, the EU reached a share of 22.1% of RES in gross final energy consumption, exceeding the 2020 target of 20% set by the RES Directive. The overall RES share increased by 2.2 percentage points from 2019 to 2020. On average, it has been increasing by 0.8 percentage points annually since 2011.

With a contribution of 37.5% in 2020, the relative share of renewables was largest in the electricity sector. The sector saw an especially strong increase of 2 percentage points from 2018 to 2019 and of 3.4 percentage points from 2019 to 2020. The share of renewables in the H&C sector reached 23.1% in 2020 but has increased only by 5.7 percentage points in the last ten years. For the transport sector, developments were less dynamic and slower and getting above the 10% level posed a challenge for several MS.

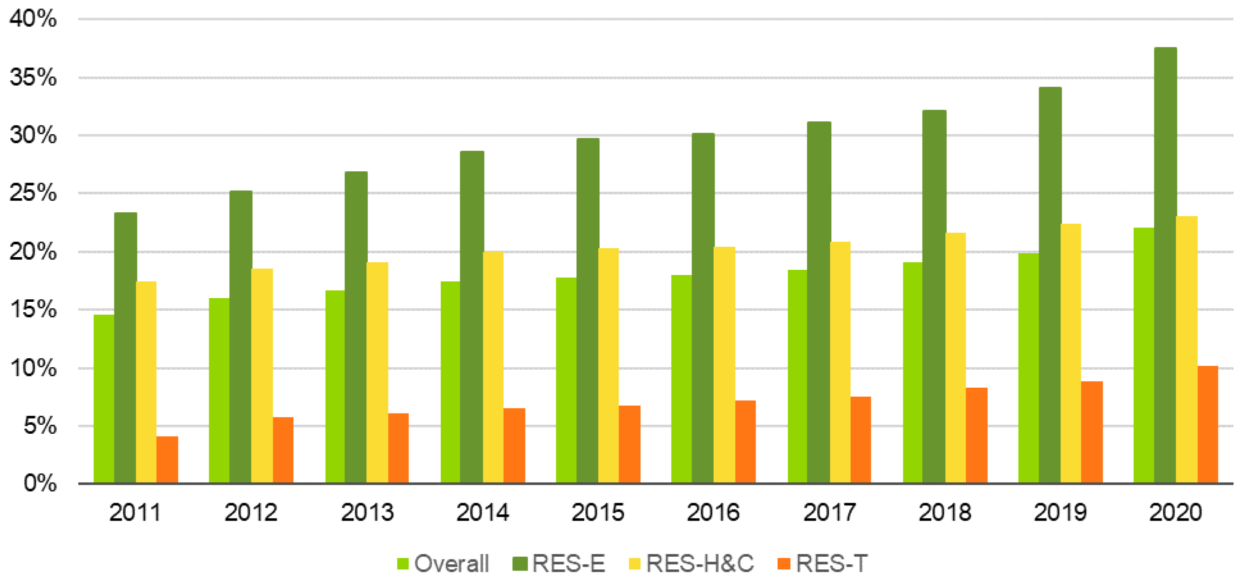


**Figure 2. EU-27 RES shares 2011-2020 (%). Source: Eurostat SHARES**

If we take a closer look at bioenergy, in general it continues to be the main source of renewable energy in the EU, with a share of 58.1% in 2020 (Figure 3). Solid biofuels represent the largest share of all bioenergy with a 69.5%. The other forms of bioenergy are liquid biofuels (12.9%), biogas (10.6%), the renewable share of municipal waste (6.9%) and charcoal (0.2%).

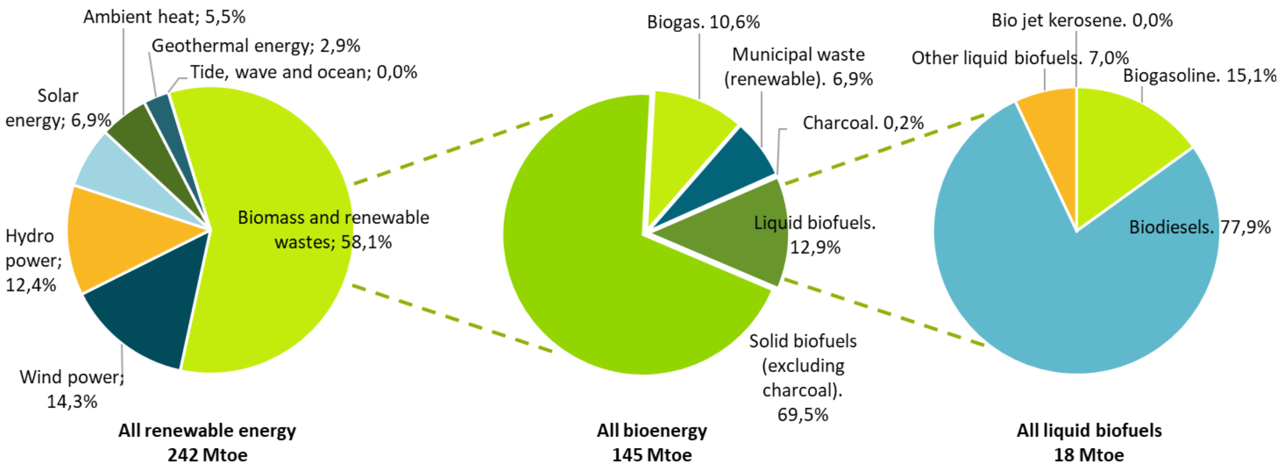


**Figure 3. Gross EU consumption of renewable energy per type (2020, % and Mtoe). Source: Eurostat**

### 2.2.2 Overall RES shares per MS

As shown in Figure 4, the RES shares in 2020 vary widely across MS, reflecting the different starting positions and national targets set for each MS in the RES Directive. The figure shows the overall RES share with and without accounting for statistical transfers. Sweden achieved the highest RES share in 2020 (60.1%), followed by Finland (43.8%) and Latvia (42.1%). The lowest RES shares were seen in Malta (10.7%) and Luxembourg (11.7%). Despite the low overall RES share observed in Malta and Luxembourg, both countries increased their RES shares from 2019 to 2020 by +2.5 percentage points and +4.7 percentage points, respectively (including statistical transfers).

We provide a closer look at the reasons behind the achieved targets in section 3.2. In particular, we qualitatively analyse the policy trends in the three sectors in the period considered (2011-2020), the use of statistical transfers, certain market developments, the impacts of COVID, and a review of policies implemented in the MS that showed the highest RES progress from 2019 to 2020.

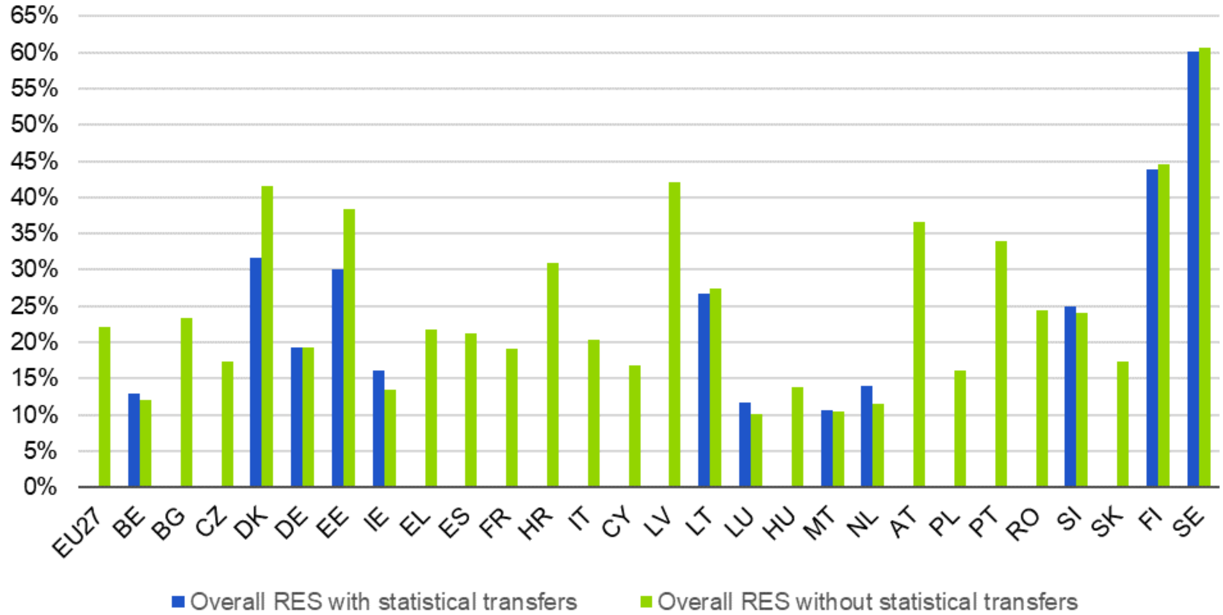


**Figure 4. Actual renewable energy shares in 2020. Source: Eurostat SHARES**

Table 2 shows that Belgium, Ireland, Luxembourg, Malta, Netherlands and Slovenia used statistical transfers to achieve their RES target in the RES Directive. Malta would have also achieved the RES target without using statistical transfers. Germany received very little statistical transfers from the joint solar PV auction with Denmark.

**Table 2. Overview of Member States that bought statistical transfers in 2020. Source: Eurostat SHARES**

| Country | Overall RES without statistical transfers | Overall RES with statistical transfers deducted |
|---|---|---|
| Belgium | 12% | 13% |
| Germany[6] | 19.3% | 19.3% |
| Ireland | 13.5% | 16.2% |
| Luxembourg | 10.1% | 11.7% |
| Malta | 10.4% | 10.7% |
| Netherlands | 11.5% | 14% |
| Slovenia | 24.1% | 25% |

Denmark, Estonia and Lithuania sold statistical transfers. The deduction of the overall RES in Sweden was due to joint support schemes with Norway (Table 3).

[6] Germany received statistical transfers from a joint cross-border solar PV auction with Denmark. The statistical transfer from the auction does not significantly influence the overall RES share.

**Table 3. Overview of Member States that sold statistical transfers in 2020. Source: Eurostat SHARES**

| Country | Overall RES without statistical transfers | Overall RES with statistical transfers deducted |
|---|---|---|
| Denmark | 41.6% | 31.7% |
| Estonia | 38.4% | 30,1% |
| Lithuania | 27.4% | 26.8% |
| Sweden | 60.7% | 60.1% |
| Finland | 44.5% | 43.8% |

The other cooperation mechanisms remained largely unused, whereby the already established joint support schemes between Germany and Denmark and Sweden and Norway continued to deliver results. Nevertheless, the cross-border collaboration in the form of joint projects is expected to be further incentivized following the implementation of the new instruments that are set up at EU level, notably the Renewable Energy Financing Mechanism[7] and the renewable energy window of the Connecting Europe Facility[8].

### 2.2.3 Shares per sector (RES-E, RES-H&C, RES-T) and technologies

This section displays the RES shares of each MS in three sectors, RES-E, RES-H&C and RES-T. For each sector we provide:

- A graph with the shares of each MS in the year 2020
- For the EU as a whole we show the progress 2011-2020 per RE technology regarding generation/consumption and installed capacity (the latter only for the RES-E sector)
- In the Appendix A, we present a table per each MS, showing the progress in the last 10 years per sector (RES-E, RES-T, and RES-H&C) and per RE technology

Statistical transfers were not added or deducted for the sectoral shares (RES-E, RES-H&C, RES-T).

[7] See https://energy.ec.europa.eu/topics/renewable-energy/financing/eu-renewable-energy-financing-mechanism_en.
[8] See https://energy.ec.europa.eu/topics/renewable-energy/financing/financing-cross-border-cooperation_en.

### 2.2.4 RES-E sector

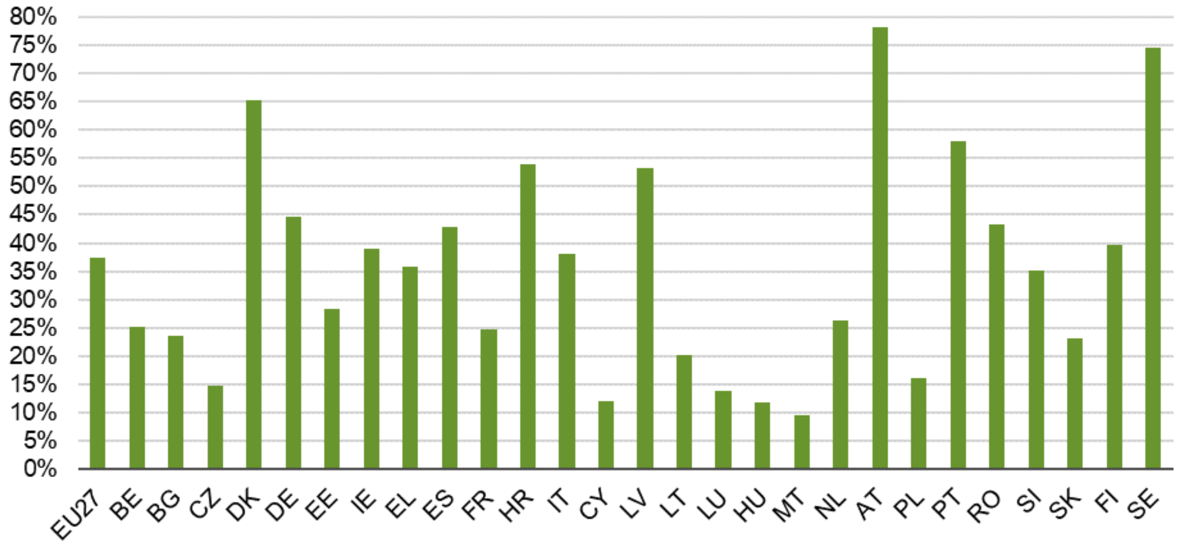


Figure 5 shows the RES-E share per MS. In 2020, Austria had the highest RES-E share of 78.8% followed by Sweden (74.5%) and Denmark (65.3%). Malta (9.5%), Hungary (11.9%) and Cyprus (12.4%) had the lowest RES-E share of all MS in 2020. In section 3.2 we provide a qualitative analysis of the reasons behind the observed results (policy trends in the three sectors, use of statistical transfers, certain market developments, the impacts of COVID, and a review of policies implemented in the MS that showed the highest RES progress from 2019 to 2020).

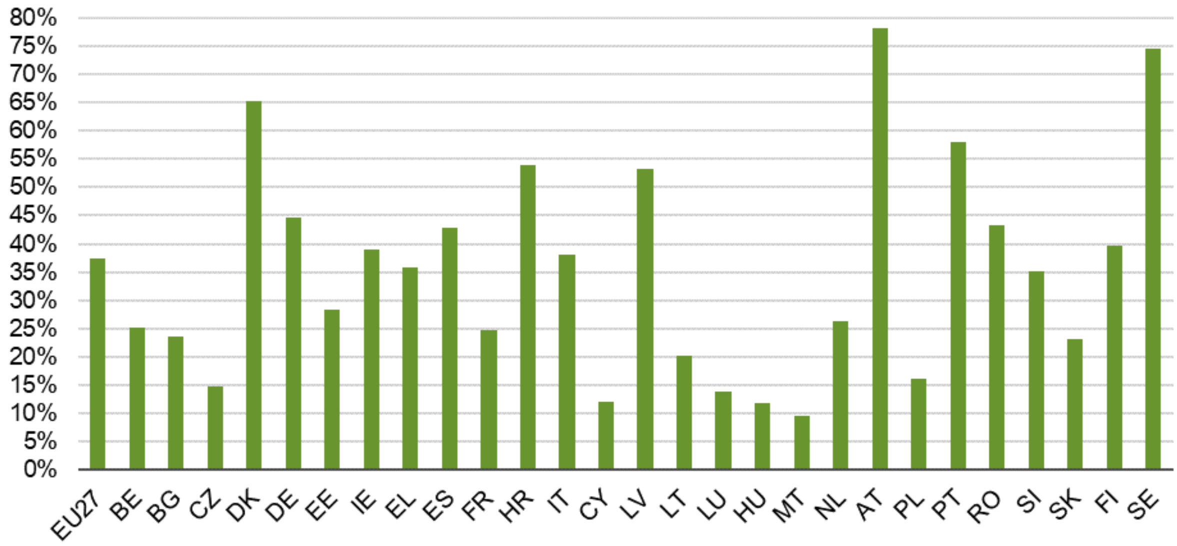


**Figure 5. RES-E share per Member State in 2020. Source: Eurostat SHARES**

Figure 6 shows the trends in total **electricity generation** by RES technology between 2011-2020. It can be observed that the upward trend of the last years has been continuing in most technologies. In 2020, for the first-time, onshore wind held the largest share in RES-E technologies with 350,085 GWh production in 2020 (not normalised[9]), followed by 345,146 GWh for hydro, PV with 139,127 GWh, solid biomass with 82,953 GWh, biogas with 56,341 GWh, offshore wind with 47,344 GWh (not normalised). Geothermal electricity (6,717 GWh), solar thermal (4,992 GWh) and bioliquids (4,919 GWh) played minor roles in the RES-E mix.

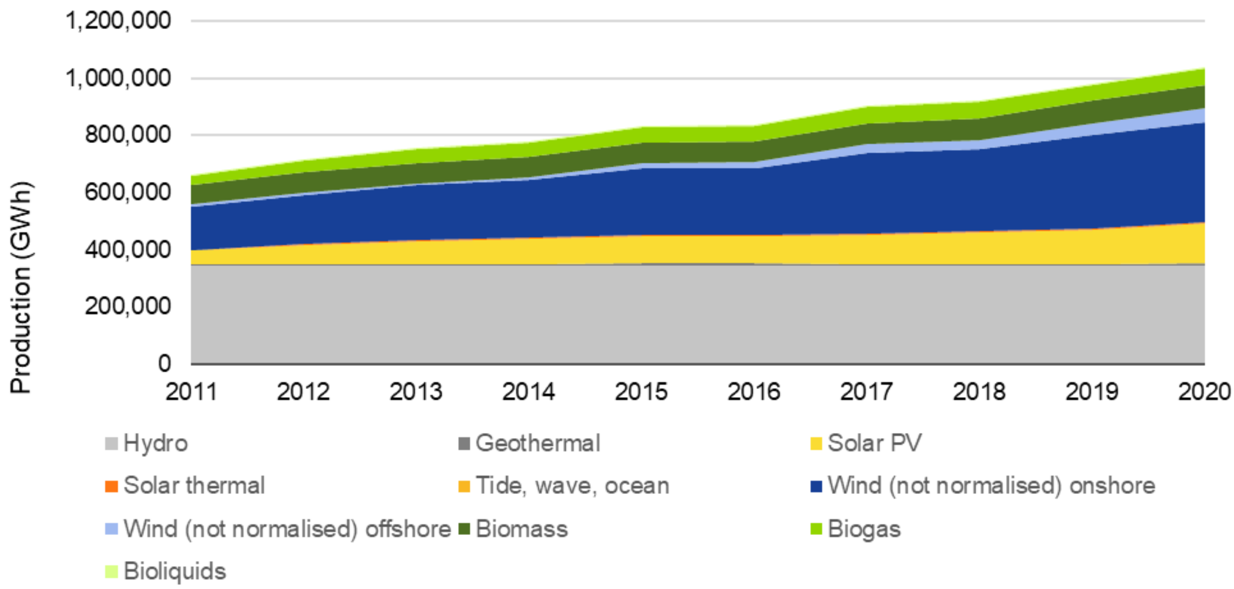


**Figure 6. Gross electricity generation by RE technology in the EU-27 for 2011-2020. Source: Eurostat SHARES**

**The development over the last ten years in RES-E generation capacity is shown in Figure 7**

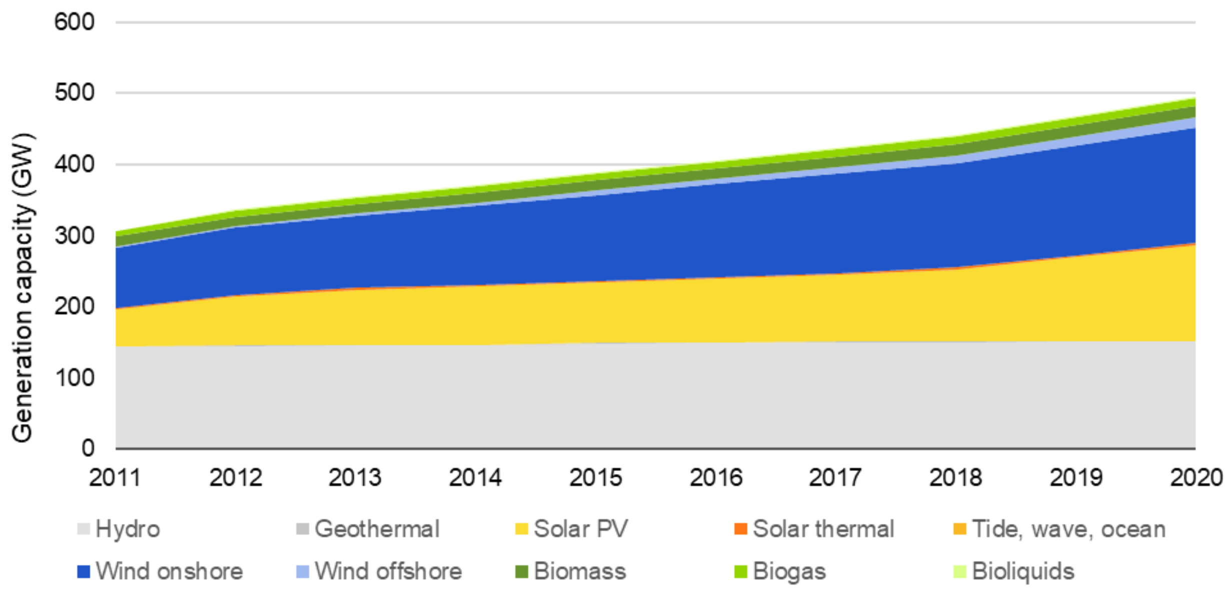


Figure 7. The installed capacity observed in 2020 fits well the results shown for RES-E production above. In 2020 the technology with the highest installed capacity was wind

[9] According to Statistic Netherlands CBS, normalised "refers to normalised gross electricity production, adjusted for (1) weather conditions and including (…) Additional explanation to 1: Normalised production in a particular year is defined as the capacity in that year multiplied by the average production per unit of capacity in the past five years (wind) or fifteen years (hydropower). Source: https://www.cbs.nl/en-gb/news/2016/09/more-and-more-renewable-electricity-generated-by-wind-turbines/normalised

onshore with 162,5 GW. Wind onshore presented a significant increase from 2019 to 2020 of 7,4 GW added. Hydro had the second largest generation capacity (150,8 GW), however, its total installed capacity has remained largely unaltered with an increase of only 6,5 GW in the last 10 years.

Hydropower is followed by solar PV which increased from 117,9 GW in 2019 to 135,7 GW in 2020 (+17,7 GW). Wind offshore increased from 12 GW in 2019 to 14,5 GW in 2020. Biomass (15,6 GW), Biogas (11,7 GW), Bioliquids (1,2 GW) and Geothermal (0,9 GW) had a relatively smaller share of the RES-E generation capacity in 2020.

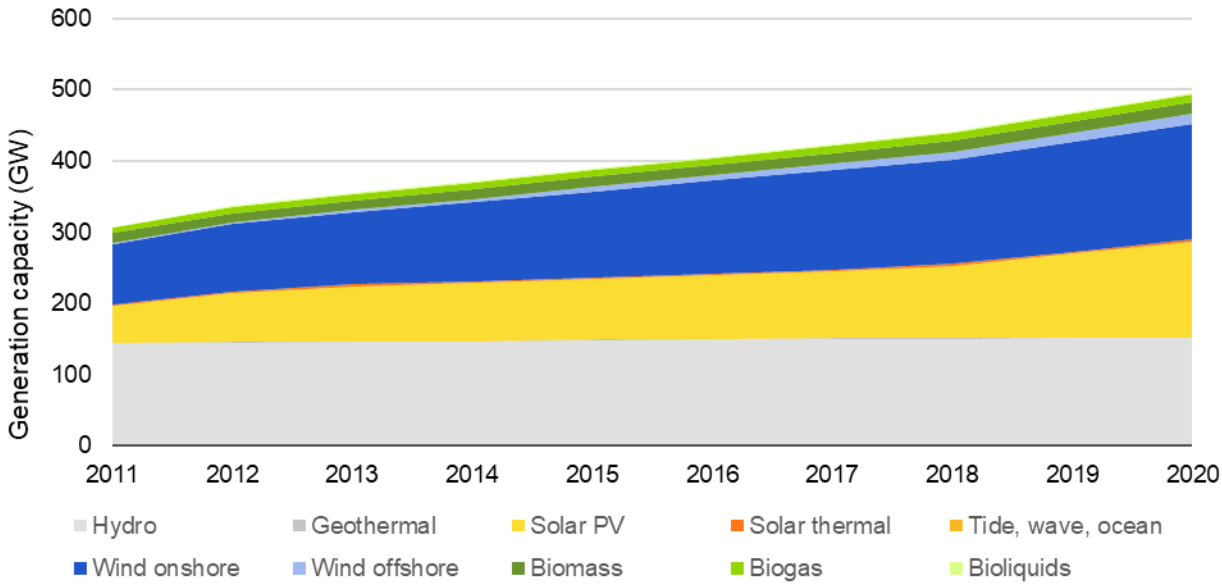


**Figure 7. RES-E generation capacity in the EU-27 for 2011-2020. Source: Eurostat SHARES**

### 2.2.5 RES-H&C sector

Figure 8 provides an overview of the RES-H&C share per MS in 2020. Sweden (66.4%) had the highest share of renewable energy in 2020, followed by Estonia (58.8%), Finland (57.6%) and Latvia (57.1%). In contrast, Ireland (6.3%), the Netherlands (8.1%) and Belgium (8.4%) had the lowest RES share in H&C.

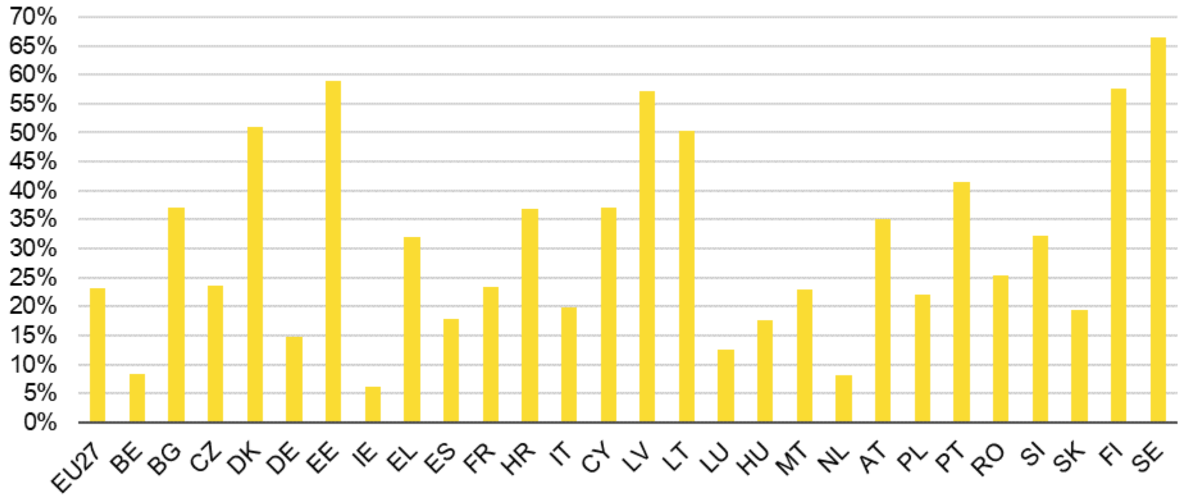


**Figure 8. RES-H&C share per Member State in 2020. Source: Eurostat SHARES**

As depicted in Figure 9, consumption of RES-H&C has increased gradually over the last decade. In 2020, RES-H&C consumption at EU-27 level reached 100,561 ktoe. Thereby, solid biomass was the largest RE contributor to the sector with 79,151 ktoe.
Heat consumption from heat pumps stood at 13,316 ktoe, biogas at 4,055 ktoe, solar thermal heating at 2,503 ktoe, bioliquids at 669 ktoe and geothermal heating at 867 ktoe.

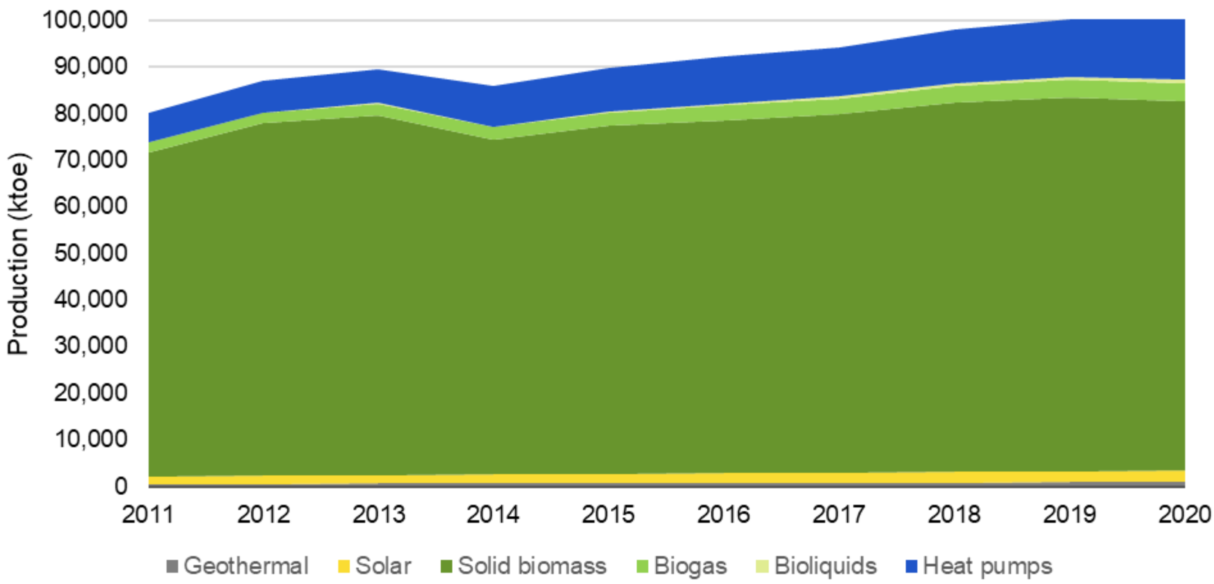


**Figure 9. Production of heating and cooling from RES-H&C technologies in the EU-27 for 2011-2020. Source: Eurostat SHARES**

### 2.2.6 RES-T sector

Figure 10 provides an overview of the RES-T share per MS in 2020[10]. The highest shares can be observed in Sweden, where the RES-T share stood at 31.9%, followed by Finland (13.4%) the Netherlands and Luxemburg (both 12.6%).

[10] The calculation of the RES-T shares follows the RED I methodology, including the multipliers as set in that Directive. This is in line with how SHARES/Eurostat currently calculates the RES-T shares.

Only 13 countries achieved the 10% renewable energy in transport target in 2020[11] as set in RED I article 3 (the 10% target is indicated by the yellow line). Among all MS, Greece (5.3%), Lithuania (5.5%), Poland and Hungary (both 6.6%) showed the lowest RES-T share in 2020.

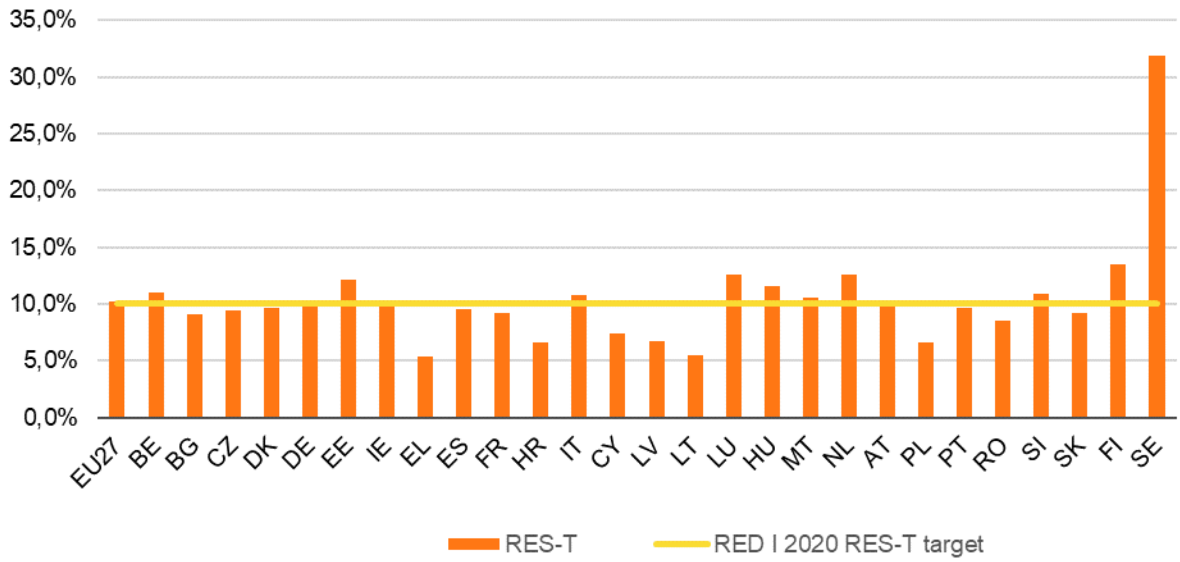


**Figure 10. Share of renewable energies in transport in the he EU-27 for 2011-2020. Source: Eurostat SHARES**

The development of biofuels and renewable electricity consumption in transport since 2011 is shown in Figure 11.

The consumption of biodiesel and bioethanol had stagnated between 2014 and 2016 and has been increasing ever since. Due to the high contribution of biodiesel and bioethanol to the RES-T sector, the development of these biofuels has led to a growth in biofuel consumption in total since 2016. The most widely used fuel over the full period was biodiesel, which is also the largest contributor to the RES-T target in 2020, with 13,164 ktoe. The amount of biodiesel has strongly increased after 2016. Biogasoline accounted for 2,661 ktoe. "Other biofuels", a category, which includes primary solid biofuels, biogas and other liquid biofuels, has been on a growth track again since 2011 and stood at 287 ktoe in 2020.

[11] With the entry into force of the RED II (EU 2018/2001), the 10% target share for RES-T in RED I article 3 was repealed.

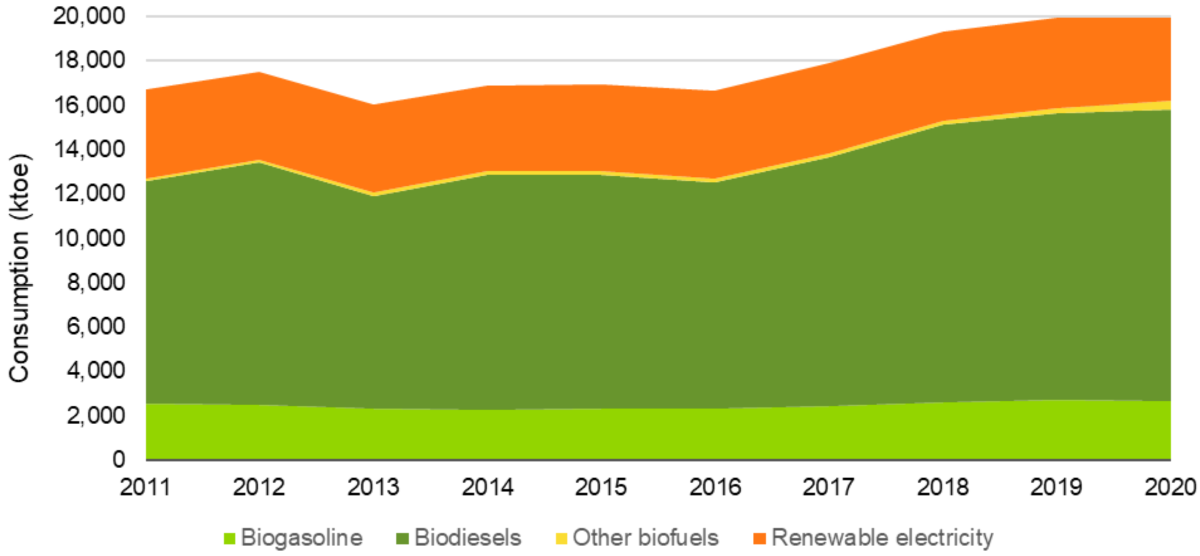


**Figure 11. Consumption of energy in transport (RES-T) in the EU-27 for 2011-2020. Source: Eurostat SHARES**

The use of renewable electricity for transport has significantly increased in the last 10 years. A particularly large increase can be seen in the road transport sector which moved from 10 ktoe in 2011 to 112 ktoe in 2020. The highest share of electricity from renewable energy sources can be accounted in the rail transport sector as shown in Figure 12.

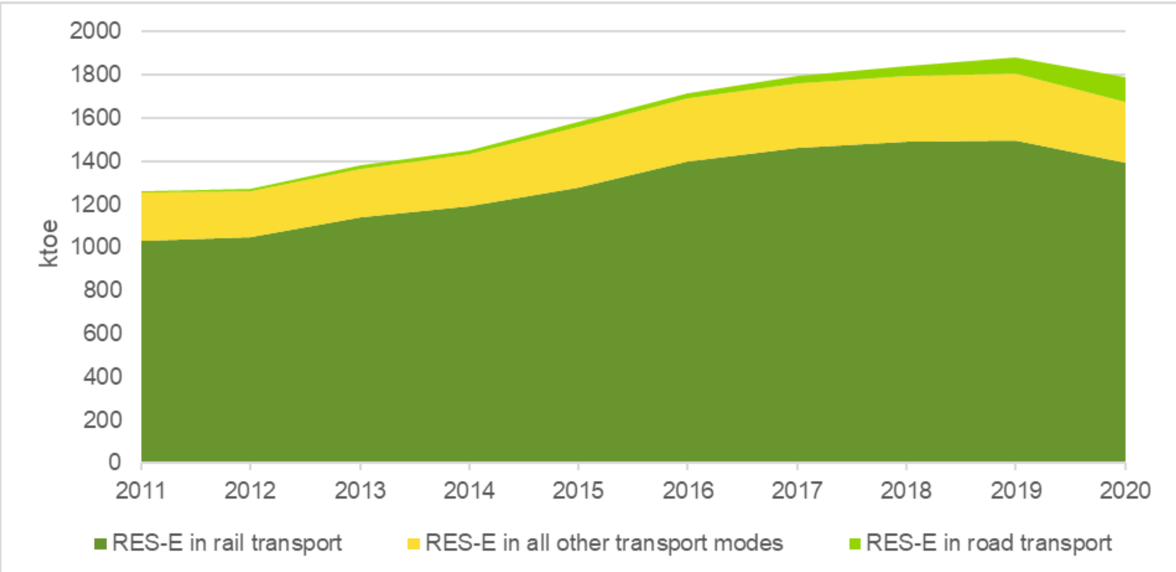


**Figure 12. Development of renewable electricity used in the transport sector. Source: Eurostat SHARES**

To explore the progress in the last 10 years per sector (RES-E, RES-T, and RES-H&C) and per RE technology in each MS, please see Appendix A.

## 2.3 Biofuels and bioliquids produced from cereal and other starch-rich crops, sugars and oil crops in energy consumption in transport

In this chapter we look into the category of food/feed crops in more detail. To be more specific these are biofuels and bioliquids produced from cereal and other starch-rich crops, sugars and oil crops consumed in transport. For 2020, the contribution of these types of feedstocks was capped at 7% and towards 2030 they are capped depending on their 2020 share.

To identify the amounts of food and feed crops consumed in the EU, Eurostat SHARES is used (the category of '3(4) first paragraph' compliant biofuels as consumed per MS). Figure 13 shows the historical consumption of food and feed crops in the EU as a whole since 2016. After an initial steady increase in consumption from 2016 onwards, a small decline followed from 2019 to 2020 (due to the introduction of the Directive (EU) 2015/1513 (ILUC Directive) which introduced a cap for biofuels based on food and feed crops).

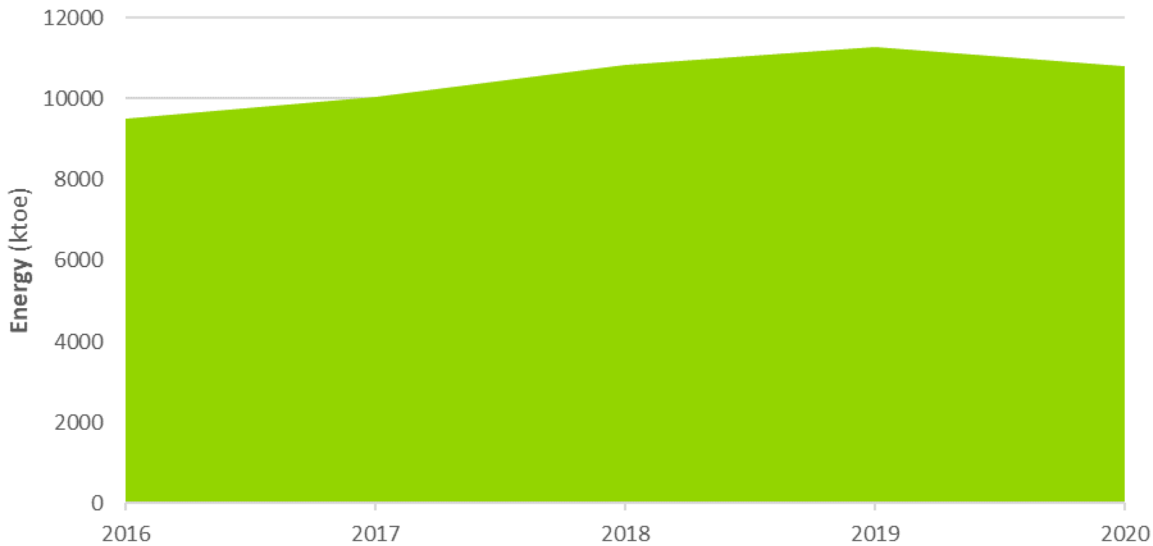


**Figure 13 Trend of food and feed crops in transport in the EU27**

Figure 14 demonstrates the historical consumption 2016-2020 for all MS, indicating that the trend actually differed per MS. Some (like France and Slovenia) followed the EU trend, with an initial increase followed by a reduced consumption of these crops in 2020. Others (like Belgium, Germany and Romania) did not see the reduction in 2020, but actually saw an increase over the total period of 2016-2020.

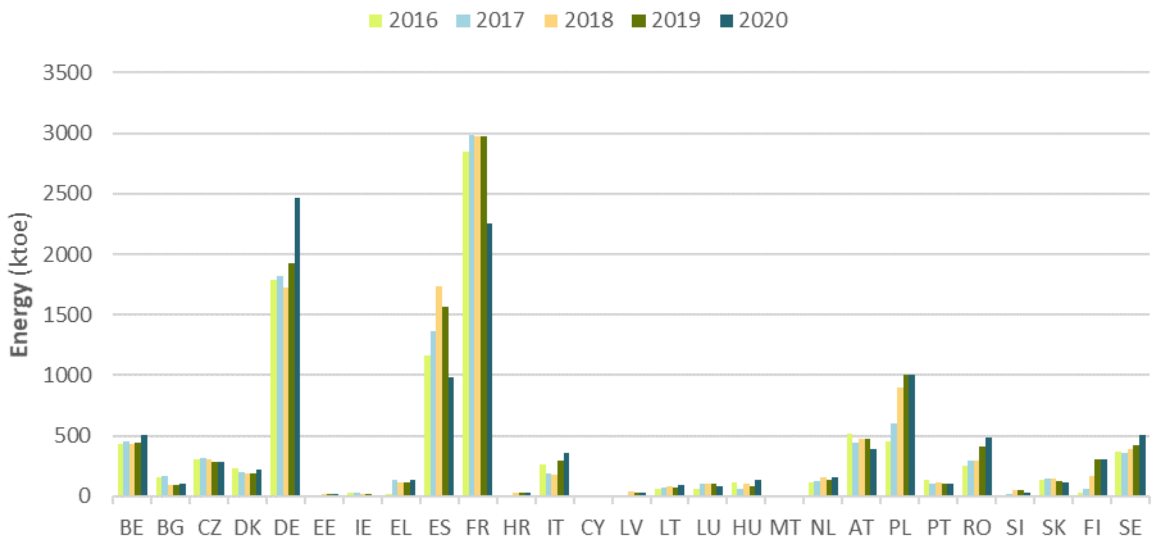


**Figure 14. Trend of food and feed crops in transport in the Member States**

More details per MS are provided in 0.

Figure 15 shows the share of food and feed crops in transport in 2019 and 2020.[12] Based on the 2020 share, the food and feed cap per MS can be deduced, namely one percent above the 2020 share (with a maximum of 7%).

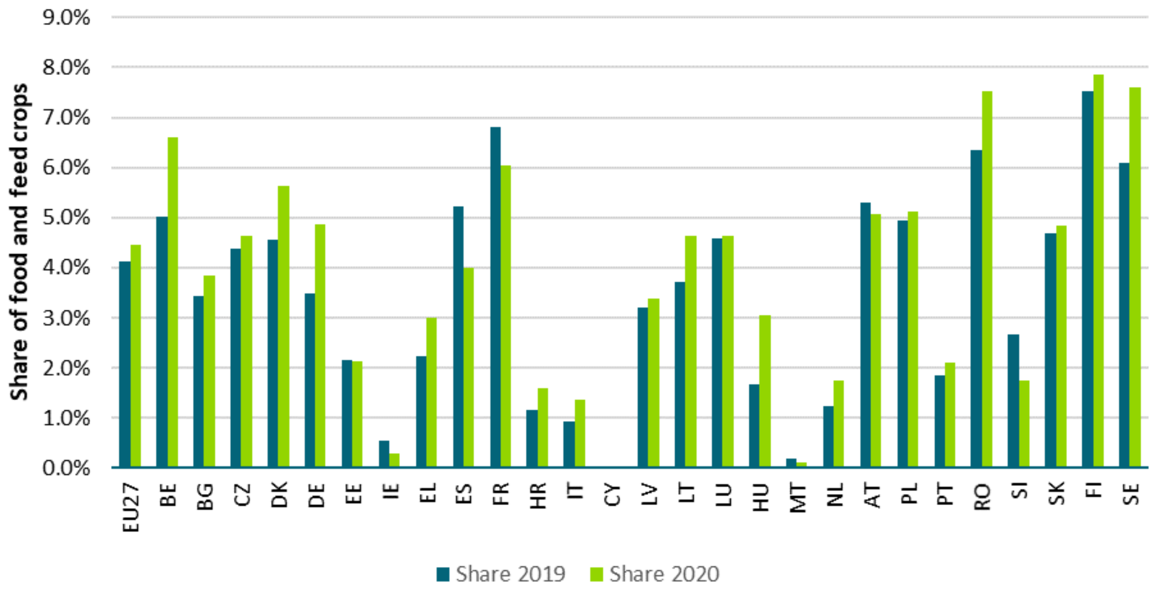


**Figure 15 Share of food and feed crops in transport in relation to total energy use in transport**

[12] The calculation of the shares follows the RED I methodology, including the multipliers as set in that Directive. This is in line with how SHARES/Eurostat currently calculates the RES-T shares.

## 2.4 Biofuels and biogas for transport produced from feedstock and other fuels listed in Part A Annex IX Directive 2009/28/EC[13]

In this section the consumption (in transport) of biofuels and biogas from Annex IX Part A feedstocks is analysed. These are typically identified as advanced biofuels for which a sub target is included as part of the renewables in the RED II transport target.

To analyse the amounts of Annex IX Part A feedstock consumed in the EU, Eurostat SHARES data is used. Figure 16 shows the historical consumption of Annex IX Part A feedstocks in the EU as a whole since 2016. After a small decline in 2017, a steady increase in consumption from 2017 onwards can be seen. In 2020, the types of Annex IX Part A feedstocks with the highest consumption in the EU were 'd) Biomass fraction of industrial waste not fit for use in the food or feed chain' and 'g) Palm oil mill effluent and empty palm fruit bunches'.

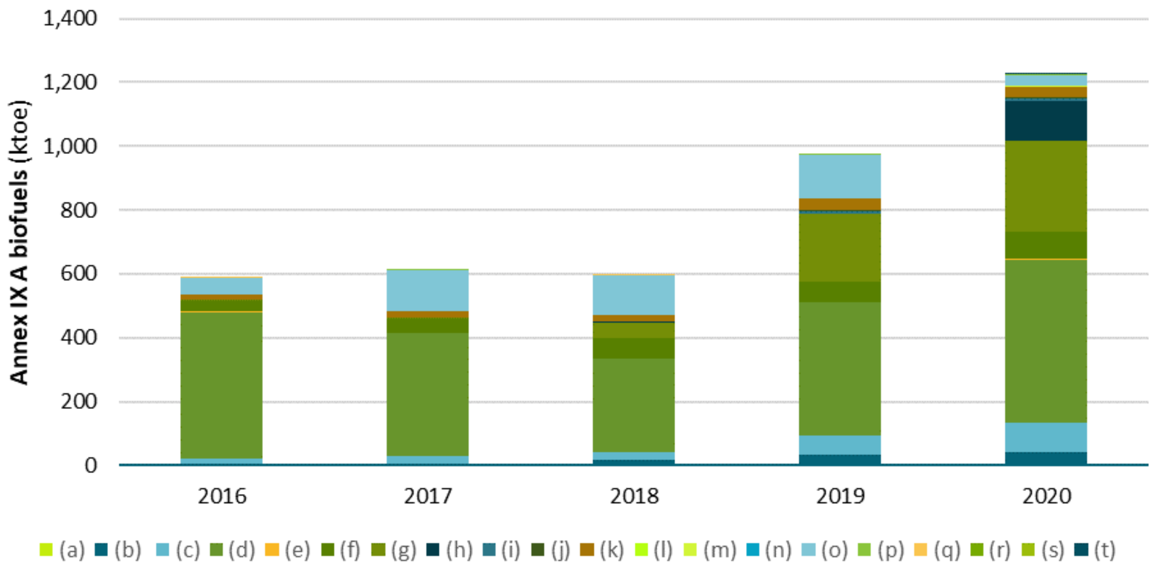


**Figure 16. EU27 share of Annex IX A biofuels and biogas in transport**

**Table 4. Annex IX part A feedstocks**

| Annex IX A | Feedstock description |
|---|---|
| (a) | Algae if cultivated on land in ponds or photobioreactors |
| (b) | Biomass fraction of mixed municipal waste, but not separated household waste subject to recycling targets under point (a) of Article 11(2) of Directive 2008/98/EC |
| (c) | Biowaste as defined in point (4) of Article 3 of Directive 2008/98/EC from private households subject to separate collection as defined in point (11) of Article 3 of that Directive |
| (d) | Biomass fraction of industrial waste not fit for use in the food or feed chain, including material from retail and wholesale and the agro-food and |

[13] Part A of Annex IX to Directive 2009/28/EC in the version in force on 31 December 2020.

| Annex IX A | Feedstock description |
|---|---|
| | fish and aquaculture industry, and excluding feedstocks listed in part B of this Annex |
| (e) | Straw |
| (f) | Animal manure and sewage sludge |
| (g) | Palm oil mill effluent and empty palm fruit bunches |
| (h) | Tall oil pitch |
| (i) | Crude glycerine |
| (j) | Bagasse |
| (k) | Grape marcs and wine lees |
| (l) | Nut shells |
| (m) | Husks |
| (n) | Cobs cleaned of kernels of corn |
| (o) | Biomass fraction of wastes and residues from forestry and forest-based industries, namely, bark, branches, pre- commercial thinnings, leaves, needles, tree tops, saw dust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil |
| (p) | Other non-food cellulosic material |
| (q) | Other ligno-cellulosic material except saw logs and veneer logs |

The MS with the largest absolute amounts of Annex IX Part A consumption were Italy and Sweden followed by Germany, the Netherlands and Finland.

Details per MS, including the split in feedstock types is provided in 0. Figure 15Figure 17 provides the share of the Annex IX Part A feedstocks as part of the total fuels consumed in transport.[14] For 2020 there was an indicative target of 0.5% in RED I[15], which was exactly met at the EU level as a whole. Not all MS reached a share of 0.5% of their total of fuels consumed in transport, but several MS far exceeded the 0.5% (such as Finland, Sweden and Estonia) pulling the total share at EU level up.

[14] The calculation of the shares follows the RED I methodology, including the multipliers as set in that Directive. This is in line with how SHARES/Eurostat currently calculates the RES-T shares.

[15] With the adoption of RED II, this target obligation was repealed.

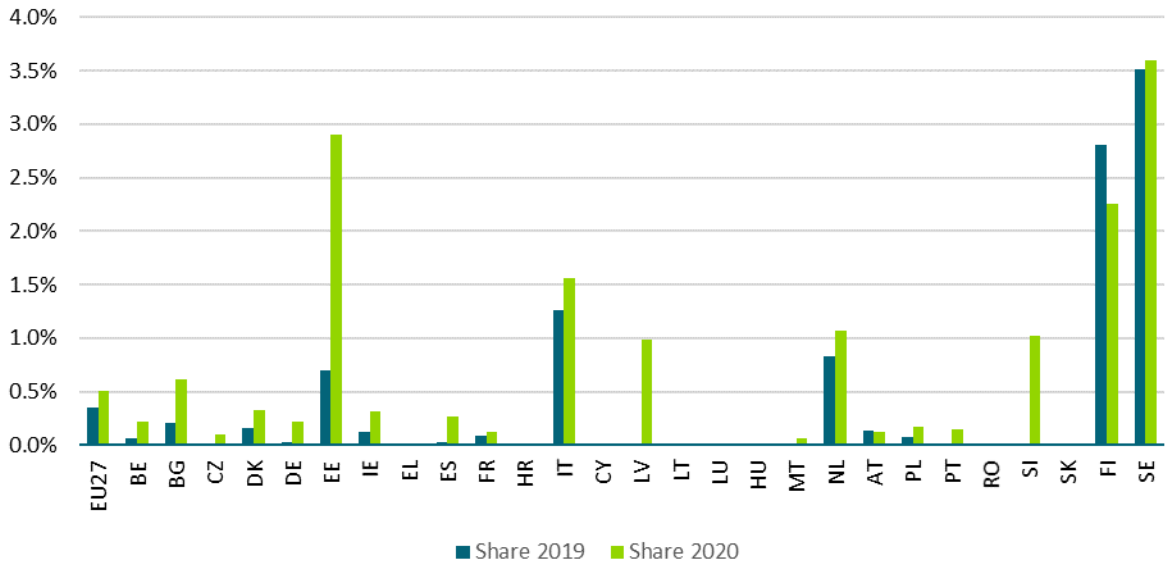


**Figure 17. Annex IX A biofuels share (2019 and 2020). Based on SHARES, Eurostat.**

# 3. Qualitative analysis of achieved RES shares and policy drivers in the EU and Member States

## 3.1 Achievement of overall targets for RES shares in 2020

Table 5 below shows the actual 2020 RES shares achieved compared to the 2020 binding targets of RES Directive. Column 2 lists the binding RES target per MS. In column 3, the table shows the achieved 2020 RES shares per MS as reported in SHARES. On the right, column 4 indicates whether a MS used statistical transfers (positive numbers when bought, negative numbers when sold). In addition, based on the deviation from the binding targets (last column), the table follows a three-colour coding:

Green: indicates that the achieved 2020 RES share is >1 percentage point above RES binding target of RES Directive

Yellow: indicates that the achieved 2020 RES share is between 0 and 1 percentage point above RES binding target of RES Directive

Red: indicates that the achieved 2020 RES share is below RES binding target of RES Directive

**Table 5. 2020 actual (Eurostat) RES shares compared to the 2020 binding targets of RES Directive**

| Member State | 2020 Binding RES target according to RES Directive [%] | Achieved 2020 RES share [%] using statistical transfers[16] | Use of statistical transfers (percentage points bought + or sold -) | Deviation from binding RES target in percentage points |
|---|---|---|---|---|
| Belgium | 13.0 | 13.0 | + 1 | 0 |
| Bulgaria | 16.0 | 23.3 | - | 7.3 |
| Czech Republic | 13.0 | 17.3 | - | 4.3 |
| Denmark | 30.0 | 31.7 | -9.9 | 1.7 |
| Germany[17] | 18.0 | 19.3 | - | 1.3 |
| Estonia | 25.0 | 30.1 | -8.3 | 5.1 |
| Ireland | 16.0 | 16.2 | +2.7 | 0.2 |
| Greece | 18.0 | 21.7 | - | 3.7 |
| Spain | 20.0 | 21.2 | - | 1.2 |
| France | 23.0 | 19.1 | - | -3.9 |
| Croatia | 20.0 | 31.0 | - | 11 |
| Italy | 17.0 | 20.4 | - | 3.4 |
| Cyprus | 13.0 | 16.9 | - | 3.9 |
| Latvia | 40.0 | 42.1 | - | 2.1 |
| Lithuania | 23.0 | 26.8 | -0.6 | 3.8 |

[16] Some data are preliminary for 2020 (e.g., some statistical transfers may not yet be concluded). We will review the MS progress reports and update them as necessary.

[17] Germany received statistical transfers from a joint cross-border solar PV auction with Denmark. The statistical transfer from the auction does not significantly influence the overall RES share.

| Member State | 2020 Binding RES target according to RES Directive [%] | Achieved 2020 RES share [%] using statistical transfers[16] | Use of statistical transfers (percentage points bought + or sold -) | Deviation from binding RES target in percentage points |
|---|---|---|---|---|
| Luxembourg | 11.0 | 11.7 | +1.6 | 0.7 |
| Hungary | 13.0 | 13.9 | - | 0.9 |
| Malta | 10.0 | 10.7 | +0.3 | 0.7 |
| Netherlands | 14.0 | 14.0 | +2.5 | 0 |
| Austria | 34.0 | 36.5 | - | 2.5 |
| Poland | 15.0 | 16.1 | - | 1.1 |
| Portugal | 31.0 | 34.0 | - | 3 |
| Romania | 24.0 | 24.5 | - | 0.5 |
| Slovenia | 25.0 | 25.0 | +0.9 | 0 |
| Slovakia | 14.0 | 17.3 | - | 3.3 |
| Finland | 38.0 | 43.8 | - | 5.8 |
| Sweden | 49.0 | 60.1 | -0.6 | 11.1 |
| EU-27 | 20.0 | 22.1 | - | 2.1 |

Figure 18 depicts the deviation of each MS from their binding 2020 RES target (in percentage points). A majority of 18 MS and the EU as a whole presented a share at least 1 percentage point higher than their RES binding target. Some cases showed a considerably positive deviation, such as Sweden (+11.1 pp), Croatia (+11 pp) and Bulgaria (+7.3 pp).

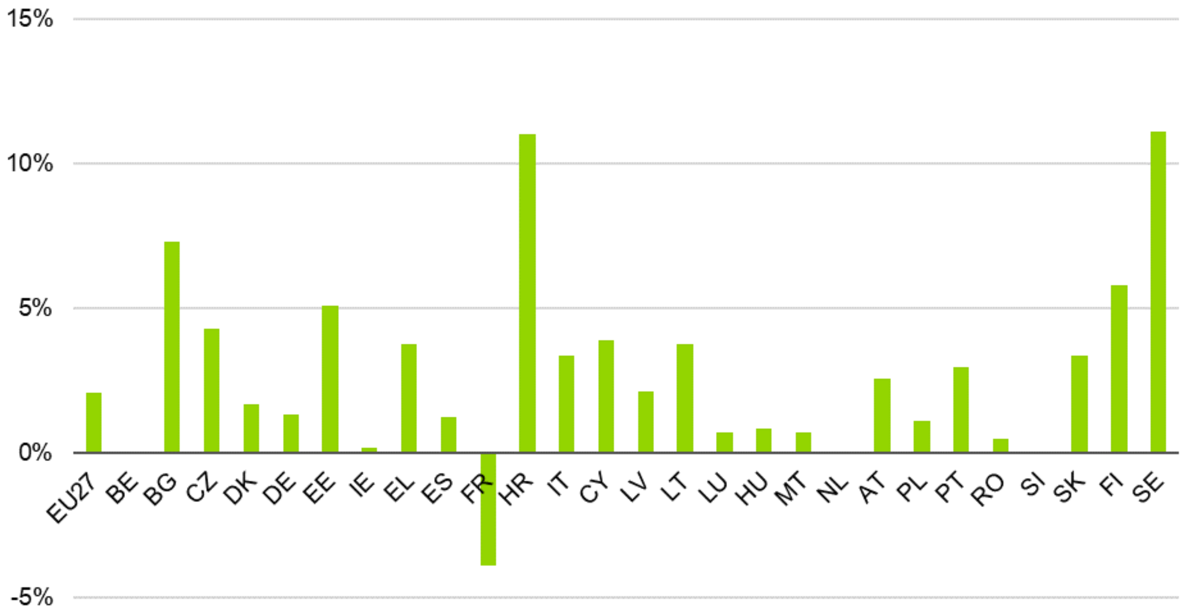


**Figure 18. Deviation from binding 2020 RES target in percentage points. Source: Eurostat SHARES**

Figure 19 shows actual RES shares by MS and compares them to the 2020 RES target according to the RES Directive. The comparison of the actual RES shares and the targets set in the RES Directive shows that, based on the current available data (September 2022), all countries except France reached their RES 2020 target. Multiple reasons contribute to explaining why France did not meet its 2020 target. The IEA[18] has reported on the following obstacles identified in France:

- Large delivery gap of needed wind and solar capacities mainly driven by:
  - Lack of administrative staff and lengthy permitting procedures
  - Retroactive revision of support mechanisms has been chaotic and implementation takes too long
  - Stop-go policies, such as the retroactive cuts on incentives for solar plants built between 2006-2010, are undermining investors' confidence and increasing risks and costs of future investment
  - Regarding offshore wind, France lags behind its neighbours in the implementation of an offshore strategy
- In the area of energy efficiency and renewables, the public support schemes remain complex, multiple and fragmented and do not yet support large-scale investment.

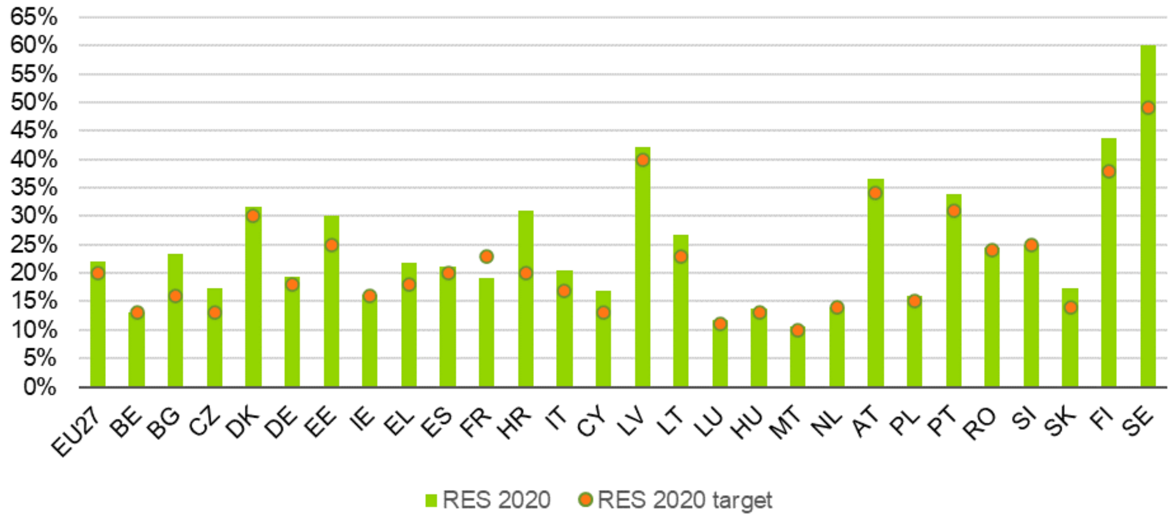


**Figure 19. Achieved 2020 RES share compared to 2020 RES target (Directive). Source: Eurostat SHARES; RES Directive.**

Figure 20 compares the overall RES shares with and without statistical transfers against the 2020 RES target for each MS. In Figure 18 the overall RES shares with and without statistical transfers are compared against the 2020 RES targets.

[18] https://www.iea.org/reports/france-2021

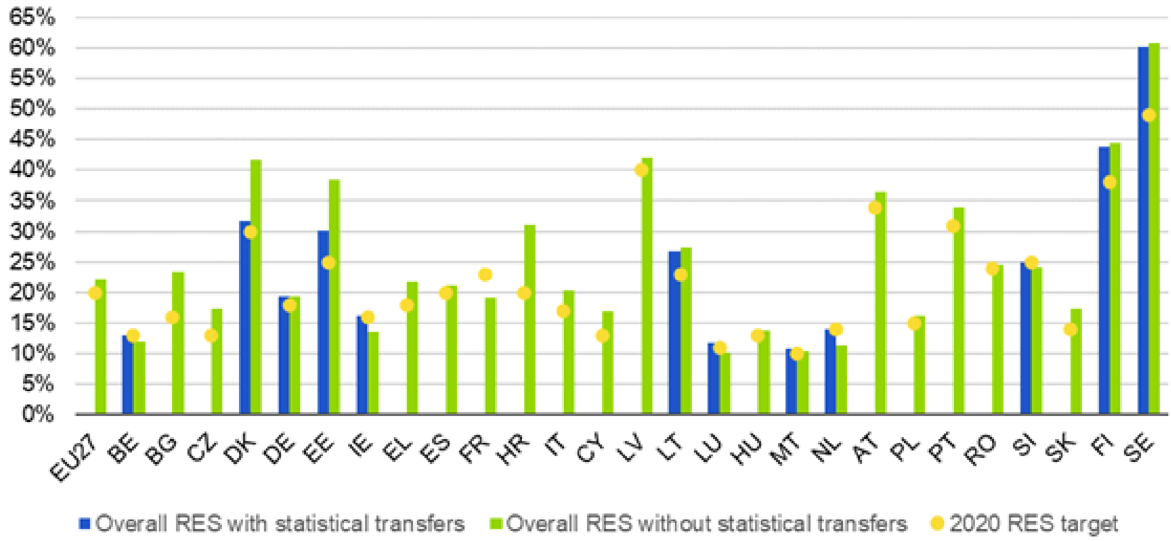


**Figure 20: Overall RES shares with and without statistical transfers vs. 2020 RES targets. Source Eurostat SHARES; RES Directive.**

In the early years of the considered period (2011-2020), some MS were already above their binding RES targets for 2020 and/or above their sectoral National Renewable Energy Action Plans (NREAP) trajectories for the years before 2020. This can be observed in many MS that overachieved their 2020 binding targets, such as Sweden, Croatia, Finland, among others.

The following MS have achieved their mandatory overall RES share before 2020: Bulgaria (as of 2013), Czechia (as of 2013), Estonia (as of 2011), Croatia (as of 2010), Italy (as of 2014), Lithuania (as of 2014), Finland (As of 2014), and Sweden (As of 2012).

The list of early-achievers MS closely relates with the previous analysis conducted for the project "Technical assistance in realisation of the 5th report on progress of renewable energy in the EU"[19]. In the former analysis, the actual RES shares per sector in 2018 were compared to the NREAP indicative sectoral trajectories for 2018. In the RES-E sector, Bulgaria, Denmark, Germany, Estonia, Croatia, Italy, Finland and Sweden were above their indicative NREAP target. In the H&C sector, all MS except Belgium, Ireland, France, the Netherlands, Poland and Slovakia, were above their NREAP indicative sectoral trajectories. For example, Croatia showed the highest positive deviation. The RES-T sector has seen slower progress than the RES-E and RES-H&C sectors. A total of 23 MS were below the envisioned shares of RES-T for 2018 of their NREAPs. The highest share, as well as the highest positive deviation was observed in Sweden.

## 3.2 Reasons and policy trends behind the observed results

The achieved 2020 RES shares are the result of a combination of drivers that developed over the years. To a large extent, the development and expansion of RES was driven by sectoral policies that aimed to support new RES projects, further market integration, and mitigation of barriers. Moreover, an important policy factor to consider is that six MS bought statistical transfers in 2020 to achieve their RES targets.

[19] European Commission, Directorate-General for Energy, Klessmann, C., Sach, T., Grigiene, M., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU final update report. Task 1 & 2, Publications Office of the European Union, 2021, https://data.europa.eu/doi/10.2833/559777

Besides, particular market developments contributed to further RES deployment, such as the reduction of technology costs over time, which in some cases translated into the development of purely market-based renewables through, for example, PPAs.

Other non-policy causes also had a considerable impact on the observed overall RES shares. Certain factors reduced total energy demand which, when coupled with a general increase in RES generation, led to higher overall RES shares in 2020. The COVID pandemic had a strong impact in the total energy demand in 2020, which experienced a general decrease in all 27 MS. Besides, energy efficiency policies and weather fluctuations also reduced total energy demand in certain time periods.

In the following subsections we present the main causes that contribute to explaining the observed results.

### 3.2.1 Policy trends

During the period considered (2011-2020), the 27 MS have implemented different policies to support the development of RES. In each of the three sectors (RES-E, RES-H&C, RES-T) we have identified high-level policy trends as described below. We present a more detailed overview of support schemes in section 3.4.1 and of best practice examples in section 3.5.1.

In the **RES-E sector**, one of the policy trends that occurred in almost all MS was the transition from administratively set FIT towards the allocation of FIP to enable a better RES integration into the power markets. Besides, another policy trend was the shift from support levels defined centrally by the administration to auction-based determination of support levels. Many MS had already implemented auctions to allocate support schemes in the early years (2011-2016), such as France, the Netherlands, or Italy. Other MS adopted auctions later on (2017-2020) including Slovenia, Greece, Luxembourg, Hungary, Croatia, Malta, among others. By 2020, 19 MS have implemented auctions for RES-E support and 4 MS were considering transitioning to auctions.

The general shift towards auctions has multiple reasons. Well-designed auctions have been an attractive policy for governments as they can increase competition among RES developers and thus lower the total support costs. In turn, auctions allow for a better control of the total budget spent or the volume deployed by the MS. In addition, the shift from FIT to FIP as well as the adoption of auctions have gained traction through the EC's Guidelines on state aid for environmental protection and energy (2014/C 200/01) adopted in 2014, stating that MS should use auctions to determine support levels (with some exceptions). For greater details in auctions schemes in MS, please refer to sections 3.4.1 and 3.5.1.

In many cases, auctions have contributed to lowering the support levels and encouraging further RES deployment, which in turn can be associated with higher RES shares. The decrease in support level has been largely driven by the mentioned increased competitive pressure. However, other macro-variables, such as falling technology costs and low interest rates (financing costs) in the period considered also explain the observed support costs decrease (more details in section 3.2.3).

When MS decide to transition to auction-based support, a slow-down in RES-E deployment could be experienced in some cases. The deployment gap can occur for two reasons[20].

[20] European Commission, Directorate-General for Energy, Klessmann, C., Sach, T., Grigiene, M., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU final update report. Task 1 & 2, Publications Office of the European Union, 2021, https://data.europa.eu/doi/10.2833/559777

On the one side, there is generally a time lag between the auction and the actual RES capacity deployment because awarded bidders need time to realise the project and connect it to the grid. Depending on the technology, the time span can range between 2-3 years, for example, the realisation period for wind offshore in Poland was 72 months, and the realisation period for solar PV in Germany was 18 months. Also, some MS do not publish an auction schedule that provides a clear outlook on auction volumes and thus deployment levels in the coming years. Therefore, no incentives or signals are sent so that the value chain around RES development is prepared for future auctions.

On the other side, in few cases, the transition phase itself – the time between phasing out the old support scheme and implementing the new scheme – can take time to be fully prepared and implemented. For instance, Croatia is one of the Member States in which RES-E support has been on hold for a longer time due to the policy switch. While a new support scheme was introduced in 2016 the support scheme was not immediately operational as most of the by-laws necessary to enforce the support scheme were adopted only several years after its adoption[21].

Although the general trend has shown that auctions reduced the overall support costs, in some cases the interaction of variables such as competition levels, auction design, technology costs, financing costs, etc, led to increasing support levels. In Germany, for example, while the 2017 onshore wind price decrease was mainly due to strong competition in the first year of the auctions, the price increase in 2018 was caused by a lack of competition resulting from missing bid volume[22].

The observed transition from FIT to FIP has also impacted the cost distribution of integrating RES to the system. Previously, under FIT schemes, the responsibility and associated costs for the integration of RES into the system relied mainly on the grid operators. With the widespread adoption of FIP schemes, the responsibility and costs are being transferred to the RES operators. This shift does not directly affect the level of RES deployment but is still an important trend to consider as it reduces system integration costs and enables systems based on larger variable RES shares.

An identified policy trend, as further described in section 3.4.1.1, is that MS have been increasingly providing support to small-scale RES-E systems, such as financial support for rooftop solar PV equipment, net-metering, or introduction of regulation for individual and collective self-consumption as well as for energy communities. Small-scale RES equipment, either in the RES-E or RES-H&C sectors, can be deployed and connected to the grid faster than large projects (e.g. ground-mounted PV that won an auction) and thus these policies can have a more immediate effect on the observed RES shares.

Besides FIP and auctions, other support schemes in the RES-E sector have been implemented in the MS, such as quota schemes, tax incentives, net-metering, investment grants and loans as detailed in section 3.4.1.

[21] Ibid.

[22] There were multiple reasons for the missing bids. A major factor was that the announced change of the support mechanism towards auctions led to a peak in wind capacity additions at the end of the old administrative support scheme (5.5 GW in 2017 alone). Additionally, the onshore wind development in Germany faced challenges due to acceptance issues, delays in the land-use planning, emerging minimum distance rules on state level and lawsuits against wind projects. Source: European Commission, Directorate-General for Energy, Horváth, G., Schöniger, F., Zubel, K., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU : task 1-2 : final report, Publications Office, 2020, https://data.europa.eu/doi/10.2833/325152. More information on the topic can, e.g., be found in the AURES II report on Auctions for the support of renewable energy in Germany, available from: http://aures2project.eu/wp-content/uploads/2020/04/AURES_II_case_study_Germany_v3.pdf.

An important element to consider is that during the period under analysis, some MS experienced interruptions in their RES-E support schemes (e.g. Ireland, Greece, Croatia, Hungary and Latvia)[23]. In the early years, some other MS interrupted their RES-E support schemes due to high costs (e.g. Spain and Czechia). Due to a lack of transparency in implementation and high costs for the consumer, Latvia's RES-E support scheme was suspended since 2011 and closed for new plants until 1 January 2020. Hungary introduced a new support scheme in early 2017, however, no tenders for larger installations took place until November 2019. Ireland granted a FIT support until December 2015 and there was no support scheme available from January 2016 to June 2018 when an investment subsidy scheme was launched ("solar PV pilot scheme"). In 2017, Ireland proposed the Renewable Electricity Support Scheme (RESS) and it only got the approval from the EU Commission in July 2020. Greece also faced challenges regarding its new support scheme and had to postpone tendering rounds that were planned for 2018. On the other hand, the support in other MS (e.g. Spain, Portugal and Slovenia) was re-established after legislative changes took place.

In the **RES-H&C** sector, most policies have focused on providing investment support (e.g. investment grants) rather than operational support as in the RES-E sector. In 2020, 22 MS provided investment support in the form of subsidies, while 12 MS used loans to support the deployment of RES-H&C technologies. The support instruments usually apply to a broad range of technologies. The most popular technology were biomass heating systems. In addition, commonly supported technologies were geothermal, aerothermal and hydrothermal heat pumps as well as solar thermal plants.

By providing direct financial support, beneficiaries of the programmes, such as households, are able to add RES installed capacity for heating and cooling generation. More details can be found in section 3.4.1.

The main policy trend in the **RES-T** sector has been the implementation of a biofuel quota obligation. By 2020, some form of obligation scheme has been the main RES-T policy measure in all MS. The only two MS that did not use a quota as main support scheme for RES-T until 2018 were Sweden and Estonia. While Sweden relied on tax incentives (more details can be found in section 3.5.1.2), Estonia's main instruments in the past were subsidies for biomethane consumption and infrastructure. In addition to its tax incentives, Sweden introduced a biofuel quota in April 2018. Estonia followed in May 2018, but also kept its subsidies in place.

Most of the biofuel quota schemes targeted a 10% share by 2020, and the required shares of biofuels were increasing year by year. Germany and Sweden did not impose an increasing share of biofuel content, but demand increasing GHG emissions reductions by fuel suppliers, which has a similar effect in the end. Several MS have adjusted their quota schemes after the implementation of the ILUC Directive in 2015 which had to be transposed by September 2017. This Directive introduced a cap on conventional[24] biofuels and a sub-target for advanced biofuels.

A more recent trend in the RES-T sector is the up-take of electric vehicles (EV) through fiscal support. These support schemes usually consist of tax exemptions, direct subsidies or bonuses for purchasing EV, or support the construction of charging points for EV. However, the impact of EV on actual RES-T share was not significant yet.

[23] Ibid.

[24] Biofuels produced from cereal and other starch-rich crops, sugars and oil crops and from crops grown as main crops primarily for energy purposes on agricultural land.

### 3.2.2 Statistical transfers

In the previous project "Technical assistance in realisation of the 5th report on progress of renewable energy in the EU"[25] our assessment pointed out that the EU would succeed in meeting its binding 2020 RES target with an estimated share of 22.4% to 22.6%. For six MS (Belgium, Ireland, France, Luxembourg, the Netherlands and Poland) the implemented RES policies appeared insufficient to trigger the required RES volumes to reach their binding 2020 targets purely domestically, despite the strong decline in energy consumption that the pandemic caused in 2020.

Thus, the assessment concluded that initiating RES cooperation with other MS and/or third countries represented a viable option for them to meet their binding RED 2020 RES targets, assuming that domestic RES potentials were insufficient, comparatively costly or hardly to be mobilised in time. The use of statistical transfers between MS as a cooperation mechanism has a direct impact in the overall RES share as soon as the transfer is agreed and formalised.

As can be observed in Table 5, five of the six MS that were at risk of not reaching their target were able to successfully achieve them. The use of statistical transfers played a key role in Belgium, Ireland, Luxembourg, and the Netherlands. These MS also saw some progress in the expansion of certain RES technologies in the electricity, heating and cooling, and transport sectors as described below. For further details on the policies behind RES expansion, please refer to sections 3.2.5 and 3.4.

In the case of **Luxembourg**, the statistical transfers played an important role but the RES shares in the three sectors also experienced an expansion. From 2019 to 2020, Luxembourg increased its RES overall share from 7.0% to 11.7%. Of that increase, 1.6 pp were attributed to statistical transfers, i.e. Luxembourg saw a domestically increase of 3.1 pp. The three sectors also increased from 2019 to 2020. The RES-E share moved from 10.9% to 13.9%, with an increase in generation from biomass from 160 to 266 GWh. In the RES-H&C, the share increased to 12.6% from 8.7%, where generation from solid biomass experienced an increase from 83 to 124 ktoe from 2019 to 2020. Last, the RES-T sector share increased from 7.7% to 12.6% and generation from biodiesels moved from 113 to 129 ktoe (2019 to 2020).

The **Netherlands** also reached its target of 14.0% RES overall using statistical transfers. In 2019 the RES overall share reached 8.9% and moved to 14.0% in 2020, of which 2.5 pp corresponded to statistical transfers and 2.6 pp to domestic resources. In the previous assessment[26], the RES-E sector was lagging behind, but it experienced a considerable increase from 18.2% in 2019 to 26.4% in 2020. The generation and installed capacities of solar PV, wind onshore, and wind offshore showed an expansion in the last two years. On the generation side, solar PV produced 5401 GWh in 2019 and 8765 GWh in 2020, whereas wind onshore generated 7935 GWh in 2019 and 9856 GWh in 2020. Wind offshore moved from 3573 GWh to 5484 GWh. The installed capacities of these technologies also saw a surge from 2019 to 2020: solar PV moved from 7226 MW to 10950 MW, wind onshore from 3527 MW to 4159 MW, and wind offshore from 957 MW to 2460 MW.

[25] European Commission, Directorate-General for Energy, Klessmann, C., Sach, T., Grigiene, M., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU final update report. Task 1 & 2, Publications Office of the European Union, 2021, https://data.europa.eu/doi/10.2833/559777
[26] Ibid.

**Belgium** achieved its 13% RES overall target. In 2019, its RES overall share was 9.9%, meaning that from 2019 to 2020 it saw and increase of 3.1 pp, of which 1 pp was from statistical transfers and 2.1 pp domestic increase. Belgium experienced an expansion of wind offshore and solar PV from 2019 to 2020. Wind offshore installed capacity moved from 1556 MW to 2262 MW, which translated into an increased generation from 4794 GWh to 6974 GWh. Solar PV installed capacity increased from 4637 MW to 5575 MW and its generation expanded from 4254 GWh to 5105 GWh. In the transport sector, the RES share moved from 6.8% in 2019 to 11% in 2020. Biodiesel saw an expansion from 356 ktoe to 572 ktoe.

The use of statistical transfers was an important measure for **Ireland** to achieve its RES overall target of 16% (it achieved 16.2%). From 12% RES overall share in 2019, it increased to 16.2% in 2020, of which 2.7 pp were due to statistical transfers. The RES-E sector shares increased from 36.5% in 2019 to 39.1% in 2020. Biomass generation moved from 346 GWh to 433 GWh in 2020, whereas the installed capacity of solar PV increased from 58 MW in 2019 to 93 MW in 2020. Solar PV generation also increased from 40 GWh to 64 GWh in 2020. The RES-T sector also showed progress from 8.9% in 2019 to 10.2% in 2020. Ireland has implemented a successful biofuel quota obligation in its transport sector.

In the abovementioned previous project, when assessing possible 2020 scenarios, **Poland** was not on track to meet its 2020 target because it was lagging in the RES-E and RES-T sectors. However, Poland achieved its target and did not need to buy statistical transfers. The main driver was that the statistical method for the calculation of RES shares was changed to better account for the use of solid biomass in the heating sector. In particular, the Polish Central Statistical Office introduced a change in the manner it calculates the use of timber in household boilers, fireplaces ad kitchens[27]. It was reported that the solid biomass consumption numbers have been underestimated in the last years and thus the review was made[28]. The data and overall RES shares for the last three years (2018-2020) was corrected. This largely explains the jump in solid biomass heating consumption from 2017 to 2018, which saw an increase from 5222 ktoe to 8316 ktoe.

The only MS that did not achieve its 2020 RES target is **France**. By 2020 the RES overall share reached 19.1% over the target of 23% (-3.9 pp). The Eurostat SHARES data shows that from 2019 to 2020, France experienced an increase in the RES shares overall, as well as in the electricity and in the heating and cooling sectors. The RES share overall moved from 17.2% in 2019 to 19.1% in 2020. In the RES-E sector, the RES share increased from 22.4% to 24.8%, whereas in the heating and cooling sector, the RES shares moved from 22.4% to 23.4% (2019 to 2020, respectively). The RES share in the transport sector remained at 9.2% in both years. Despite the observed increased shares in 2020 compared to 2019 (and to previous years), it was not sufficient to achieve the RES share of 23%. At the time of writing this report, France did not report the use of statistical transfers.

In addition to the analysed MS, **Slovenia** and **Malta** also bought statistical transfers as presented in Table 5. The use of statistical transfers was key for Slovenia to meet its 25% RES share in 2020. Slovenia's overall RES shares in 2019 was 22% and it increased to 25% in 2020, of which 0.87 pp corresponds to statistical transfers and 2.13 pp to domestic growth. The RES-E sector saw an increase from 32.6% in 2019 to 35.1% in 2020.

27 https://wysokienapiecie.pl/en/70450-poland-has-reached-res-objective-for-2020-thanks-to-the-statistics-improvement/

28 Ibid.

It is largely explained by the increase in solar PV installed capacity, which increased from 278 MW to 370 MW, and the associated solar PV generation, which in turn moved from 303 GWh to 368 GWh in 2020.

Malta's mandatory RES target was 10% and it overachieved it with 10.7%. Without statistical transfers, it achieved a total of 10.4% RES shares, meaning that the 0.3 pp of statistical transfers bought would not have been strictly necessary to achieve its target. Besides the statistical transfers, Malta saw an increase in its RES-E sector from 7.5% in 2019 to 9.5% in 2020. The installed capacity of solar PV increased from 155 MW to 188 MW, and its generation moved from 195 GWh in 2019 to 237 GWh in 2020.

### 3.2.3 Market developments

Besides the described policy trends, other market developments have taken place in the period under analysis and provide more rationales behind the observed RES increase.

On the one side, the average costs for newly installed Solar PV, onshore and offshore wind projects have fallen in the last ten years and continued to decrease despite the impact of the COVID-19 pandemic.

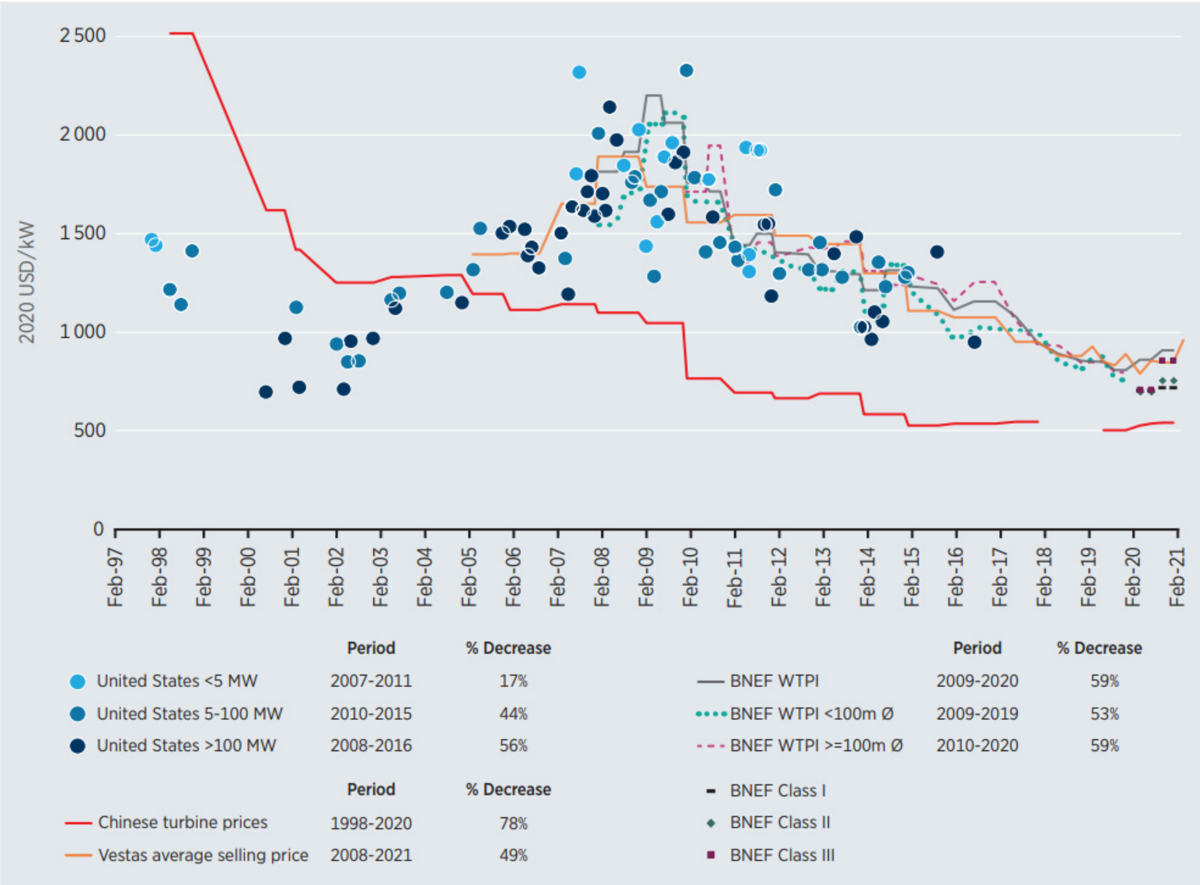


**Figure 21. Wind turbine price indices and price trends, 1997-2021. Source: IRENA (2020)[29]**

[29] International Renewable Energy Agency (IRENA). Renewable Power Generation Cost in 2020, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Jun/IRENA_Power_Generation_Costs_2020.pdf

Due to economies of scale, larger competition, and the maturation of the industry, overall installation, operation, and maintenance (O&M) costs and Levelized Costs of Electricity (LCOE) in the onshore wind sector have decreased in the last decade. The weighted average total cost of onshore wind projects in Europe decreased by 38% between 2010 and 2020, from $2429/kW to $1515/kW. Wind turbines account for the highest proportion of total installation costs, between 64% and 84% of total costs. While international wind turbine prices peaked between 2007 and 2010, they declined by 44% to 78% by the end of 2020 and are between $700/kW and $910/kW in 2020, with the exception of Chinese turbines, which are around $500/kW. In addition to these developments, onshore wind turbine technology has significantly advanced in the past years. Increased hub-heights, greater rotor diameters, and larger, more reliable turbines have all contributed to increased capacity factors.[30]

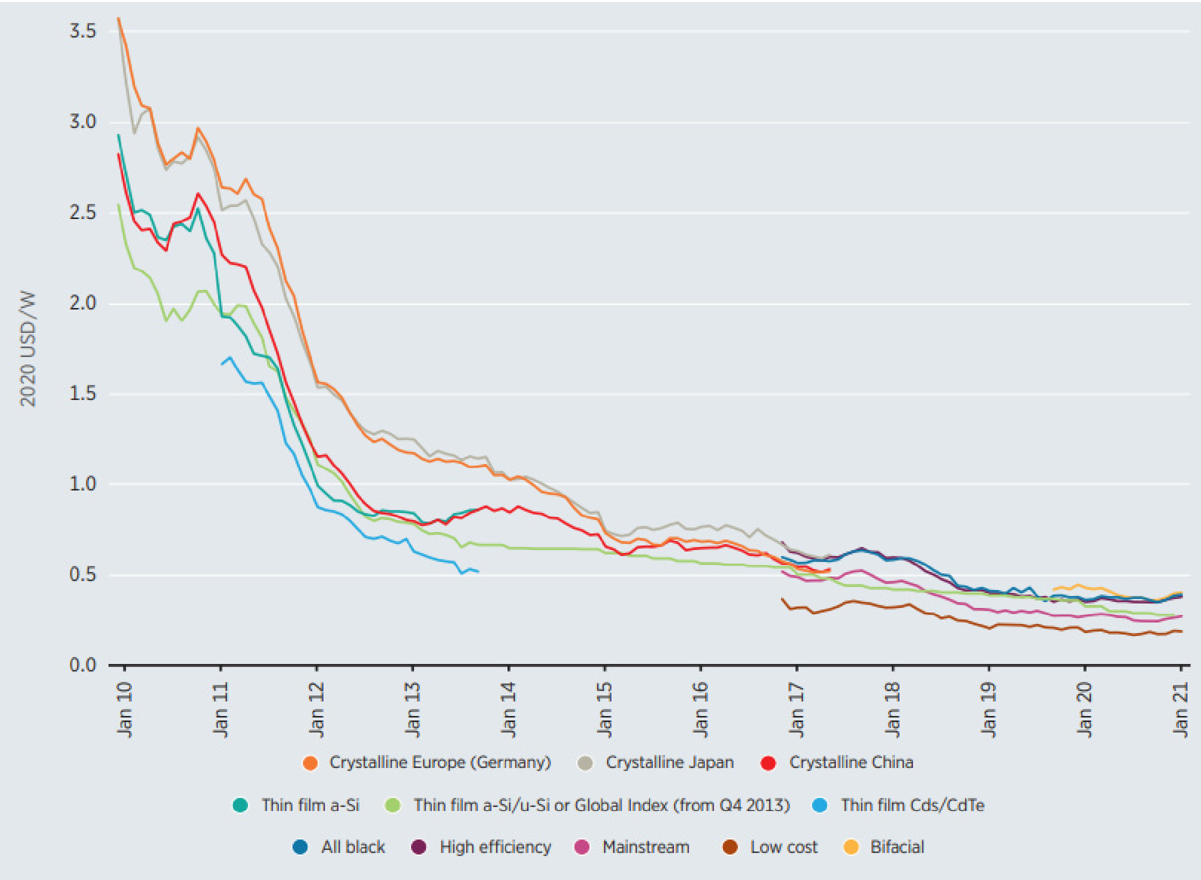


**Figure 22. Average monthly solar PV module prices by technology and manufacturing country sold in Europe. IRENA (2020)[31]**

Significant cost reductions can also be observed in the Solar PV sector. Between December 2009 and December 2020, the cost of crystalline silicon modules sold in Europe fell by around 93% depending on the type of Solar PV module. At the same time, production has continuously been expanded and optimized, and the efficiency of the modules has been increased, e.g. the efficiency of crystalline modules increased from 14.7% in 2010 to 20% in 2020.[32]

30 Ibid.

31 Ibid.

32 Ibid.

On the other side, the cost reduction, learning curves and maturity of technology and business cases have allowed for some RES projects to operate on a purely market-based approach, for instance through PPAs. According to the 2019 Wind Energy Barometer (EuroObservER)[33], in the EU a total of 4.7 GW of wind energy will be covered by PPAs, 1.5 GW of which was installed in 2018 and 1.3 GW in 2017. In addition, article 15.8 of RED II states that MS shall assess the regulatory and administrative barriers to long-term renewables PPAs, and shall remove unjustified barriers to, and facilitate the uptake of, such agreements.

However, the market-based expansion of renewables could only take place if the expected market returns to investors is higher than their investment and operating costs, which is not the case for all MS[34].

### 3.2.4 COVID Pandemic and other energy consumption reduction factors

The year 2020 was marked by the **COVID-19 outbreak** that rapidly turned into a pandemic. The first response of governments was strict lockdowns, which had a direct impact on the energy sector, since the energy consumption of large consumption centres such as industries or the service sector decreased to historic levels and people were confined to their homes.

On the **demand side**, the impact was drastic. As reported by IEA, "in June and July 2020 the electricity demands, weather corrected, stayed 10% and 15% respectively below the 2019 level of the same month"[35]. Demand reached 2019 levels by October but saw a new drop in November 2020 with new measures to contain the spread of the virus. By the end of 2020 electricity demand ended above 2019 levels after weather adjustment[36].

As Table 6 shows, all MS (and the EU as a whole) reduced the total gross final consumption of energy in 2020 compared to 2019. The significant drop in energy consumption can be explained largely by the impacts of the COVID pandemic. However, other factors, such as weather fluctuations and implementation of energy efficiency policies may also have lowered the total gross final consumption in a given year.

**Table 6. Total gross final consumption of Energy (2019-2020). Source: Eurostat SHARES**

| MS | Total gross final consumption of energy (ktoe) in 2019 | Total gross final consumption of energy (ktoe) in 2020 | % Change |
|---|---|---|---|
| EU-27[37] | 1017415.1 | 935894.2 | -8.01 |
| Belgium | 36321.00 | 33776.00 | -7.01% |
| Bulgaria | 10775.00 | 10423.00 | -3.27% |

33 https://www.eurobserv-er.org/wind-energy-barometer-2019/

34 Bartek-Lesi, M.; Diallo, A.; Szabó, L.; Mezósi, A.; Geipel, J.; Resch, G. Auctions in a zero-subsidy environment. REKK & TU Wien. http://aures2project.eu/wp-content/uploads/2022/03/AURES_II_ES_zero_support_auctions.pdf

35 International Energy Agency (IEA). Covid-19 impact on electricity. https://www.iea.org/reports/covid-19-impact-on-electricity

36 Ibid.

37 The dataset used is "SHARES summary results 2020", retrieved from https://ec.europa.eu/eurostat/web/energy/data/shares

| MS | Total gross final consumption of energy (ktoe) in 2019 | Total gross final consumption of energy (ktoe) in 2020 | % Change |
|---|---|---|---|
| Czechia | 26872.00 | 26050.00 | -3.06% |
| Denmark | 15276.00 | 14297.00 | -6.41% |
| Germany | 222316.00 | 207374.00 | -6.72% |
| Estonia | 3173.00 | 3016.00 | -4.95% |
| Ireland | 12296.00 | 11461.00 | -6.79% |
| Greece | 16160.20 | 15659.60 | -3.10% |
| Spain | 88413.00 | 77561.00 | -12.27% |
| France | 153927.30 | 138692.30 | -9.90% |
| Croatia | 7174.60 | 6739.70 | -6.06% |
| Italy | 120329.80 | 107572.40 | -10.60% |
| Cyprus | 1728.70 | 1622.60 | -6.14% |
| Latvia | 4264.40 | 4006.30 | -6.05% |
| Lithuania | 5788.80 | 5543.70 | -4.23% |
| Luxembourg | 4109.50 | 3545.10 | -13.73% |
| Hungary | 19144.40 | 18535.80 | -3.18% |
| Malta | 592.70 | 539.30 | -9.01% |
| Netherlands | 49622.70 | 46436.00 | -6.42% |
| Austria | 1227710.10 | 1133481.60 | -7.68% |
| Poland | 76625.80 | 74068.90 | -3.34% |
| Portugal | 17809.80 | 16099.90 | -9.60% |
| Romania | 25117.00 | 24760.70 | -1.42% |
| Slovenia | 5088.80 | 4640.50 | -8.81% |
| Slovakia | 11534.30 | 10795.80 | -6.40% |
| Finland | 26589,70 | 24509,70 | -7.82% |

| MS | Total gross final consumption of energy (ktoe) in 2019 | Total gross final consumption of energy (ktoe) in 2020 | % Change |
|---|---|---|---|
| Sweden | 34885,10 | 34034,60 | -2.44% |

On the **supply side**, in general terms, RES generation was less affected than other energy production. Power plants operating on solar, wind and hydropower could run their operations without major disruptions since their ability to generate electricity depends on weather and not on demand. Similarly, electricity production from dispatchable RES like biomass appeared also to be hardly affected since their operation is largely driven by RES support (which in general was not affected by the COVID-19 pandemic). For biofuels in transport or biomass used for heating purposes, however, the crisis associated with lower demand had certain impacts[38].

A combination of factors such as the unprecedented lower demand with the associated price drop, RES priority of dispatch, and the fact that RES generation was not largely impacted by lockdowns, translated into a shift towards RES generation in the power mix, as reported by IEA[39]. In turn, the historic lower demand can also translate into a higher RES *share* in the MS in 2020, even if the actual installed capacity and generation of RES stays equal to pre-pandemic levels.

In the EU Commission report of the progress made by MS towards the national energy efficiency targets for 2020, it was concluded that "Given the limited time to implement new policies, it seems increasingly unlikely that the 2020 targets could be reached without a strong impact of external factors, such as the COVID-19 crisis. However, it is still important that efforts are quickly stepped up, as any remaining delivery gap to the 2020 targets, or a rebound of energy demand after the COVID-19 crisis would also make reaching the 2030 targets more challenging"[40].

### 3.2.5 A closer look at countries with significant RES progress from 2019 to 2020

From 2019 to 2020, some MS considerably increased the gross final consumption of overall RES (excluding statistical transfers). The increase could signal that as a result of policies or market developments, new capacity was added and/or more generation took place. The top ten MS are presented in Table 7 and examined in the subsequent paragraphs.

[38] European Commission, Directorate-General for Energy, Klessmann, C., Sach, T., Grigiene, M., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU final update report. Task 1 & 2, Publications Office of the European Union, 2021, https://data.europa.eu/doi/10.2833/559777

[39] https://www.iea.org/reports/covid-19-impact-on-electricity

[40] Report from the Commission to the European Parliament and the Council. 2019 assessment of the progress made by Member States towards the national energy efficiency targets for 2020 and towards the implementation of the Energy Efficiency Directive as required by Article 24(3) of the Energy Efficiency Directive 2012/27/EU.

**Table 7. Member states with highest percentage increase in gross final consumption of RES in all sectors (excl. statistical transfers), from 2019 to 2020**

| Country | Gross final consumption of RES in all sectors in 2019 (excl. statistical transfers) (ktoe) | Gross final consumption of RES in all sectors in 2020 (excl. statistical transfers) (ktoe) | Percentage increase in gross final consumption of RES in all sectors (excl. statistical transfers), from 2019 to 2020 |
|---|---|---|---|
| Luxembourg | 289,60 | 358,80 | 23,9% |
| Netherlands | 4409,50 | 5326,80 | 20,8% |
| Estonia | 1006,00 | 1157,90 | 15,1% |
| Cyprus | 238,20 | 273,90 | 14,9% |
| Malta | 48,80 | 56,10 | 14,9% |
| Belgium | 3606,00 | 4058,00 | 12,5% |
| Greece | 3172,70 | 3405,80 | 7,3% |
| Hungary | 2418,70 | 2567,20 | 6,1% |
| Ireland | 1472,90 | 1551,3 | 5,3% |
| Denmark | 5659,40 | 5943,70 | 5% |

**Luxembourg**, which showed the largest increase in domestic RES consumption, introduced a tendering procedure for larger solar PV installations (min. 500 kW) in August 2018 to allocate a one-sided sliding FIP. A total of 15 MW was awarded with a realisation period of 18 months, which partly explains that in 2020, 27 MW of solar PV installed capacity were added. The auction system significantly supported the increased uptake of solar PV technologies. In addition, Luxembourg has also supported smaller solar PV installations through investment grants. In the RES-H&C sector, Luxembourg experienced a significant uptake of biomass. Biomass and other eligible technologies including heat pumps and geothermal energy are granted investment support which ranges from 25% to 50% of investment costs. A notable increase in RESE-T can also observed in Luxembourg, rising from 7.7% in 2019 to 12.6% in 2020. This is a direct effect of the increase of the biofuel quota which increased from 5.85% in 2019 to 7.7% in 2020.

The **Netherlands** showed an increase of 20.8% in total RES consumption from 2019 to 2020. It is partly explained by the substantive new installed capacity added in 2020 in the RES-E sector: solar PV (632 MW), wind onshore (3724 MW), and wind offshore (1503 MW). The Netherlands has used a technology-neutral auction scheme since 2011 called SDE+ (replaced in 2020 by the SDE++ auction) and separate auctions for wind offshore. The auctioned cumulative capacity between 2016-2019 considering all technologies was approximately 16.6 GW, of which solar PV represents around half of the supported capacity[41]. As reported in AURES II, the realization rates in the first years of SDE+ were low and the budget was increased too late, which translated into a rather late actual deployment and operation of winning projects. This contributes to explaining why the steep increase (+6342MW) in solar PV installed capacity took place later, between 2018-2020. Regarding offshore wind, a total capacity of 1503 MW has been added in 2020, which can be partly attributed to the offshore wind auctions that took place between 2016-2018.

In 2018 **Estonia** adopted an auction-based technology-neutral FIP support scheme to increase the share of renewables in electricity production. Also in 2018, Estonia implemented a grant scheme for small scale solar PV panels (up to 200 kW) to be installed in buildings[42]. The results of support schemes for solar PV relate to the 87 MW of solar PV that were added between 2019 and 2020.

In addition to growth in in the RES-E sector, Estonia also experienced a growth of RES-H&C from 52.2% in 2019 to 58.8% in 2020. Particularly, RES-H&C generation from solid biomass increased from 691 ktoe to 763 ktoe and heat pumps increased from 78 ktoe to 88 ktoe. Estonia has a variety of measures to promote the uptake of RES-H&C technologies that focus on investment support, e.g., investment support for bioenergy production, modernisation of heating systems in small residential buildings, and renovation of apartments.

Similar to Estonia, **Cyprus** also experienced significant growth in PV capacity additions between 2019 and 2020. During this period, 78 MW of solar PV was newly added. Since 2018 Cyprus specifically supports the installation of solar PV systems up to 10 kW (up to 20 MW installed) through a net-metering/ net billing scheme.

**Malta** experienced an increase in its RES-T shares from 8.9% in 2019 to 10.6% in 2020. Since 2011, a biofuel quota has been Malta's main policy measure regarding RES-T. The biofuel content level has been gradually increased from 1.5% in 2011 to 10% in 2020. Biodiesel moved from 11 ktoe in 2019 to 14 ktoe in 2020.

The RES-E share in Malta also saw an increase from 7.5% in 2019 to 9.5% in 2020. The increase was driven by solar PV. Malta has two support schemes, an administratively set feed-in-tariff for small PV installations and auctions to allocate one-sided sliding FIP for larger PV and wind plants[43]. In 2020, 33 MW of solar PV installed capacity were added, and the generation moved from 196 GWh in 2019 to 237 GWh in 2020.

**Belgium's** RES consumption increased by 12.5% between 2019 and 2020. Most notably, wind offshore (+706 MW) and solar PV (+938 MW) capacities increased between 2019 and 2020. The main support instrument for RES-E in Belgium are tradable green certificates with slight differences in application and price levels between the regions. The green certificate system requires electricity suppliers to demonstrate that a certain proportion (quota) of the electricity they supply was generated from renewable sources. Belgium additionally experienced a significant growth in RES-T, which increased from 6.8% in 2019 to 11% in 2020. This development can be explained by the biofuel quota for road transport, which was increased from 8.5% in 2019 to 9.9% in April 2020.

[41] D2.1-NL, December 2019, Auctions for the support of renewable energy in the Netherlands Authors: Martin Jakob, Paul Noothout, Felix von Bluecher, Corinna Klessmann (Navigant). http://aures2project.eu/wp-content/uploads/2019/12/AURES_II_case_study_Netherlands.pdf

[42] https://www.riigiteataja.ee/akt/129122021050?leiaKehtiv

[43] European Commission, Directorate-General for Energy, Horváth, G., Schöniger, F., Zubel, K., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU : task 1-2 : final report, Publications Office, 2020, https://data.europa.eu/doi/10.2833/325152

The RES consumption in **Greece** grew by 7.3% between 2019 and 2020. The highest growth was observed in the RES-E sector, where onshore wind capacities increased by 524 MW during this period. Since 2017, the key support schemes in Greece for RES-E plants have been FIP, the amount of which is determined by an auction mechanism.

**Hungary's** RES consumption increased by 6.1% between 2019 and 2020. The Hungarian support scheme METÀR includes an auction in which RES-E plants with a capacity of more than 1 MW receive a two-sided sliding premium (Contract for Difference (CfD)). In the first METÀR auction in 2019, 200 GWh were awarded, and in the second tender, 36 projects were awarded to support 390 GWh of renewable generation. In both auctions, most of the awarded installations were solar PV projects which is reflected in the growth of installed capacity for solar PV (+ 731 MW) between 2019 and 2020. Next to the growth in RES-E capacities, Hungary also experienced an increase in RES-T. The RES-T share increased from 8.1% in 2019 to 11.6% in 2020 as a result of the rise in the biofuel quota from 6.4% to 8.2%.

The increase of 5.3% in the RES consumption of **Ireland** can be primarily attributed to growth in wind onshore capacities, which increased by 181 MW between 2019 and 2020. Until 2015, Ireland mainly support RES-E technologies including wind, hydro and biomass/landfill gas power plants through its Renewable Energy Feed-in Tariff (REFIT) scheme. In December 2019, **Ireland** introduced a new auction-based 'Renewable Energy Support Scheme' (RESS) providing FIP to waste/biomass/biogas based high efficiency Combined Heat and Power (CHP), solar PV and onshore/offshore wind projects.

In 2018, **Denmark** held a multi-technology auction to provide installations with a fixed premium on top of the electricity price for the entire actual production of electricity for 20 years. The auction awarded premiums to three onshore wind projects with a volume of 165 MW and three solar PV projects with a total volume of 101 MW. Tender-based incentives have been particularly successful in promoting the expansion of PV systems, which increased by 224 MW between 2019 and 2020.

Besides, the share of RES-H&C increased from 47.3% in 2019 to 51.1% in 2020. As further explained in section 3.5.1.3, the observed RES-H growth is a result of multiple support policies in place that allowed the sector to grow steadily and sustained over years. Denmark has been supporting the expansion of district heating and CHP since the 1990s. Upgraded biogas fed into gas grids were eligible for a subsidy in the form of a price surcharge until 2020.

## 3.3 Qualitative analysis of the information presented by Member States regarding biofuels

In this section, we provide a qualitative analysis of the trends and markets behind the quantitative information presented in Task 1.2 and 1.3.

### 3.3.1 Biofuels produced from food and feed crops

The transport fuel market is for more than 55% divided over only four MS, namely Germany, France, Italy and Spain. Germany and France jointly represent over one third of the EU transport market in terms of volume.

For Europe as a whole there is no clear trend visible in the consumption of food and feed crops for the period 2016-2020, as seen in Figure 13. After a steady increase from 2016-2019, 2020 consumption is slightly lower. However, the share of food and feed crops in transport for the EU as a whole increased from 4.1% to 4.5% between 2019 and 2020.

This increase can be largely explained by a 2.8 times higher decrease in final energy consumption in the EU (which was probably a decrease caused by reduced movement and transport fuel consumed in the first COVID year) compared to the consumption of food and feed crops. Behind this is actually the main different behaviour of the two largest transport fuel markets, Germany and France. These two MS together represent 44% of the food and feed crops fuels consumed in Europe in 2020, and if Poland is added (the 3rd largest consumer) they jointly cover 53% of the EU food and feed crops fuels consumption.

Where Germany after the introduction of the ILUC Directive saw a decline in food and feed crops fuels, the amount and share of food and feed crops fuels has been increasing again in period 2018-2020. The fact that the total consumption of fuel in 2020 saw a large dip, makes the share in 2020 even higher. In 2020, Germany consumed 2464 ktoe food and feed crops fuels, resulting in a share of 4.9%.

France on the other hand consumed a relatively stable amount of food and feed crops fuels over the period 2016-2019, with a strong decline in 2020 to 2253 ktoe. One of the reasons for the decline can be found is the introduction of the ban on palm oil in January 202044. The drop of consumption of the total fuel market in 2020 even 'softens' the percentage wise drop. The percentage share in France is however still higher than the share in Germany - 6% versus 5%, both higher than the EU overall share (4.5%).

Poland follows the German trend, but then a lot sharper. The drop in consumption after 2016 is strong (halving consumption), but the increase towards 2020 is also sharper resulting in 1005 ktoe, even increasing beyond pre-2016 levels.

To provide two more cases, we look at the 3rd and 4th largest EU transport fuel markets, Italy and Spain. In Italy the consumption of food and feed crops fuels dropped strongly after 2016, with the introduction of the ILUC Directive. Consumption of food and feed crops fuel has slightly increased towards 2020, but remains at a very low share compared to the rest of the EU of 1.4% (only 3 MS have a lower share). Italy has put a strong emphasis on the increase of advanced and Annex IX based biofuels, with a specific focus on the development of biomethane. In Spain food and feed crops fuel consumption increased till 2018, after which it started to decline towards 2020, both in absolute amounts as well as percentage. Their share in 2020 dropped to 4%.

None of the above-mentioned countries has put in a specific policy regarding food and feed crops fuels, besides the transposition of the ILUC Directive (or at least not as far as identified).

On the other side of the spectrum, the three countries with the smallest volume of biofuels and bioliquids produced from food and feed crops in 2020 were Malta (0.2 ktoe), Ireland (10 ktoe) and Estonia (16 ktoe). Cyprus was the only Member State that did not consume biofuels and bioliquids produced from food and feed crops in 2020.

In absolute terms, the biggest trend increase between 2016 and 2020 was realised in Germany (680 ktoe) and Poland (547 ktoe) as illustrated in Figure 14. Percentage wise, Croatia, Finland, Greece, Latvia, and Poland all increased the consumption of biofuels and bioliquids produced from food and feed crops by greater than 100%. Two countries who had almost no consumption of biofuels and bioliquids produced from food and feed crops in 2016 are Ireland and Slovenia. They increased their consumption to 10 ktoe and 28 ktoe respectively in 2020.

[44] USDA 'European Union: Biofuels Annual', published on July 13 2022 https://www.fas.usda.gov/data/european-union-biofuels-annual-2

A decreasing trend in consumption of food and feed crops fuel is observed in this period for ten Member States. Malta, Ireland, and Bulgaria all showed a decrease of over 50%, with Bulgaria having a decrease of almost 85%. Other Member States with a decreasing trend are Czechia, Denmark, Spain, Slovakia, France, Austria and Portugal. Note that in absolute terms France, with -549 ktoe, and Spain, with -175 ktoe, saw the largest decrease. The decrease of France could be explained by the early phase out of palm oil-based biofuels, effectively since January 2020. Table 91 in the Appendix contains more detailed information on the use of food and feed crops for the production of biofuels and bioliquids in the Member States between 2016-2020.

Figure 15 shows the share of food and feed crops in relation to the total energy use in transport. The five countries with the highest share in 2020 were Finland, Romania, Sweden, Belgium, France. Of these, Finland, Romania and Sweden were above the 7% cap on the share of food and feed crops in transport. For these countries the amounts of biofuels consumed over the 7% cap were not included in their RES-T achievement as presented in section 2.2.6. Countries whose share is below 1% were Malta, Ireland, and Cyprus.

Romania has seen a steady increase in food and feed crop fuel consumption. They do not meet the 10%, even if the above-cap amount of feed crop fuel consumption would have counted towards the target. Finland and Sweden didn't need the higher shares of food and feed crops, above the 7%, to reach their 10% RES-T targets. For both of them it could be due to domestic obligations which are set at levels higher than the RED RES-T target of 10%. For example, for Finland, the Act on promoting the use of biofuels for transport in Finland set an obligation of 20% in 2020. In Sweden, the combination of the general tax exemption and the 2018 implemented reduction obligation can explain an increase in the consumption of biofuels in general also resulting in higher use of food and feed crop fuels.

### 3.3.2 Annex IX A

The use of Annex IX A feedstocks in the EU biofuel consumption has increased since 2016. Table 4 provides an overview of the different feedstocks included in Annex IX A. In the period 2016 to 2020, consumption went from 589 ktoe in 2016 to 1224 ktoe in 2020. Figure 16 shows that the trend in consumption was relatively stable between 2016-2018, around 600 ktoe, but doubled from 2019 to 2020.

The reference value for Annex IX A is the target of 0.5%[45] share of biofuels and biogas in transport produced from Annex IX A in 2020. The EU had an exact share of 0.5% in 2020. Eight Member States were above the 0.5% threshold. These were, from highest to the lowest share, Sweden (3.6%), Estonia (2.9%), Finland (2.3%), Italy (1.6%), The Netherlands (1.1%), Slovenia (1.0%), Latvia (1.0%) and Bulgaria (0.6%). Bulgaria amended in 2019 the Ordinance on the sustainability criteria for biofuels and bioliquids. The amendment of the Ordinance introduced requirements to prevent the deliberate conversion of raw materials into waste to be used for the production of new generation biofuels and introduced traceability of advanced biofuels. Most of the 0.6% Annex IX A share in Bulgaria in 2020 is coming from Annex IX A(d) biomass.

The trend of biofuels and biogas in transport produced from Annex IX A feedstocks is assessed in more detail in Figure 23 and Table 8. The main Annex IX A feedstocks used fluctuated over the years, moving from mainly using one feedstock to multiple towards 2020. In 2016, 78% of total Annex IX part A consumption was from Annex IX A(d) feedstocks. From 2016 onwards there was no observed trend in the consumption of Annex IX A(d), but

[45] The 0.5% was an indicative target from RED I and includes 'double counting' of the energy content of fuels. Member States have the freedom to set a lower target.

consumption in 2020 was higher than in 2016 in absolute numbers. However, the total consumption of Annex IX A biofuels increased as well, resulting in a decrease in the share of Annex IX A(d) in 2020 to 42%.

In 2020, the main Annex IX A feedstocks used in the EU were Annex IX A(d) 42%, Annex IX A(g) 23%, Annex IX A(h) 10% and Annex IX A(f) 7%. These collectively represented 82% of all biofuels and biogas produced from Annex IX A feedstocks. While the trend of Annex IX A(g) had a steep increase from 2018 onwards, Annex IX (h) only had a noticeable share in 2020 going from 1 ktoe in 2019 to 124 in 2020 (due to a consumption of this type of biofuel in Sweden in 2020). This increase however coincides with a strong decline in the use of Annex IX (o) feedstock in Sweden in 2020. Since (h) is tall oil pitch, and (o) includes among others tall oil, we suspect this is not a different type of biofuel, but more an administrative change or reclassification of the same feedstock.  Other feedstocks with a small share, including Annex IX (b), Annex IX (c) and Annex IX (k) all had a relatively stable growth over the 2016-2020 period.

In 2020, there was no consumption of Annex IX A(a), Annex IX A(m), Annex IX A(n), Annex IX A(q), Annex IX A(r), Annex IX A(s), Annex IX A(t) feedstocks for biofuels and biogas in transport. Consumption was less than 10% in 2020 for Annex IX A(e), Annex IX A(i), Annex IX A(j), Annex IX A(l) and Annex IX A(p) feedstocks.

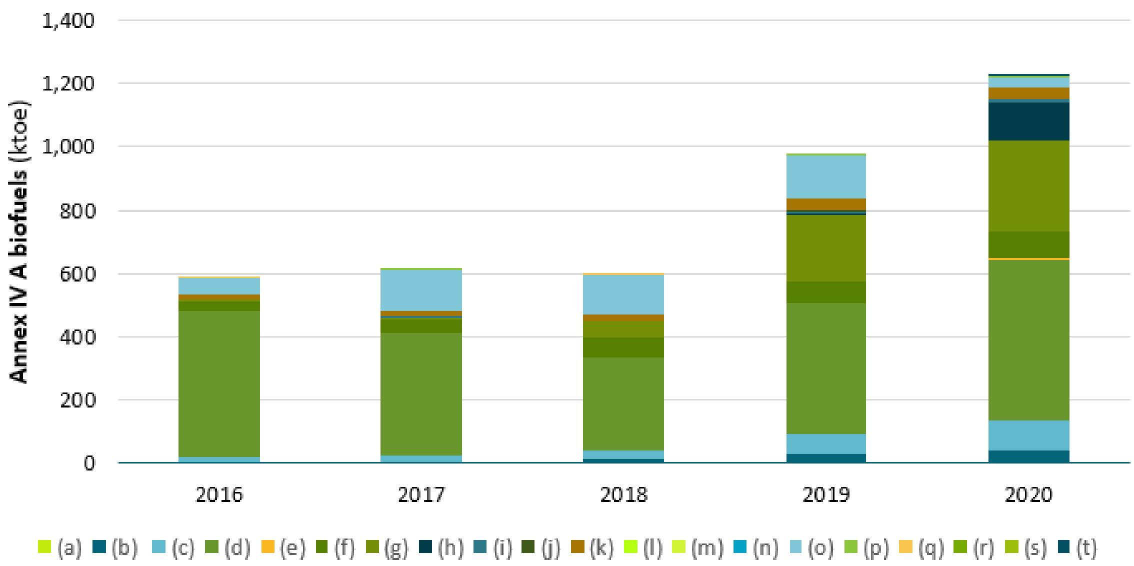


**Figure 23. EU trend of use biofuels and biogas in transport produced from Annex IX A**

**Table 8. EU consumption of biofuels and biogas in transport produced from Annex IX A**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Total consumption Annex IX A | 589 | 611 | 598 | 975 | 1,224 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 4 | 17 | 32 | 40 |
| (c) | 21 | 24 | 24 | 61 | 94 |
| (d) | 460 | 385 | 292 | 417 | 510 |

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| (e) | 0 | 0 | 0 | 0 | 5 |
| (f) | 33 | 44 | 66 | 64 | 85 |
| (g) | 3 | 5 | 49 | 213 | 285 |
| (h) | 0 | 0 | 1 | 1 | 124 |
| (i) | 1 | 2 | 1 | 9 | 8 |
| (j) | 0 | 0 | 0 | 1 | 3 |
| (k) | 17 | 19 | 21 | 39 | 32 |
| (l) | 0 | 0 | 0 | 0 | 1 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 52 | 127 | 124 | 134 | 34 |
| (p) | 1 | 0 | 1 | 3 | 2 |
| (q) | 1 | 0 | 1 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

The Annex IX A biofuels and biogas share in transport for the different Member States are shown in tables 96-113 in the Appendix. In 2016, Sweden and Finland were almost the only countries who consumed Annex IX A biofuels (95% of reported consumption). In the following years, Sweden and Finland remain important countries when regarding the consumption of Annex IX A in the EU.

From 2016 to 2017, consumption of Annex IX A fuels dropped considerable in Sweden (mostly due to a high spike of Annex IX A(d) fuels consumed in 2016) but remained to have a relatively stable consumption of Annex IX A fuel throughout the rest of the period (2017-2020). The Swedish progress report on the period 2017-2018 indicated as clarification that 'abrupt jumps in certain types may be the result of blended raw materials being reclassified'.

Sweden's Annex IX A biofuels are very likely based on domestic resources and production facilities. From 2019 to 2020, there was a shift from Annex IX A(o) to Annex IX A(h) feedstock. The shift could be a classificational changes, as a change from tall oil to tall oil pitch results in change in Annex IX A sub-categories.

Finland remained an important consumer of Annex IX A biofuels after 2016, although the consumption declined after 2017. Finland consumes only Annex IX A (d) feedstock (the biomass fraction of industrial waste). It is uncertain why consumption has declined. It could be due to an increasing demand in other EU countries, causing production to be exported or the specific waste streams being less available.

In 2019, Italy and the Netherlands join Sweden and Finland as key consumers of Annex IX A biofuels. Italy immediately becomes the largest consumer with over 400 kton consumption, based partially on Annex IX A(d) and Annex IX A(g). In the Netherlands, waste streams are an important feedstock for the Annex IX A biofuels, especially Annex IX A(b), (d) and (g), combined 83% of the Annex IX A biofuel consumption in 2019.

In 2020 also Germany joins the group larger consumers. In terms of share, Sweden was the biggest consumer in 2020 of Annex IX A biofuels, with 3.6%. Followed by Estonia, Finland, Italy, and The Netherlands, which were all above 1%. The lowest share was 0.1% in 2020, which was the case for Malta, Chechia, France, Austria and Poland. The 0.1% share of Malta in 2020 was embedded in national strategy. Malta introduced a support scheme in 2011 for the biofuel substitution obligation in imported road transport fuels to gradually reach 10% by 2020. The scheme includes a 0.1% share of advanced biofuels in 2020. Hungary also introduced a target of advanced biofuels, but did this later than Malta, in 2019. The target introduced is 0.1% of advanced biofuels by 2020, which wasn't met.

Not all Member States consumed Annex IX A biofuels. In 2020, Greece, Croatia, Cyprus, Lithuania, Luxembourg, Hungary, Romania, and Slovakia consumed no, or almost none, Annex IX A based biofuels and biogas.

Between 2016-2020, Estonia had the biggest trend increase of biofuels and biogas share in transport of 2.9%. Estonia pushed the consumption of consumption and delivery of biomethane with different support schemes from 2017 onwards, which could be the reason behind this increase. Other countries also showed an increasing trend, such as Italy (1.5%), The Netherlands (1.5%), Slovenia (1.0%) and Latvia (1.0%). The consumption of Annex IX A biofuels seems strongly linked to the countries that are also developing production facilities or have specific feedstock streams available (e.g. by-products from domestic industry). This is the case for Finland, Sweden, Italy and the Netherlands for example. Recent developments in the construction of new production facilities, such as in Romania, Poland and France do not show up yet in the 2020 statistics.

The production of Annex IX Part A fuels in Europe is fast developing. A selection of some of notable market developments covering the period 2016 to 2020 are listed below.

Hydrotreated lipids: There are several operational HVO biorefineries in Europe and more are anticipated as several existing fossil refineries will be converted into HVO biorefineries. ENI has converted two of its fossil refineries in Italy to HVO biorefineries, first at Venice in 2014 and later at Gela in 2019. The Venice biorefinery uses vegetable oils, used cooking oil and animal fats, while the Gela biorefinery treats used cooking oil, animal fats, algae and by-products4647. These biorefineries have a combined capacity of 1,060,000 tonnes/year. In Finland, UPM built the Lappeenranta biorefinery using crude tall oil residue from the co-located UPM Kaukas pulp and paper mill. The UPM refinery has a capacity of 1,300,000 tonnes/year. In France, Total converted its fossil refinery at Le Mede in 2019 into a HVO biorefinery with a capacity of 500,000 tonnes/yr.[48]

Fast pyrolysis: This technology is already applied for several years in the EU, mainly in The Netherlands and Finland. As the upgrading of pyrolysis oils to biofuels is still considered very expensive, at present the technology developers are moving towards co-processing pyrolysis oils in petroleum refineries. Fortum in Finland integrated a fast pyrolysis unit in a CHP plant for advanced biofuels at their refinery from 2013, with a capacity of 50,000 tonnes/year. This technology is being further developed by Valmet, Fortum and Preem. BTG developed the EC funded Empura plant in 2015 in The Netherlands.

A second plant was taken into operation in 2020 at Green Fuel Nordic and a third Pyrocell project is under construction by a joint venture of Setra Group and Preem. Each of these projects has a capacity of 24,000 tonnes/year.[49]

[46] https://www.eni.com/en-IT/operations/italy-venice-biorefinery.html
[47] https://www.eni.com/en-IT/media/press-release/2019/09/eni-opens-its-bio-refinery-in-gela.html
[48] Imperial college London (August 2021), 'Sustainable biomass availability in the EU, to 2050', via https://www.concawe.eu/publication/sustainable-biomass-availability-in-the-eu-to-2050/
[49] Imperial college London (August 2021), 'Sustainable biomass availability in the EU, to 2050', via https://www.concawe.eu/publication/sustainable-biomass-availability-in-the-eu-to-2050/

Gasification followed by fermentation: This technology has been developed by Lanzatech. Their first project is in Europe, at ArcelorMittal in Ghent. The project is built in 2021 and has a maximum capacity of 62,000 tonnes ethanol/year. The project uses biomass as a feed in the steel mill in order for the ethanol to be classified as bioethanol for consumption in the EU market.[50]

Cellulosic ethanol: There are two notable cellulosic ethanol projects in the EU. Clariant has built a plant in Romania using 250,000 tons of straw to produce 50,000 tonnes/year cellulosic ethanol[51], which was commissioned in 2021. Furthermore, ORLEN has also announced that it will build a plant with a capacity of 25,000 tonnes/year in Poland, also largely using straw.[52]

Bio-SNG projects: Project Gaya bio-SNG project uses thermal gasification to produce biomethane53. Gasunie is developing a project in The Netherlands based on hydrothermal gasification of wet biomass streams, including manure, green waste and sewage sludge.[54]

## 3.4 Measures taken to achieve the 2020 national renewable energy targets

Article 27 of the Governance Regulation states that MS shall report the measures taken to achieve the 2020 national renewable energy targets, including measures related to support schemes, guarantees of origin and simplification of administrative procedures.

To process all the information of the submitted MS reports, we created an Excel Masterfile that collects all informed policies and measures. To ensure consistency of the analysis, we classified the policies in the following categories:

- Support scheme
- Guarantees of Origin
- Simplification of administrative procedures
- Statistical transfer
- Energy Efficiency
- Other

In turn, we reclassified the category support scheme into the following subcategories:

- FIT
- FIP
- Quota system
- Tax incentive
- Subsidy
- Loan
- Net-metering

[50] Imperial college London (August 2021), 'Sustainable biomass availability in the EU, to 2050', https://www.concawe.eu/publication/sustainable-biomass-availability-in-the-eu-to-2050/

[51] https://www.clariant.com/en/Corporate/News/2022/06/Clariant-produces-first-commercial-sunliquid-cellulosic-ethanol-at-new-plant-in-Podari-Romania

[52] https://www.orlen.pl/en/about-the-company/media/press-releases/2021/december/ORLEN-to-invest-in-production-of-new-generation-biofuel

[53] https://www.projetgaya.com/en/biomethane-a-green-energy/

[54] https://www.gasunie.nl/en/projects/supercritical-water-gasification

In the following subsections we present a summary and analysis of the main trends observed in: a) **support schemes**; b) **guarantees of origin**; and c) **simplification of administrative procedures**.

The analysis is based on the submitted MS reports, on the reports from the previous project "Technical assistance in realisation of the 5th report on progress of renewable energy in the EU"[55] and on additional research when needed. Additional sources were taken into account to complement the information provided in the MS Reports, for example official government websites and legal texts as well as assessments thereof.

## 3.4.1 A closer look at support schemes measures

In the template of the MS reports, MS were asked to "report on major legislative and non-legislative policies, measures and financing measures and programmes implemented in 2019 and 2020 which contribute towards the overall national energy efficiency and renewable energy targets for 2020 (art 27 b & Annex IX, part 2, point a)". However, MS also reported on policies that go much further back than 2019 (even from the 90s). We focused primarily on policies of the last 5 years (2016-2020), with some exemptions.

### *3.4.1.1 RES-E sector*

Between 2016 and 2020, different combinations of RES-E support schemes have been implemented in the EU-27 countries. The most common RES-E support scheme in 2020 was FIP, often combined with auctioning systems. The FIP were most commonly two-sided sliding FIP (CfD) or one-sided sliding FIP. Quota systems, tax incentives, net metering, subsidies, loans, and FIT were all used to support RES-E generation. Almost all MS have at least two support schemes that provide more targeted and specific support to different technologies, plant sizes, and actors. Results are summarised per MS in Figure 24.

[55] European Commission, Directorate-General for Energy, Horváth, G., Schöniger, F., Zubel, K., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU : task 1-2 : final report, Publications Office, 2020, https://data.europa.eu/doi/10.2833/325152

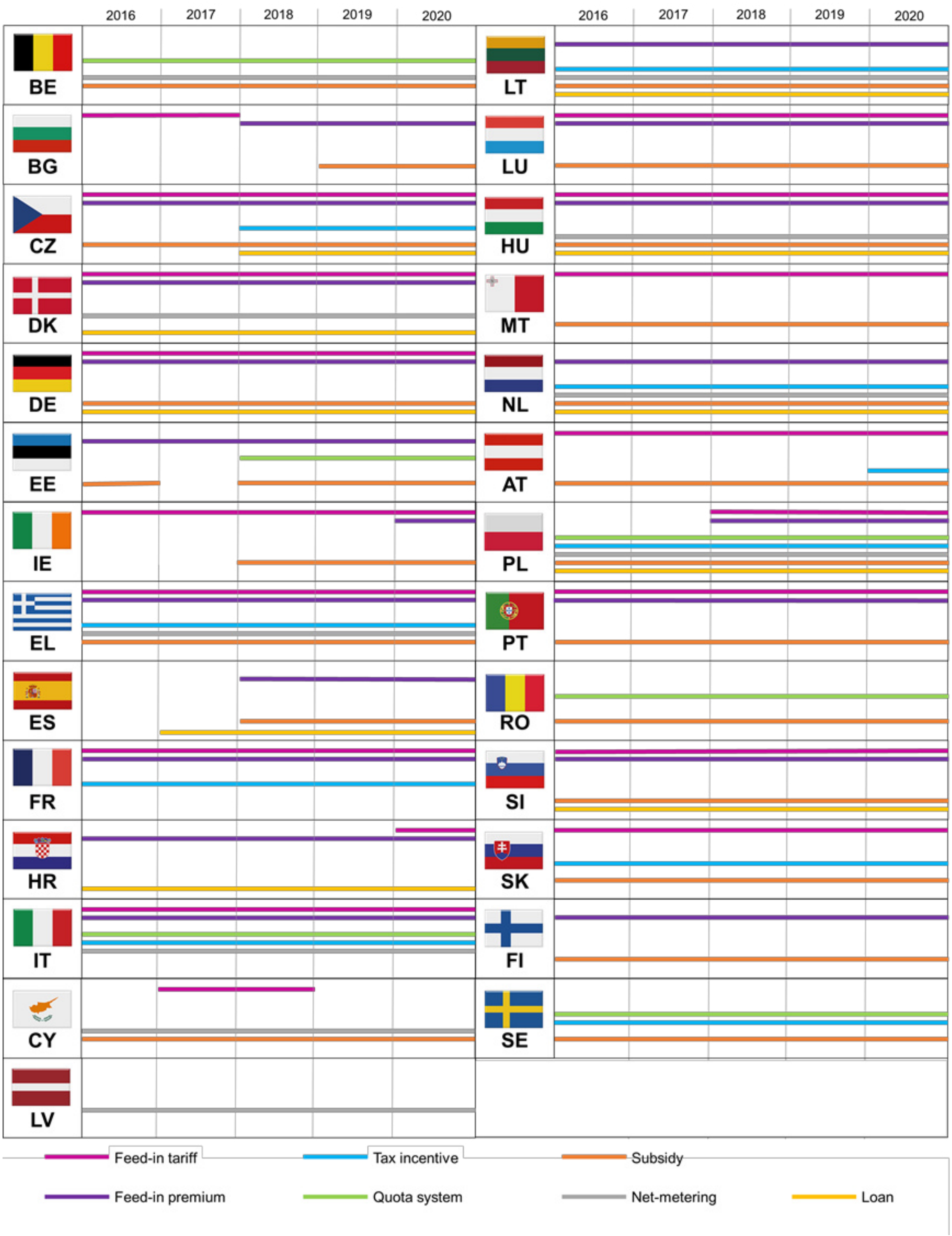


**Figure 24. Overview of the support schemes in the RES-E sector between 2016 and 2020. Source: Member States Reports and Guidehouse elaboration on previous work**

A general trend that took place in the period under evaluation is the transition from administratively set FIT towards FIP schemes that facilitate a higher market integration of renewables, as in Germany when it introduced solar PV auction in 2015 and later for other RES technologies in 2017 to allocate a sliding premium instead of the previous administratively-set FIT.

In particular, the mechanisms used to allocate support also reflects an important trend in the EU: through competitive mechanisms, i.e., auctions. As it can be observed in Figure 25, 19 MS have implemented auctions for RES-E support until 2020. After 2020, Belgium (2021) and Romania (2022) introduced auctions for wind and solar projects and four MS considered introducing auctions[56].

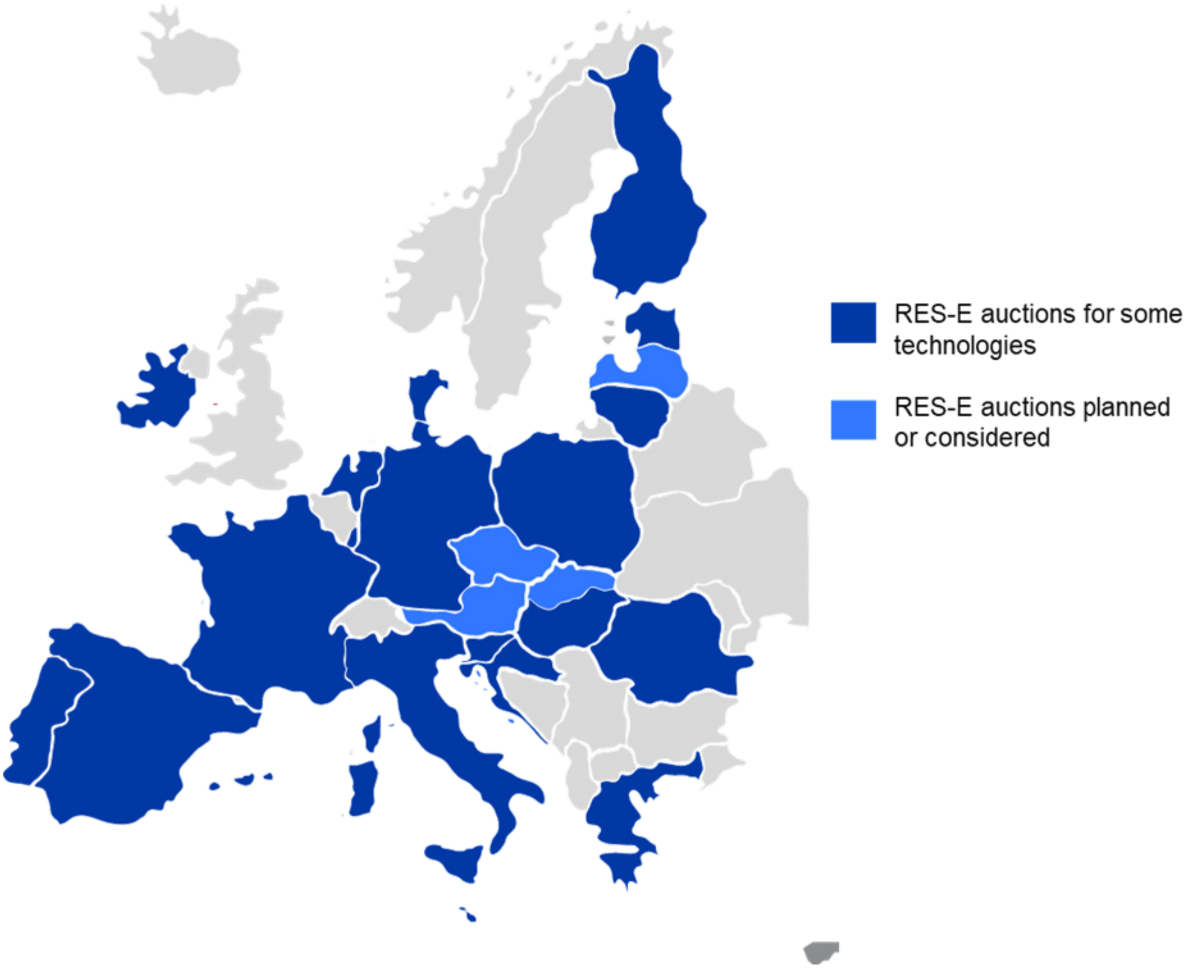


**Figure 25. Auctions for RES-E across the EU (2022). Source: Guidehouse 2022**

As pointed out in the previous project report[57], the trend towards auctioning has multiple causes. With the implementation of competition-based schemes for the allocation of support, MS thrived to lower the costs of renewables support and to maintain an effective control either of the volume of new installations or the total budget spent. In addition, the implementation of auctions and premiums has been triggered by the EC's Guidelines on state aid for environmental protection and energy (2014/C 200/01) adopted in 2014.

According to the Environmental and Energy State Aid Guidelines 2014–2020, MS should use auctions to determine support levels with few exceptions as small-scale assets. Although as of 2020 most MS chose to implement technology-specific auctions, multi-technology auctions have been on the rise.

[56] https://taiyangnews.info/tenders/romanias-950-mw-renewables-tender/

[57] European Commission, Directorate-General for Energy, Klessmann, C., Sach, T., Grigiene, M., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU final update report. Task 1 & 2, Publications Office of the European Union, 2021, https://data.europa.eu/doi/10.2833/559777

As reported in the AURES II project[58], in 2020, almost 40% of auctions were multi-technology auctions and also the number of countries using multi-technology auctions is increasing (11 countries have conducted multi-technology auctions in 2020). The need for technology diversification was mentioned in most cases as reason to make an exception from the principle of technology-neutrality[59]. It remains to be seen whether multi-technology auctions will be implemented at a larger scale and in more MS in the coming years.

In terms of support schemes allocated through auctions, most MS allocated some sort of FIP, such as a fixed FIP, a one-sided sliding FIP or a two-sided sliding FIP (CfD) (Figure 24). Only Italy and Slovenia also have in place a FIT for small-scale units (projects below 250 kW in Italy, and below 500 kW in Slovenia). Since 2017, many MS have implemented CfD schemes: France, Greece, Hungary, Ireland, Italy, Poland, and Spain. One-sided sliding FIPs were auctioned in Estonia, Germany, Malta, and Slovenia. In some auction schemes, Denmark, France and Germany offered a fixed FIP. Some other MS, as Finland and Lithuania auctioned a hybrid support scheme. In 2018, Finland offered a hybrid between a fixed and sliding FIP, where the support is bound to a three-month average market price for electricity, with a reference price of €30 per MWh.

As reported in the AURES II auction database[60], "when the market price is below the reference price, the support is fixed according to the awarded bid for the premium. However, when the three-month average price of electricity is above the reference price, the support becomes sliding, where the support to be paid is the difference between the reference price plus premium minus the market price average. The premium is no longer paid out when the average market price exceeds the reference price plus the premium".

An interesting auction example is the SDE++ support scheme in the Netherlands, which was introduced in 2020 and builds on the previous SDE+. The scheme not only focuses on promoting renewable energy production, but also supports other techniques that reduce greenhouse gas (GHG) emissions in general, marking a technology-neutral scheme.

As some auctions results showed record low prices (e.g., offshore wind in the Netherlands in 2017[61], solar PV in Portugal in July 2019, or offshore wind in Denmark in 2021), it has been argued that in some MS renewable capacities could be deployed on a pure market basis, for example through power purchase agreements (PPAs). According to findings of the AURES II project[62], deployment of renewables based on zero-subsidy auctions and PPAs could take place only if the expected market returns to investors is higher than their investment and operating costs, which could be the case for some MS. However, the AURES II study also points that the market-based expansion could be limited due to the negative impact of massive scale-up of renewables that reduces the market values.

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[58] D7.2, July 2021, D7.1, July 2021. The state of multi-technology auctions in Europe. Authors: Jenny Winkler (Fraunhofer ISI) http://aures2project.eu/2022/04/13/the-state-of-multitechnology-auctions-in-europe/

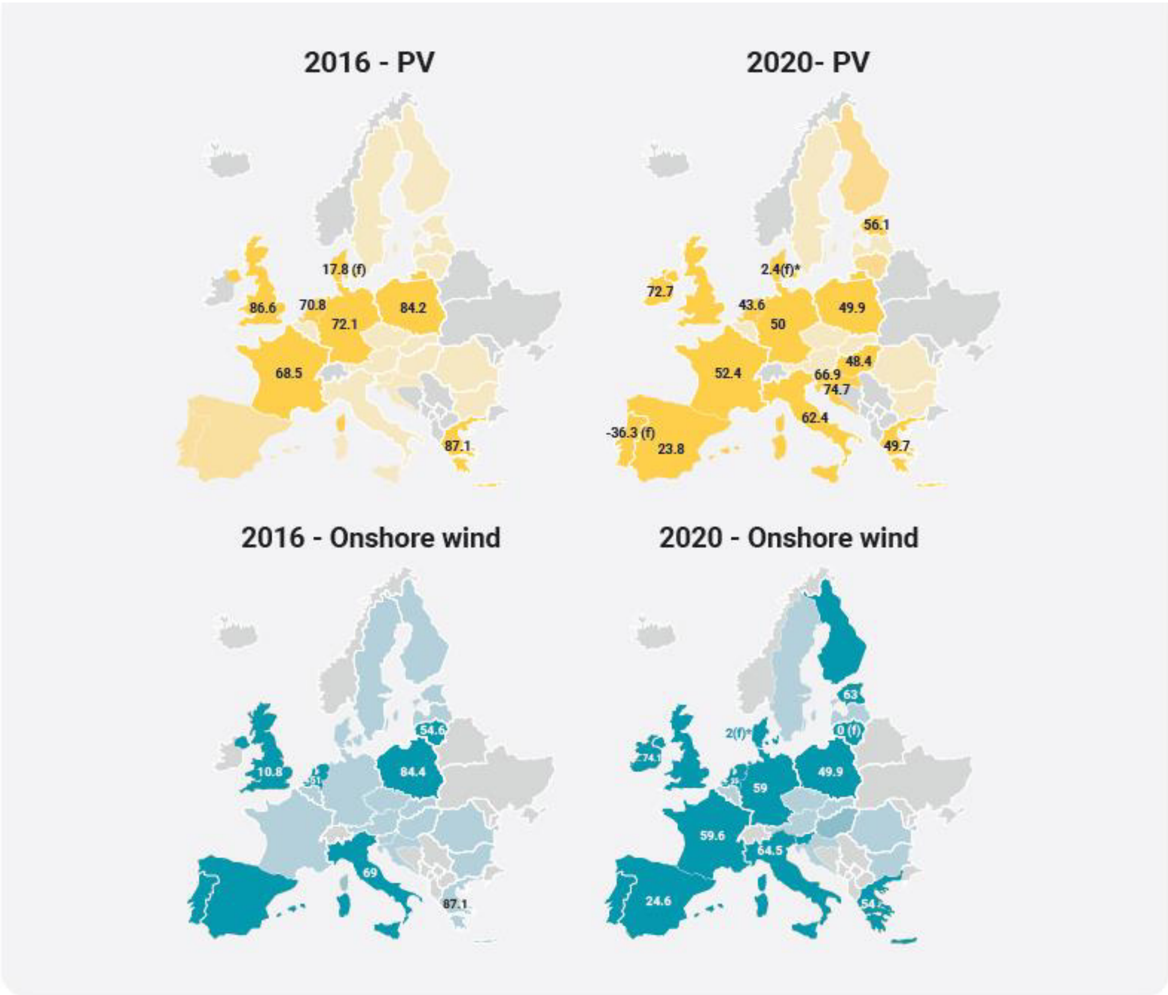
[59] European Commission, Directorate-General for Energy, Klessmann, C., Sach, T., Grigiene, M., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU final update report. Task 1 & 2, Publications Office of the European Union, 2021, https://data.europa.eu/doi/10.2833/559777

[60] D3.1., AURES II Auction Database and D3.2, Updates of auctions database http://aures2project.eu/auction-database/

[61] D2.1-NL, December 2019, Auctions for the support of renewable energy in the Netherlands Authors: Martin Jakob, Paul Noothout, Felix von Bluecher, Corinna Klessmann (Navigant). http://aures2project.eu/wp-content/uploads/2019/12/AURES_II_case_study_Netherlands.pdf

[62] Bartek-Lesi, M.; Diallo, A.; Szabó, L.; Mezósi, A.; Geipel, J.; Resch, G. Auctions in a zero-subsidy environment. REKK & TU Wien. http://aures2project.eu/wp-content/uploads/2022/03/AURES_II_ES_zero_support_auctions.pdf

In the AURES II project, it was reported that certain MS with more favourable resource potentials, auction prices may fall below wholesale prices as RES electricity generation becomes more competitive. In the AURES II Executive Summary "Auctions in a zero-subsidy environment"[63], Figure 26 was created to depict the minimum average prices formed in auctions held in the EU in 2016 and 2020.




*Source: AURES II auction database. Remarks: (f) fixed premium auctions, * auction prices corresponding to the previous year. Light yellow and blue colours indicate countries where multi-technology auctions were organised for the corresponding technology, but no capacity has been awarded.*

**Figure 26. Occurrence and the lowest annual average auction price for PV and onshore wind capacities in the EU, 2016 and 2020 (2019 €/MWh). Source: AURES II project**

In the period under analysis, FIPs (including CfDs) in combination with auctions remained the most prominent support scheme for RES-E in the EU. However, at the same time, Sweden, Belgium and Romania, continued to support RES-E through a quota system.

In addition to FITs and FIPs, all MS (except for Latvia) implemented complementary fiscal measures, including subsidies, loans, and tax credits/exemptions, to encourage the deployment of RES-E technologies. These fiscal measures ranged from investment subsidies to loan programs for RE power plants.

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[63] http://aures2project.eu/executive-summaries/ Bartek-Lesi, M.; Diallo, A.; Szabó, L.; Mezősi, A.; Geipel, J.; Resch, G.

Most fiscal measures were very specific and focused on a specific technology, e.g. Germany's support financing programme for offshore wind farms which started already in 2011, or the Grant Scheme of the installation of net-metering PV systems in Residential Buildings in Cyprus.

Another observable trend is the continued support by MS to the deployment of smaller-scale RES-E systems in homes and communities. For instance, a number of MS have net metering support schemes in place. Net metering support schemes have been introduced in Belgium, Denmark, Lithuania, Hungary, the Netherlands, Poland, Greece, Italy, Cyprus and Latvia. Under this scheme, the prosumer is only charged for the difference between the electricity they feed into the grid and the electricity they draw from the grid. There are various sorts of net metering schemes which vary in the details.

Another example is Italy that in 2020 introduced incentives to support collective self-consumption and energy communities. As informed in its MS report, the mechanism provides for 20 years two different contributions: a) a premium tariff for the shared electricity (100 €/MWh for the group of prosumers – 110 €/MWh for energy communities); b) a contribution which is the sum of transmission fee and the highest value of the variable distribution component for consumers/loads in low voltage.

Moreover, for a group of self-consumers acting collectively, an additional contribution, due for the avoided grid losses is granted. Besides, specific regulations and simplification of administrative procedures have been introduced in Portugal and Spain to promote RE self-consumption.

As informed in the MS reports, in 2020 the following countries added a new RES-E support schemes: Portugal held an auction for PV and PV plus storage to allocate a FIP and investment grants. Malta completed a Competitive Bidding Scheme for FIT for RES installations between 400 kWp and 1,000 kWp. Hungary started the "Second METÁR auction". Italy has introduced a legal framework for energy communities and collective self-consumers that allows end users/producers to share locally generated electricity.

#### *3.4.1.2 RES-T sector*

Figure 27 shows the RES-T support schemes in the EU-27 from 2016-2020. The most noticeable trend in 2020 in the RES-T sector is the growing implementation of fiscal support schemes that target the uptake of EV. These measures either target the uptake of electric or plug-in vehicles directly, e.g. through tax exemptions, direct subsidies (or bonuses) to the purchase of EV, or support the development of charging infrastructure for EV. Among those MS that have support schemes in place, we find Germany, Cyprus, Hungary, Malta, Netherlands, Romania, Slovenia, Spain, Greece, Portugal. The details and the concrete fiscal measures vary between countries.

For instance, in 2020 Greece, the Netherlands, Spain and Hungary introduced support schemes that promote e-mobility. The support schemes offer primarily subsidies to the purchase of EV. Spain implemented a support programme called MOVES II to cover a wide range of aspects including support to encourage the purchase of EV, installation of EV charging infrastructures, and support for electric bicycle loan systems. The Subsidy for Electric Cars for Private Individuals (SEPP) introduced in the Netherlands includes subsidy options for consumers that want to buy full electric passenger cars for private use. Hungary launched a tendering system for EV in which individuals and companies can apply for different levels of support in the purchase of an EV. Greece introduced law 4710/2020 for the promotion of e-mobility that provides tax incentives to promote the purchase of EV.

Besides the increasing support to EV and sustainable mobility, as shown in Figure 27, the predominant support scheme for RES-T in the EU continues to be a biofuel quota obligation. In 2020 all countries in the EU use an obligation scheme, predominantly a quota as the main support scheme to increase the share of RES-T. While the biofuel quota schemes differ in detail, they all require fuel suppliers to use a certain proportion of biofuels in their fuels. In 2020, the predominant support scheme in the for RES-T continues to be the biofuel quota obligation. The required shares of biofuels are generally increasing year by year and are targeting a 10% share by 2020. MS are now required to have an obligation that allows them to achieve their 2030 target.

Several MS adjusted their quota systems following the introduction of the ILUC Directive in 2015, which had to be transposed by the MS by September 2017. ILUC introduced a cap for conventional biofuels and a sub-target for advanced biofuels. Germany and Sweden do not mandate an increase in biofuel shares but have introduced a GHG quota that requires fuel suppliers to gradually reduce GHG emissions, which has a similar effect to the biofuel quota.

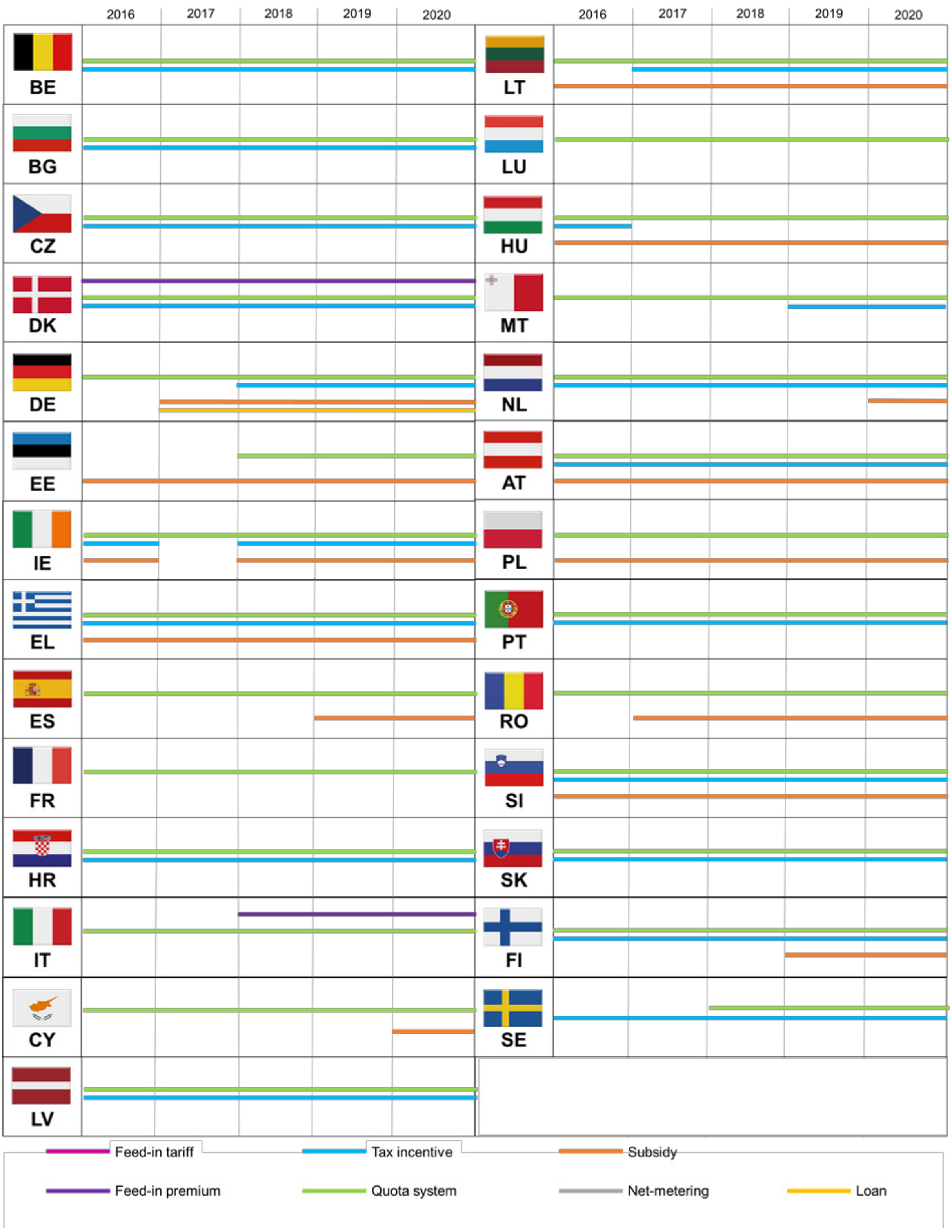


**Figure 27. Overview of the support schemes in the RES-T sector between 2016 and 2020. Source: Member States Reports & Guidehouse elaboration on previous work**

### *3.4.1.3 RES-H&C sector*

Figure 28 shows the RES-H&C support schemes from 2016 to 2020 in the EU. In general, it can be observed that fewer support schemes are implemented in the RES-H&C sector than in the RES-E sector. While most countries had support schemes in place, Croatia, Cyprus, and Portugal had no operational support scheme for RES-H&C in 2020. MS support in the H&C sector is primarily focused on investment support rather than operational support as in the RES-E sector. Support is provided either through subsidies or loans. In 2020, 22 MS provided investment support in the form of subsidies, while 12 MS used loans to support the deployment of RES-H&C technologies.

New RES-H&C support schemes have been introduced in 2020 in some MS, including in Hungary, the Netherlands, Denmark, Finland and in some regions in Austria. The focus of these newly introduced programs is primarily on improving the energy efficiency of homes and installing heat pumps. The subsidy programs include support for home improvements and energy savings through renovation, as well as support for the installation and purchase of heat pumps and subsidies for the replacement of oil heating systems in buildings.

In 2018, Ireland introduced a support scheme for Renewable Heat (SSRH) to grant aid for the adoption of renewable heat systems by commercial, industrial, agricultural, district heating, public sector and other non-domestic users not covered by ETS. The scheme has a budget allocation of €300m over its lifetime 2018-2035[64].

In its MS report, Poland reported that in 2018 the National Fund for Environmental Protection and Water Management (NFOŚiGW) launched the "Clean Air" program, with a budget of PLN 103 billion, which aims to reduce emissions of harmful substances into the atmosphere from heating of single-family houses with outdated, high-emission heat sources and low-quality fuel. The program offers subsidies to households to replace inefficient sources with modern heat sources that meet the highest standards.

The existing support instruments generally apply to a wide range of technologies. The most supported technology is biomass. The most common support schemes for biomass are investment aid in the form of grants or financing, operational support, and tax incentives such as income tax relief or VAT reductions. Other commonly supported technologies include geothermal, aerothermal, and hydrothermal heat pumps, as well as solar thermal systems. In addition to promoting the adoption of RES-H&C technologies, support programs also focus on energy conservation and energy efficiency measures, e.g., energy-efficient renovation projects, wall insulation, basement insulation, high-efficiency glass, among others.

[64] https://www.gov.ie/en/publication/8b810d-support-scheme-for-renewable-heat/

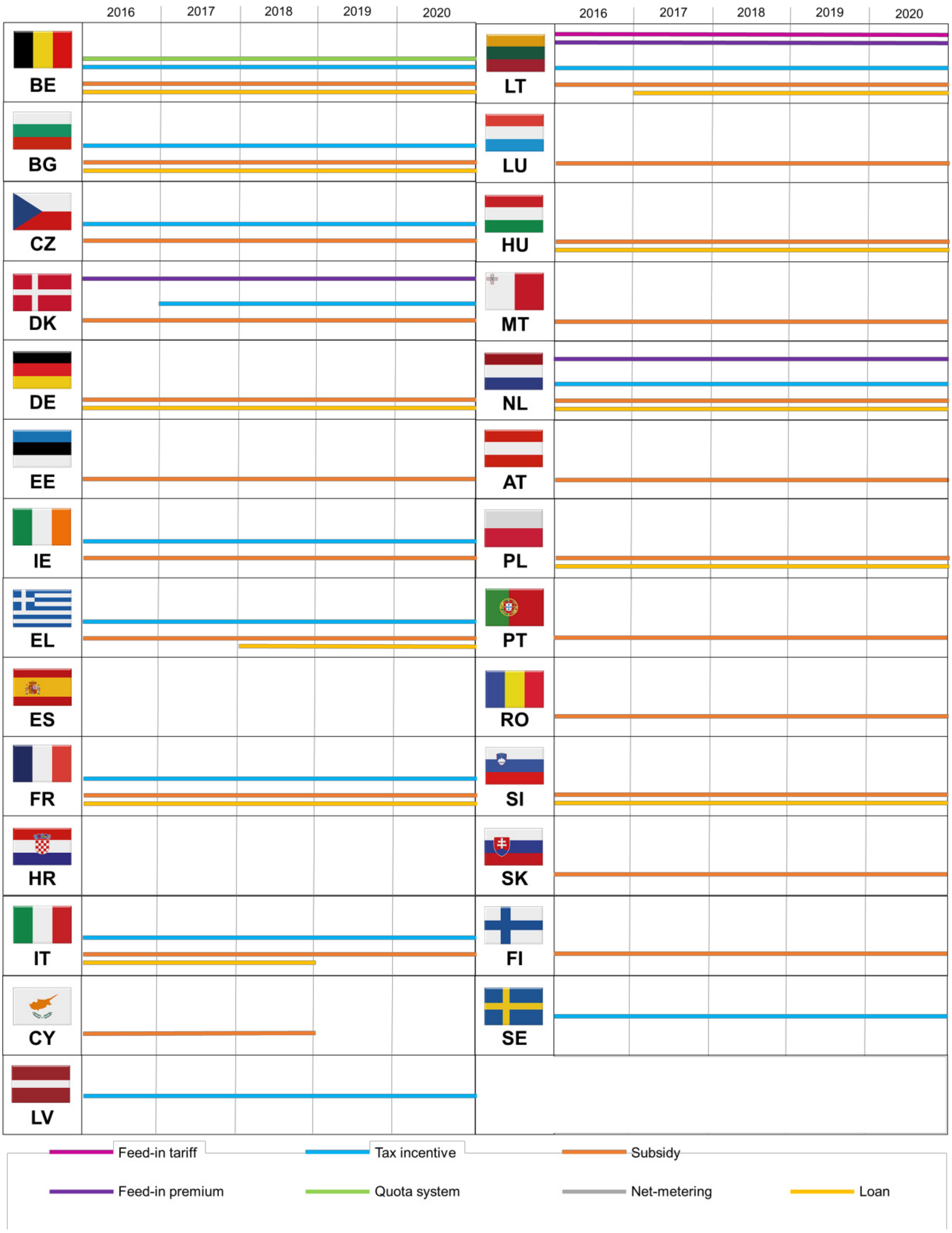


**Figure 28. Overview of the support schemes in the RES-H&C sector between 2016 and 2020. Source: Member States Reports & Guidehouse elaboration on previous work**

### 3.4.2 A closer look at guarantees of origin systems

According to the Recast of the Renewable Energy Directive (Directive (EU) 2018/2001) (RED II), Guarantees of Origin (GOs) have the purpose of demonstrating to final consumers the share or quantity of energy from renewable sources in a determined supplier's energy mix and in the energy supplied to consumers under contracts. MS shall ensure that the origin of energy from renewable sources can be guaranteed as such within the meaning of the Directive, in accordance with objective, transparent and non-discriminatory criteria.

Article 19 of RED II prescribes that MS shall ensure that when a producer receives financial support from a support scheme, the market value of the guarantee of origin for the same production is taken into account appropriately in the relevant support scheme. Therefore, MS have different ways to account for supported electricity and, in general, different ways to set up their GO systems.

Table 9 presents an overview of the main features of the GOs systems in the MS. It shows if the GO system covers RES-E, RES-H&C, and/or RE gases. It also clusters MS in three approaches that were identified. First, some MS issue GOs also to supported renewable energy. This is the case for Greece, Finland, the Netherlands, Czechia, Estonia, Cyprus, Lithuania, Poland, Romania, and Sweden. For instance, in Cyprus "issuing of GOs to RES producers is independent of any support received, e.g. investment support or FIT premium. Revenues from GOs will thus be an additional benefit to producers" [65]. The producers in Cyprus have to get approval from RES Fund for trading GOs.

A second approach is not to issue GOs to supported electricity, or to issue GOs but cancelling them right away. Under this approach we find Belgium, Germany, Spain, Ireland, Malta, Austria, and Slovenia. For example, the subsidiary legislation 545.36[66], paragraph 12 of Malta states that "the Regulator shall not issue any guarantee of origin to a producer of energy from RES that receives financial support from a support scheme". Another example is Austria that issues GOs for supported and non-supported renewable energy but only the GOs from non-supported renewable energy plants can be traded internationally, whereas supported GOs must be used for Austrian disclosure purposes[67]. In Slovenia, Gos are issued for supported electricity, but these Gos are cancelled by the Energy Agency in the Slovenian energy market (AGEN-RS) on the names of the Slovenian electricity suppliers based on their market shares in the preceding calendar year[68].

Third, MS can opt for issuing Gos to supported renewable energy, but these Gos are centrally auctioned to compensate for the support costs to renewable energies. In this category we find Italy, Luxembourg, France, Portugal, Croatia, Slovakia, Latvia, and Hungary. For example, in Italy, GOs for supported renewable energy have been auctioned since 2013. The revenues accrued from the auctions are used to compensate the costs of the supported renewable energy[69].

[65] https://www.aib-net.org/facts/national-datasheets-gos-and-disclosure

[66] https://legislation.mt/eli/sl/545.36/eng

[67] https://www.aib-net.org/facts/national-datasheets-gos-and-disclosure

[68] https://www.aib-net.org/facts/market-information/auctioning-gos-aib-members

[69] Ibid.

**Table 9. Guarantees of Origin in the EU. Source: National Datasheets on GOs and Disclosure – Association of Issuing Bodies**

| Country | Type of RES covered in GO certificates | | | Do RES producers receive GOs for subsidized RES-E? | | |
|---|---|---|---|---|---|---|
| | RES-E | RES-H/C | RE gasses | Yes | No, the GOs are not issued or cancelled right away | No, the issued GOs are centrally auctioned |
| Belgium | x | x | x | | x | |
| Germany | x | | | | x | |
| Greece | x | | | x | | |
| Spain | x | | x | | x | |
| France | x | x | x | | | x |
| Portugal | x | | x | | | x |
| Finland | x | x | x | x | | |
| Netherlands | x | x | x | x | | |
| Bulgaria | x | | | | x | |
| Czechia | x | | | x | | |
| Denmark | x | x | | x | | |
| Estonia | x | | | x | | |
| Ireland | x | | | | x | |
| Croatia | x | | | | | x |
| Italy | x | | | | | x |
| Cyprus | x | | | x | | |
| Latvia | x | | | | | x |
| Lithuania | x | | | x | | |
| Luxembourg | x | | | | | x |
| Hungary | x | | | | | x |
| Malta | x | x | | | x | |
| Austria | x | x | x | | x | |
| Poland | x | x | | x | | |
| Romania | x | | | x | | |
| Slovenia | x | x | | | x | |
| Slovakia | x | | | | | x |
| Sweden | x | | | x | | |

Besides, we analysed the evolution of GOs issuance over time from the statistics publicly available at the website of the Association of Issuing Bodies (AIB)[70]. As shown in Figure 29, GO issuing have been steadily increasing since 2011. Early adopters in 2011 were Austria, Belgium, Denmark, Finland, France, Germany, Italy, Luxembourg, Netherlands, Portugal, Slovenia, Spain and Sweden. Some MS presented a faster growth in GOs, for example, Spain went from a 3% share of total GOs issued in EU-27 in 2011 to a 17% in 2020. Austria, evolved from a 2% in 2011 to 9% in 2020, and France moved from 7% to 12% in 2020. If we consider only the national growth of issuing GOs, Luxemburg, Portugal, and Slovenia were the three MS that increased relatively the issuance of GOs the most.

[70] https://www.aib-net.org/facts/market-information/statistics

Luxembourg issued 375 certificates in 2011 and 721,645 in 2020. Portugal issued 146,606 certificates in 2011 and 12,321,771 in 2020. In 2011, Slovenia issued 72,917 certificates and in 2020 4,514,751.

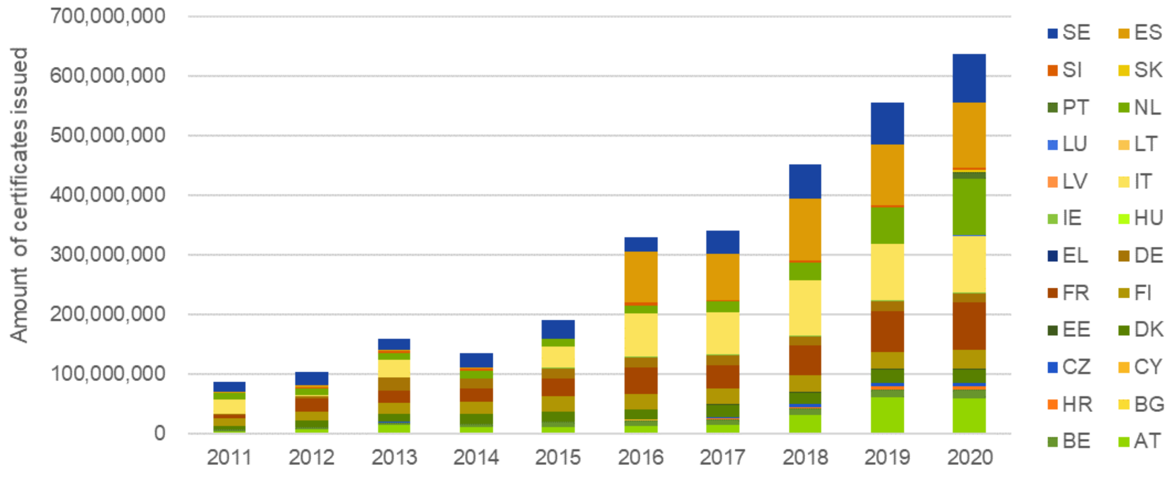


**Figure 29 Annual issuing of total GO certificates per country. Source: AIB Statistics**

AIB does not provide data for GOs issued per fuel type per Member State for the time period. It does, however, provide information per fuel in an aggregated way. Figure 30 below provides an overview of the total GOs issued by all AIB members per fuel type. The biggest contributor is hydro energy, followed by wind energy which is rapidly increasing from 2015 onwards.

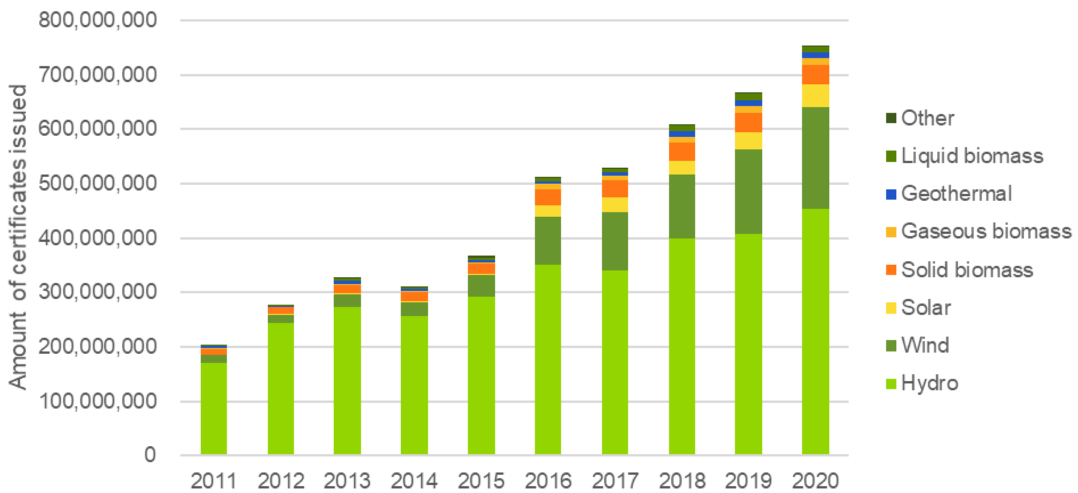


**Figure 30 Annual issuing of GO certificates per fuel type. Source: AIB Statistics**

Considering the submitted MS reports, the following countries mentioned GOs' related policy changes or updates:

- **Poland** informed that the nature of the RES-E guarantee of origin was modified in July 19, 2019 through and amendment to the RES Act. Since then, the guarantee of origin is not only a certification that the amount of electricity injected into the grid was generated from RES, but it is also a document certifying to the end user the environmental values resulting from avoided GHG emissions. As a result, guarantees

of origin covering electricity generated in the period after the entry into force of the abovementioned amendment contain data on the estimated value of avoided GHG emissions due to the generation of RES electric.
- **Belgium** (Walloon Region) put in place a GO framework for heat in 2020 based on the existing GO framework for gas and electricity.
- **Portugal** reported establishing a mechanism for issuing GOs for electricity in 2013
- **Finland** reported implementing GO frameworks for electricity, gas, hydrogen, heating, cooling, waste heat and waste cold, and nuclear power. The original act from 2013 was updated in 2019 and 2020, and came into force in 2021.

The MS did not report any new or additional measures to make the system reliable. However, in the previous PREBS report[71], most member states reported to have measures in place to make the system reliable and prevent fraud. Bulgaria and Luxembourg did not provide information on this topic in their reports, it was not applicable to Malta and Romania as they did not have a GO system in place, and Greece reported that they did not have additional specific measures to make the system reliable or prevent fraud.

### 3.4.3 A closer look at simplification of administrative procedures measures

The RES Directive and RED II/, include prescriptions for MS to streamline and simplify administrative procedures of RES projects as detailed in Table 10.

**Table 10. Simplification of administrative procedures rules in the EU Directives**

| Simplification of administrative procedures rules | Legal source |
|---|---|
| MS shall ensure that rules concerning the authorisation, certification and licensing procedures are proportionate and necessary | Article 13 RES Directive and article 15 RED II |
| MS shall take appropriate steps to ensure the respective responsibilities of national, regional and local administrative bodies are clearly coordinated and defined, with transparent timetables | Article 13 a) RES Directive |
| Ensure that comprehensive information on the processing of authorisation, certification and licensing applications for RES installations are made available at the appropriate level | Article 13 b) RES Directive |
| Ensure administrative procedures are streamlined and expedited at the appropriate administrative level | Article 13 c) RES Directive and article 15 a) RED II |
| Ensure that rules governing authorisation, certification and licensing are objective, transparent, proportionate, do not discriminate between applicants and take fully into account the particularities of individual RES technologies | Article 13 d) RES Directive and article 15 b) RED II |
| Ensure that administrative charges paid by consumers, planners, architects, builders and equipment and system installers and suppliers are transparent and cost-related | Article 13 e) RES Directive and article 15 c) RED II |

[71] European Commission, Directorate-General for Energy, Horváth, G., Schöniger, F., Zubel, K., et al., *Technical assistance in realisation of the 5th report on progress of renewable energy in the EU : task 1-2 : final report*, Publications Office, 2020, **https://data.europa.eu/doi/10.2833/325152**

| Simplification of administrative procedures rules | Legal source |
|---|---|
| MS shall ensure simplified and less burdensome authorisation procedures, including through simple notification if allowed by the applicable regulatory framework, are established for smaller projects and for decentralised devices for producing energy from renewable sources, where appropriate | Article 13 f) RES Directive and article 15 d) RED II |
| MS shall provide for either priority access or guaranteed access to the grid-system of electricity produced from RES | Article 16 2. RES Directive |
| MS *may* establish a single administrative body responsible for processing authorisations, certifications and licensing applications | Article 22, 3.a RES Directive |
| MS *shall* set up one or more contact points (one-stop-shop) to guide the applicant through the entire administrative permit application and granting process | Article 16 1) Directive RED II |
| MS *may* provide for automatic approval of planning and permit applications for RES installations where the authorising body has not responded within the set time limits | Article 22, 3.b RES Directive |
| MS may indicate geographical locations suitable for exploitation of RES in land-use planning | Article 22, 3.c RES Directive |
| Applicants *shall* be allowed to submit relevant documents also in digital form. | Article 16 2) RED II |
| Without prejudice to obligations under applicable Union environmental law, to judicial appeals, etc, the permit-granting process shall not exceed two years for power plants or three years under extraordinary circumstances. For installations with an electrical capacity of less than 150 kW, the permit-granting process shall not exceed one year or two years under extraordinary circumstances. | Article 16 4) RED II |
| MS shall establish a simple-notification procedure for grid connections whereby installations or aggregated production units of renewable self-consumption and demonstration projects with and electrical capacity of 10.8 kW or less, are to be connected to the grid following a notification to the distributions system operator (DSO). | Article 16 5) RED II |
| MS shall establish a simple-notification procedure for grid connections of RES small-scale installations | Article 17 1); 2) RED II |

According to article 36 of RED II, by 30 June 2021 MS shall adopt the necessary regulations and measures to comply with articles 15, 16 and 17 (among others). Although the guidelines and rules of RED II were not mandatory during the period considered (2011-2020), some MS have already implemented simplification measures of this Directive by 2020 and can be considered as a good practice.

Building on the previous project "Technical assistance in realisation of the 5th report on progress of renewable energy in the EU" and in the RES Simplify project, we present in Table 11 an overview of the situation of different indicators in each MS. The following **indicators** are included:

- One-stop-shop
- Automatic permission after deadline passed
- Framework foreseeing geographical locations for RES in land-use planning and district heating
- Priority of RES connection to the grid
- Online application available (Digital documents)
- Maximum time limit for administrative procedures of 2+1 an 1+1 years
- Facilitated procedures for small-scale projects
- Simple-notification for grid connection of small-scale installations

The **sources** of the analysis are:

- MS submitted reports (Article 27 Governance Regulation)
- Previous report on the "Technical assistance in realisation of the 5th report on progress of renewable energy in the EU final update report"[72]
- National reports of the project RES Simplify[73]

**Table 11. Overview of the status of the EU27 Member States on the implementation of indicators from the RES Directive and RED II by 2020**

| Indicators from RES Directives 2009/28/EC and 2018/2001 | BE | BG | CZ | DK | DE | EE | IE | EL | ES | FR | HR | IT | CY | LV | LT | LU | HU | MT | NL | AT | PL | PT | RO | SI | SK | FI | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| One-stop-shop (contact point) | Yes | No | No | Yes | Yes | No | No | No | No | Yes | No | Yes | No | No | Yes | No | Yes | No | Yes | Yes | No | No | No | No | No | Yes | No |
| Automatic permission after deadline passed | No | No | No | Yes | No | No | No | No | No | No | No | Yes | No | No | Yes | No | Yes | No | Yes | No | No | No | No | Yes | Yes | No | No |
| Framework foreseeing geographical locations for RES in land-use planning and district heating | Yes | No | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Partly | No | No | Yes | Partly | No | No | No | Yes | Yes | Yes | No | No |
| Priority of RES connection to the grid | Yes | Yes | Yes | Yes | Yes | No | Yes | No | No | No | No | Yes | Yes | No | Yes | No | Yes | Yes | Yes | No | Yes | No | Yes | Yes | Yes | No | No |
| Online application available (Digital documents) | Partly | Yes | No | Yes | Yes | Yes | No | Partly | Partly | Yes | No | Partly | No | No | Partly | No | Yes | Partly | Yes | No | No | No | No | Partly | Partly | Partly | Partly |
| Maximum time limit for administrative procedures of 2+1 an 1+1 years | No | No | No | No | No | No | No | No | No | Yes | No | No | No | No | Yes | No | No | No | No | No | No | No | No | No | No | No | Yes |
| Facilitated procedures for small-scale projects | No | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Partly | Yes | Yes | Yes | Yes | Yes | Yes | No |
| Simple-notification for grid connections of small-scale projects | No | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No | No | Yes | No | No | Yes | No | Yes | Yes | Yes | No | No | Yes | No | No |

Yes
No
Partly

From the 27 MS, 10 MS have in place some sort of **one-stop-shop approach or national contact point**. For example, Finland reported the establishment of a contact point for the permit granting process in 2020. The Centre for Economic Development, Transport and the Environment (ELY Centre) of South Ostrobothnia has been designated as the contact point for the whole territory of Finland. The contact points shall, upon request by the applicant, guide through and facilitate the entire administrative permit application and granting process. The applicant shall not be required to contact more than one contact point for the entire process. The permit-granting process shall cover the relevant administrative permits to build, repower and operate plants for the production of energy from renewable sources and assets necessary for their connection to the grid.[74]

[72] European Commission, Directorate-General for Energy, Klessmann, C., Sach, T., Grigiene, M., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU final update report. Task 1 & 2, Publications Office of the European Union, 2021, https://data.europa.eu/doi/10.2833/559777

[73] European Commission, Directorate-General for Energy, Tallat-Kelpšaitė, J., Brückmann, R., Banasiak, J., et al., Technical support for RES policy development and implementation : simplification of permission and administrative procedures for RES installations (RES simplify): interim report, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2833/239077 **and** national reports from https://www.eclareon.com/de/projects/res-simplify

[74] https://www.finlex.fi/fi/laki/alkup/2019/20190126

In few cases the silence of the administration (missed deadlines) leads to **automatic approval of permits**. For instance, in the Netherlands' RES Simplify report it was informed that for permits for physical aspects "the deadline for the decision-making process under the standard procedure is 8 weeks, which may be extended once by further 6 weeks at most. Missed deadline will automatically result in issue of a permit (under the principle of lex silencio positivo)"[75].

The deployment of new RES projects can generate opposition from local communities and civil society organizations. Hence, **identifying geographical locations for RES** in land-use can be a good policy to reduce opposition and manage land scarcity. Some MS have in place RES spatial planning measures, such as maps indicating areas where RES could be developed, but with limited effect as they are not mandatory. For instance, Spain elaborated two maps for wind and solar power, which classifies land into five environmental sensitivity classes for each type of project analysed (maximum, very high, high, moderate and low). However, the maps are only informative and do not replace or ease the necessary administrative steps, such as the EIA[76].

The situation regarding **online application** procedures and digitisation of documents is mixed across the EU. Few MS offer reliable and broad online procedures, and the trend observed in most MS is to start implementing more digital tools to ease the process.

According to the RES Simplify national reports, only France, Lithuania and Sweden account for the **maximum time limit rule** of 2+1 and 1+1 years (Article 16 RED II). However, as stated above, this measure was not mandatory until 30 June 2021 (Article 36 RED II).

Most MS have implemented some sort of **simplification for small-scale projects**, such as solar PV installed in rooftops to facilitate self-consumption and energy communities. In addition, 15 MS adopted the **simple notification procedure** for grid connections of small-scale installations of Article 17 RED II.

Besides, some MS informed about measures to simplify administrative procedures in their reports (Article 27 Governance Regulation), as described below.

**Bulgaria** reported a modification of the Spatial Planning Act in 2019 to simplify the administrative procedures for construction of RES-E and RES-H&C facilities with a total installed capacity of up to 1 MW. According to the amendments, an approval of investment projects is not required for the issuance of a building permit for RES-E and RES-H&C installations with a total installed capacity of up to 1 MW, including, on the existing buildings in urban areas and on their roof and facade constructions. In these cases, the opinion of a design-, electrical-, or heat-engineer is required, with drawings, diagrams, calculations and instructions for their implementation, as well as an opinion setting out the conditions for connection to the distribution network[77].

[75] https://www.eclareon.com/de/projects/res-simplify

[76] Ibid.

[77] Spatial Planning Act https://www.mrrb.bg/bg/zakon-za-ustrojstvo-na-teritoriyata-84665/

Besides, Bulgaria also shortened the deadlines in the procedures for connecting sites to the respective network, as well as reduction of the administrative burden. With the amendment of Ordinance № 6 of 24.02.2014 on connection of producers and customers of electricity to the transmission or distribution electricity networks, the deadlines of the procedures for connection of sites to the respective network were shortened, as well as the administrative burden in these procedures were reduced by dropping the requirements for submission some of the documents for which an official reference can be made by the operators of electric networks[78].

**France** reported that the delay of legal procedure against onshore wind was shortened. Since 2018, appeals brought against building permits, authorizations to occupy the public domain, authorizations to operate, and all administrative decisions relating to onshore wind projects can only be challenged before the administrative courts of appeal, in first and last resort[79]. The goal is the acceleration of litigation relating to onshore wind farms and their related works. Similarly, since 2020 litigation regarding offshore wind projects is addressed through a measure to accelerate the legal procedure. The measure states that the appeals brought against building permits, authorizations to occupy the public domain, authorizations to operate and all administrative decisions relating to offshore wind projects can only be challenged before the "Conseil d'Etat" in first and last resort[80].

The simplification of onshore wind farm permitting was also reported in France through the creation of a unique authorization procedure regrouping all the possible needed authorization concerning a project in 2017 (Natura 2000, protection of the environment, water law, etc.)[81].

In **Portugal**, Decree-Law nº 162/2019 established the legal scheme applicable to self-consumption of renewable energy, individual, collective or by renewable energy communities. In order to foster the distributed production and self-consumption of energy from renewable sources, this legal framework: (i) enables and fosters individual self-consumption; (ii) enables and fosters collective self-consumption; (iii) enables the formation of energy communities. It allows citizens, companies and other public and private entities to produce, consume, share, store and sell the energy produced from RES[82].

Already in 2009, **the Netherlands** introduced the Government Coordination Rule for onshore wind projects exceeding 100 MW. This rule means that, in these projects, the Minister of Economic Affairs is responsible for spatial planning and for coordinating the attribution of environmental and other permits. The bureau energy projects (located with RVO) assists governments, project initiators and residents in the complex participation and decision processes.[83]

In 2018, **Latvia** introduced simplified requirements for the connection of micro-generators (up to 11.1 kW) through the Regulator Board Resolution No.1/7. The draft agreement is intended to provide a simplified procedure for connecting micro-generators to electricity generation systems for own consumption. In addition, an amendment to the Electricity

[78] Ordinance amending and supplementing Ordinance № 6 of 24.02.2014 on connection of producers and customers of electricity to the transmission or distribution electricity networks (Promulgated, SG No. 76 of 27.09.2019, effective from September 27, 2019)

[79] Art. 23 du Décret n° 2018-1054 du 29 novembre 2018 relatif aux éoliennes terrestres, à l'autorisation environnementale et portant diverses dispositions de simplification et de clarification du droit de l'environnement.

[80] Article 55 LOI n° 2020-1525 du 7 décembre 2020 d'accélération et de simplification de l'action publique (1)

[81] Ordonnance n° 2017-80 du 26 janvier 2017 relative à l'autorisation environnementale

[82] https://data.dre.pt/eli/dec-lei/162/2019/10/25/p/dre/pt/html

[83] https://www.rijksoverheid.nl/documenten/kamerstukken/2020/04/09/wijziging-van-de-elektriciteitswet-1998-en-gaswet

Market Act was adopted in January 2020, which eliminates the need for the Ministry of Economy to approve the installation of micro-generators. This simplification in the administrative procedure is intended to help people who want to generate electricity from RES for their own consumption to overcome administrative barriers. Since 1 April 2020 households no longer have to pay the variable share of the electricity mandatory procurement component for the amount of electricity generated by them[84].

## 3.5 Analysis of successful policies and measures and recommendations towards further renewables development

### 3.5.1 Successful policies and measures

After processing and summarising the MS reports, we took a closer look at policies and measures that could indicate they were particularly successful in triggering further renewable development.

Based on the quantitative analysis conducted in section 2, we first identified some examples of MS that showed not only a steep increase at some point in the RES share in any of their sectors but also a continuous growth during the last ten years (2011-2020). We avoided cases with irregular growth, i.e., steep growth but then downward slopes, as they could indicate boom-and-bust cycles (as seen for past PV deployment in several countries, e.g. Czech Republic or Spain). Therefore, continuity of RES deployment is also considered as an indicator for success.

As a second step, we checked if the observed growth path can plausibly be related to specific policies and measures or whether it is also related to other circumstances that could explain the observed trend.

Third, we provided a qualitative, more detailed analysis of the successful policies.

Finally, based on the quantitative and qualitative analyses conducted, we elaborated a general set of recommendations that could be replicated in other MS.

We present the findings structured by sector.

#### *3.5.1.1 RES-E*

In the RES-E sector, we observed the data for installed capacity per technology in the last ten years (2011-2020) to identify steep and sustained growth trajectories that could indicate successful cases (Table 12). From the multiple examples of support policies in the EU, we highlight as successful cases the following:

- Denmark: technology specific auction for wind offshore. The auction offered first a two-sided sliding FIP (CfD) (2015-2016), then a fixed FIP (2018-2019) and finally a CfD (Thor auction, 2021)
- Germany: technology specific auction for solar PV. The auction offered a one-sided sliding FIP (from 2015 onwards)
- The Netherlands: technology neutral auction (SDE+), focus put on solar PV. Also, separate auction for wind offshore
- Sweden: certificate/quota scheme, analysis for wind onshore

[84] https://www.em.gov.lv/en/news/27970-conditions-for-net-system-users-have-been-simplified

**Table 12. RES-E Installed capacity by technology (2011 - 2020) (MW). Source: Eurostat SHARES**

| MS | Technology | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **DK** | Wind offshore | 871 | 922 | 1,271 | 1,271 | 1,271 | 1,271 | 1,264 | 1,701 | 1,701 | 1,701 |
| **DE** | Solar PV | 25,914 | 34,075 | 36,708 | 37,898 | 39,222 | 40,677 | 42,291 | 45,156 | 48,912 | 53,719 |
| **NL** | Wind offshore | 228 | 228 | 228 | 228 | 357 | 957 | 957 | 957 | 957 | 2,460 |
| **NL** | Solar PV | 149 | 287 | 650 | 1,007 | 1,526 | 2,135 | 2,911 | 4,608 | 7,226 | 10,950 |
| **SE** | Wind onshore | 2,601 | 3,443 | 3,981 | 4,875 | 5,606 | 6,232 | 6,408 | 7,097 | 8,478 | 9,773 |

As mentioned in the previous section, auctions have been widely adopted by many MS as competitive mechanisms to allocate support more efficiently and to foster and guide further RE deployment. Auctions contribute to lowering the costs of RES support and maintaining effective control of the volume of new installations and/or the total budget spent. The reduction of support costs is also explained by market developments, such as the general decrease in technology costs over time (further details in section 3.2.3).

Auctions are powerful tools that can be used to allocate goods and services. In the case of RES-E, MS have used auctions to allocate different types of support payments, such as FIP or CfD. Policymakers can decide on multiple design elements to configurate the auction. For instance, design elements determine the requirements to qualify and participate, the constitution of guarantees, the volume to be auctioned, minimum or maximum prices, among many others. Auctions can also allow the participation and thus competition of multiple technologies or rather of only one technology, for example, wind offshore. Some auction rounds in MS have not been always successful though. For instance, if there is not enough competition or if bidders place their bids with gaming behaviour, the efficiency of the allocated support could be undermined.

In **Denmark**, many wind offshore technology specific auctions have taken place since the first one in 2004[85]. More recently, further wind offshore auctions were held in 2015 (Horns Rev 3) and 2016 (Nearshore Wind and Kriegers Flak)[86] as well as the Thor auction in 2021. As presented in Table 12, wind offshore has been growing in a sustained path over years without major boom cycles which reflect the continuity of wind offshore auctions since 2004.

The main features of these auctions can be summarised as being single-item, technology specific, for projects with predefined size and location. The pricing rule was pay-as-bid and the support scheme was a sliding premium tariffs (two-sided Contract for-Differences) for a fixed amount of produced electricity (corresponding to approx. 12-15 years support duration)[87].

The particularities of these auctions that makes them a good example are manifold.

[85] Report D4.1-DK, December 2015. Auctions for Renewable Support in Denmark: Instruments and lessons learnt. Authors: Lena Kitzing (DTU), Paul Wendring (DTU) http://aures2project.eu/wp-content/uploads/2021/07/pdf_denmark.pdf

[86] After 2016, Denmark held multi-technology auctions offering a fixed premium.

[87] D2.1-DK, December 2019, Auctions for the support of renewable energy in Denmark. Authors: Mario Garzón González, Lena Kitzing (DTU) http://aures2project.eu/wp-content/uploads/2019/12/AURES_II_case_study_Denmark.pdf

First, the Danish authorities preselect a geographical location for the project to be auctioned which considerably reduces risks and costs for bidders.

Second, in auctions with large scale offshore wind farms, Energinet.dk (independent Transmission System Operator (TSO)) constructs, owns and maintains both the transformer station and the underwater cable that carries the electricity to land from the offshore wind farm[88], which in turn also facilitates the realisation of larger wind offshore projects. For the Thor tender (2021), the grid connection costs and the responsibility for grid connection moved to the developer and the support scheme adopted is a capped CfD[89].

Besides, there have been other policy measures accompanying the auctions to mitigate the barrier of social acceptance of offshore wind projects. As reported in AURES II[90], the legal framework introduced three measures to increase social acceptance: a compensation scheme for citizens whose properties' value has decreased due to the installation of a wind farm; a community benefit scheme to promote local nature restoration projects or the installation of RES in public buildings; and the possibility of co-ownership, which allows local citizens to purchase shares from wind energy projects.

The Danish auctions have been reported to be cost-efficient, as they have achieved significant reductions in support levels[91]. The reduction is support costs can also be related to macro factors, such as the renewable energies have benefited from decreasing technology costs and lower cost of capital in the period analysed (see section 3.2.3).

**Germany** introduced its first RE auction in April 2015 to grant a support scheme for ground-mounted solar PV under the ground-mounted PV Auction Ordinance. In 2017, the Renewable Energy Sources Act (EEG, Erneuerbare-Energien-Gesetz) was amended and auctions for onshore wind, offshore wind, and biomass were introduced. The amendment marked the broad shift from administratively-set support to auctions. As a principle, to receive support, producers need to participate in an auction round. Only for installations below de-minimis thresholds or pilot installations can benefit from administratively-set support payments. Germany also conducted multi-technology auctions for solar PV and onshore wind and the so-called innovation auctions as a technology-neutral auction.

The EEG determined a regular auction schedule for each technology, specifying dates and tender volumes for the upcoming years. The main goal of auctions under the EEG has been the competitive determination of market premiums for RES-E as well as the precise steering of volumes in line with the capacity addition targets set for each technology[92].

[88] https://ens.dk/en/our-responsibilities/wind-power/offshore-procedures-permits

[89] European Commission, Directorate-General for Energy, Gephart, M., Boeve, S., Klessmann, C., et al., Recommendations for an integrated framework for the financing of joint (hybrid) offshore wind projects : final report, Publications Office, 2020, https://data.europa.eu/doi/10.2833/269908 and OffshoreWindBiz, 2019. Denmark Rolls Out New Subsidy Scheme for Offshore Wind. https://www.offshorewind.biz/2019/11/15/denmark-rolls-out-new-subsidy-scheme-for-offshore-wind/

[90] D2.1-DK, December 2019, Auctions for the support of renewable energy in Denmark. Authors: Mario Garzón González, Lena Kitzing (DTU) http://aures2project.eu/wp-content/uploads/2019/12/AURES_II_case_study_Denmark.pdf

[91] D2.1-DK, December 2019, Auctions for the support of renewable energy in Denmark. Authors: Mario Garzón González, Lena Kitzing (DTU) http://aures2project.eu/wp-content/uploads/2019/12/AURES_II_case_study_Denmark.pdf

[92] D2.1-DE, December 2019, Auctions for the support of renewable energy in Germany Authors: Thobias Sach, Bastian Lotz, Felix von Blücher (Navigant), http://aures2project.eu/2020/02/05/auctions-for-the-support-of-renewable-energy-in-germany/

The allocated support has been generally a sliding market premium for a period of 20 years. Technology-specific average day-ahead market prices are determined on a monthly basis for the calculation of the market premium paid out to awarded projects.

While wind onshore auctions have offered a mixed picture mainly due to undersubscription in several auction rounds, solar PV auctions have been particularly successful in terms of competition and its rounds have been oversubscribed[93]. The realisation rates of the solar PV auction rounds have been also very high ranging from 90 to 100%.

Besides, the solar PV auction rounds have also shown to be cost effective because the weighted average price of successful bids went down substantially since the introduction of auctions. Between the first auction in 2015 to the 2019 auction, the weighted average price decreased 47 %, from 9.17 ct/kWh to 4.9 ct/kWh[94].

The transparent auction schedule has also been a positive element of the German auction schemes. There were 3 solar PV rounds per years (2015-2018), which increased to 5 rounds in 2019. The high frequency of auction rounds has contributed to increasing the planning security for the bidders and enabling the observed continuous RES development (Table 12).

The German case has shown that ensuring the right level of competition and a transparent, high frequency of auction rounds are key success factors for RE auctions. In addition, relatively low auctioned volume per round was chosen to mitigate possible disruptions in the transition towards an auction-based system, support continuous RES deployment, reduce uncertainty in the industry and thereby mitigate boom and bust cycles[95].

The case of the **Netherlands** is remarkable since it was the first MS to introduce a large-scale technology neutral auction in 2011. The auction is known as SDE+ (*"Stimulering Duurzame Energie"*). Besides the SDE+ scheme, there have been technology-specific auctions for offshore wind. In 2020 the SDE+ scheme was replaced by the SDE++ auction. As presented in Table 1Table 12, solar PV has experienced a strong increase from 2017 to 2020. In total, the yearly installations of solar PV have increased by a factor of nearly 10 in the last ten years (comparing 2020 to 2011). Besides, wind offshore shows a steep surge from 2015 to 2016 and from 2019 to 2020.

The SDE+ is a technology neutral auction with the objective of increasing RES generation at the lowest possible cost. It includes not only electricity generation, but also renewable gas and renewable heat. The technologies that can compete are biomass, geothermal, hydro, solar photovoltaics, solar thermal, and onshore wind energy, which all compete under a single budget[96]. Support is auctioned until all budget is used up in a multiple-item sealed-bid auction. The budget increased from €1.7 billion in 2011 to €12 billion in 2017 and 2018. Offshore wind energy is auctioned under a separate budget since 2015.

As reported in the AURES II auction database, selected bids are awarded a "one-sided sliding FIP but it is based on a yearly "correction amount" (i.e., yearly electricity market

[93] The solar PV auction rounds have ensured sufficient competition. For example, between 2015 and 2019 the volume of bids accumulated to 9 GW whereas the auctioned volume was 3 GW. The AURES II database shows that auction rounds have been oversubscribed.

[94] D2.1-DE, December 2019, Auctions for the support of renewable energy in Germany Authors: Thobias Sach, Bastian Lotz, Felix von Blücher (Navigant), http://aures2project.eu/2020/02/05/auctions-for-the-support-of-renewable-energy-in-germany/

[95] Ibid.

[96] D2.1-NL, December 2019, Auctions for the support of renewable energy in the Netherlands Authors: Martin Jakob, Paul Noothout, Felix von Bluecher, Corinna Klessmann (Navigant). http://aures2project.eu/wp-content/uploads/2019/12/AURES_II_case_study_Netherlands.pdf

reference value) that cannot be lower than a predetermined, technology-specific "base energy price" (floor price) "[97].

The SDE+ scheme did not succeed in achieving significant support reductions though and the results provide a mixed picture. A successful solar PV capacity increase can be seen only in more recent years. Before, the results showed relatively high costs, at least for the non-marginal technologies that could be sure to be awarded and therefore bid close to the technology-specific ceiling price. In order to reduce this kind of strategic behaviour the Netherlands Enterprise Agency (RVO) stopped publishing interim results.

However, the success of the SDE+ relies on the learning and adaptive process the scheme saw over years as it has been continuously changed and improved to overcome challenges. For example, the initial high rates of non-realization of projects until 2014 were addressed through mandatory feasibility studies and stricter permit requirements[98].

A positive feature of the SDE+ was its regular frequency of two auction rounds a year since 2016, one in spring and one in fall. A transparent, long-term frequency plan communicated in advance is a positive characteristic that brings security to investors, lowers risks, allows for a more organized competition (avoiding aggressive bidding[99]), facilitates economies of scale and provides predictability for other sectors connected to renewables, as banks and manufacturers.

Regarding the separate offshore wind auction, similar to the commented Danish case, offshore sites for wind power were pre-developed and the costs of grid connection were covered by the TSO. In turn, a total of 3,7GW of offshore wind capacity has been awarded under the offshore auction.

For offshore wind, the guarantees of origin provided to installations can help explaining the zero subsidy bids received in the Hollandse Kust Zuid auction (2017) and the attractiveness of the zero-subsidy auction. The guarantees provide them with an additional revenue and making long-term power purchase agreements more attractive, which can be used to mitigate the merchant risk and keep financing costs low[100].

Other factors of different nature also made the SDE+ auctions more successful and triggered the surge in RE installed capacity in the Netherlands. On the one side, the Netherlands has in place a one-stop-shop approach for administrative permits which can be considered a best practice as it considerably reduces the complexity and the duration of the administrative procedures. On the other side, offshore site conditions in the Netherlands are usually excellent, i.e. limited water depths, high wind speeds and close distance to the shore[101].

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[97] D3.1., AURES II Auction Database and D3.2, Updates of auctions database. http://aures2project.eu/auction-database/

[98] Ibid.

[99] Aggressive bidding takes place when bidders offer an extremely low price. For example, when bidders perceive that winning the auction is the only way to become eligible for a grid connection and thus gain access to the wholesale electricity market. If aggressive bidding results in underbidding (i.e., the revenue stream does not cover project costs) there is a risk that the project may not be realised. Source: https://energypost.eu/why-there-is-so-much-aggressive-bidding-at-renewables-auctions-and-what-the-risks-are/

[100] OffshoreWind.biz. (2019, 05 23). Run on Offshore Wind in the Netherlands. Opgeroepen op 09 09, 2019, van www.offshorewind.biz: https://www.offshorewind.biz/2019/05/23/microsoft-to-run-on-offshorewind-in-the-netherlands/

[101] Van Steen, H., Prinsen, B., & Paberzs, M. (2019). Dutch Offshore Wind Market Update 2019. Utrecht: Navigant.

Installed capacities of wind onshore power have experienced a moderate but continuous increase in **Sweden** (2011-2020) as shown in Table 12. Since 2003, Sweden has in place an electricity certificate system, which consists of quota obligations for electricity suppliers in combination with a common electricity certificate market with Norway, which started in January 2012. Each MWh produced receives a certificate that can be freely traded in the market, which creates extra revenues for producers. Electricity suppliers and some electricity customers have the legal obligation of buying electricity certificates to meet a certain quota, which creates the demand for the certificates. The cost of the certificates is included in the electricity bills, i.e., passed on to end users.

According to IEA, "the electricity consumers calculated costs for electricity certificates in Sweden between 2003 and 2016 were between 1.5 and 5.3 Swedish öre/kilowatt hour (kWh) electricity. The average subsidy per megawatt hour generated under the system was in the 18-20 euro (EUR)/MWh range in recent years, relatively low compared to support costs in other European countries, but rather high compared to the average wholesale prices in the Nordic electricity market"[102].

Electricity suppliers, energy-intensive industries and consumers with RES self-consumption or electricity imports from Norway have the obligation to purchase *certificates* for the RES electricity that is sold or consumed. The annual number of certificates needed is set by the *quota*. For example, the 2019 quota was 30.5% and in 2020 it decreased to 28.8%.

The certificates are handed out to producers of renewable energy by the Swedish state for a maximum of 15 years and are tradable[103]. Eligible technologies/renewable energy sources are biofuels, geothermal energy, solar energy, hydropower, wind power and wave energy.

The Swedish certificates market-based policy has been successful by enhancing long-term security of support for wind onshore. Policies in place are stable and transparent from a regulatory perspective and have long planning periods – the certificate system is expected to run at least until 2045. In a fact sheet[104] of the green certificates policy of the Ministry of Sustainable Development back in 2006 it was stated that "It provides sufficient scope for stability and introduces a long-term perspective to stakeholders' investments in renewable electricity production. Further, it creates a sufficiently long planning horizon to enable suppliers with quota obligations to predict developments and act in accordance with the conditions of the system.

Besides, the joint market with Norway allows trading in both Swedish and Norwegian certificates and receiving certificates for renewable electricity production in either country[105].

According to a country report from IEA, "by mid-2016, the electricity certificate system had contributed 16.4 TWh of new renewable electricity supply (normalised annual generation) since the beginning of 2012 when Norway joined the system. Out of this total, 2.9 TWh was generated in Norway and 13.5 TWh in Sweden"[106].

[102] https://www.iea.org/reports/energy-policies-of-iea-countries-sweden-2019-review

[103] https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/lag-20111200-om-elcertifikat_sfs-2011-1200

[104] https://www.government.se/49b73b/contentassets/41902ab952bd49d887367ea10c0eefce/renewable-electricity-with-green-certificates#:~:text=The%20new%20electricity%20certificate%20system,allocation%20of%20certificates%20will%20cease.

[105] https://www.energimyndigheten.se/en/sustainability/the-electricity-certificate-system/

[106] https://www.iea.org/reports/energy-policies-of-iea-countries-sweden-2019-review

The green certificates scheme has not been the only support policy in Sweden. There is also a tax credit of SEK 0.6/kWh for the excess power fed into the grid for hydro, wind, micro-scale solar, geothermal and biomass (since 2015)[107]. Sweden also provides investment grants for solar PV of up to 30% of investment costs[108]. The limit of the investment grant is set to SEK 1.2 million (~€ 116,000) per installation and a total budget of SEK 1423 million (~€ 139 million) is available for the 2017-2019 period.[109] In its MS report, Sweden indicated that since 2009 there has been state aid for the installation of solar cells. The aid is aimed at all kinds of operators, such as businesses, public organisations and private individuals. The combination of the quota system with investment support for less competitive technologies has proven to be a solid combination to foster RES deployment.

#### *3.5.1.2 RES-T*

In each MS, we observed the evolution of the RES share in the transport sector in the last ten years and considering their policy frameworks we found that the most interesting cases are Bulgaria, Ireland, and Sweden.

These MS have shown almost constant growth over the last ten years. As can be seen in the Figure 31, Figure 32, and Figure 33, their growth does not show major fluctuations, but rather an orderly growth, which may indicate a successful policy in the background.

As reported in the previous project "Technical assistance in realisation of the 5th report on progress of renewable energy in the EU"[110] the predominant support scheme for RES-T in the EU is a biofuel quota obligation. The only MS that did not use a quota as main support scheme for RES-T until 2018 were Sweden and Estonia. While Sweden relied on tax incentives, Estonia's main instruments in the past were subsidies for biomethane consumption and infrastructure. In addition to its tax incentives, Sweden introduced a biofuel quota in April 2018. Estonia followed in May 2018, but also kept its subsidies in place.

In **Ireland** the main policy support for RES-T is a Biofuels Obligation Scheme (BOS) since 2010. Road transport fuel suppliers are obliged to blend certain percentage of biofuels in their annual fuel sales. The initial percentage was 4% and it has been progressively increased up to 11% in 2020[111][112]. The National Oil Reserves Agency (NORA) administers the BOS and issues certificates for each litre of biofuel introduced in the market (that meets the compliance sustainability requirements) and two certificates are issued for biofuels produced from biodegradable waste, residue, non-food cellulosic material, ligno-cellulosic material or algae[113]. NORA keeps records of the issued certificates and of the balance of certificates held by each party[114].

[107] Enerdata (2019): Renewable Energy Support Policies in Europe.

[108] http://www.energimyndigheten.se/fornybart/solenergi/solceller/stod-till-solceller/investeringsstod/

[109] https://www.lagboken.se/Lagboken/lagar-och-forordningar/lagar-och-forordningar/naringsliv/Statligt-stod/d_432161-forordning-2009_689-om-statligt-stod-till-solceller

[110] Report: European Commission, Directorate-General for Energy, Klessmann, C., Sach, T., Grigiene, M., et al., Technical assistance in realisation of the 5th report on progress of renewable energy in the EU final update report. Task 1 & 2, 2021, https://data.europa.eu/doi/10.2833/559777

[111] https://www.nora.ie/biofuels-obligation-scheme.141.html

[112] The percentage was increased to 14.94% in 2022.

[113] https://www.iea.org/policies/5741-ireland-biofuel-obligation-scheme

[114] https://www.nora.ie/biofuels-obligation-scheme/administration.142.html

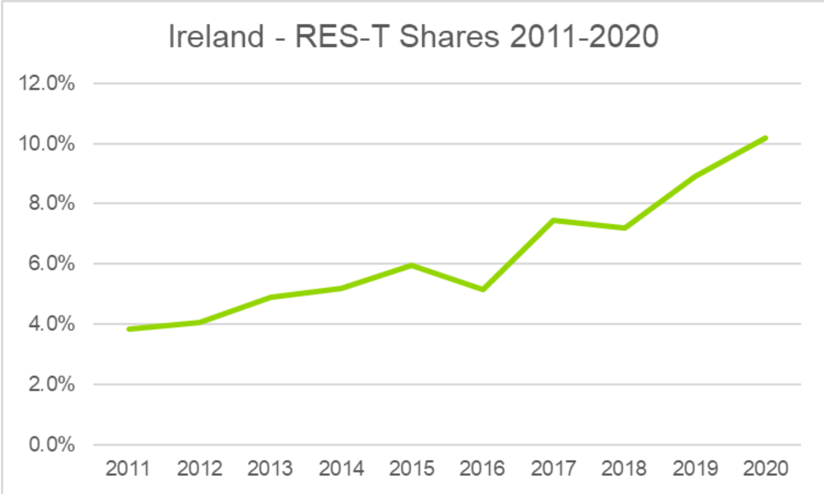


**Figure 31. RES-T Shares in 2011-2020 in Ireland**

The BOS scheme has been in place since 2010 with no unexpected changes, which provides reliability to producers. The government conducted a public consultation in 2017 to understand the views regarding the increasing percentage of biofuels and the future of the scheme. As a response to the public opinions requesting for more certainty to industry to facilitate longer planning, the government published a Policy Statement (2018)[115] where it decided to extend the BOS scheme until at least 2030 with progressive increases in the level of obligation and develop the scheme in line with EU energy policy. Public consultations every two years and in advance of percentage increases will be held. The extension to at least 2030 in addition to the public consultation processes contribute to building a solid and predictable policy framework.

Ireland reported to have a very high level of compliance with the Biofuels Obligation Scheme. The mechanism is also enforced through the requirement to pay a compliance fee when an obligated party does not meet its certificates obligation (€0.45 for each certificate that a supplier is short of their obligation)[116].

From all the MS, **Sweden** has the highest share of RES in the transport sector (31.9%) in 2020. Sweden has in place a strong fiscal policy, i.e. carbon and energy taxes, for which biofuels receive tax exemptions. Biofuels receive deductions for these taxes, ranging up to 100% for the energy tax, depending on the type of biofuel, and 100% of the carbon dioxide tax[117].

[115] https://www.gov.ie/en/publication/08251-biofuels-obligation-scheme-policy-statement/

[116] https://www.gov.ie/en/consultation/2c850-public-consultation-on-the-biofuels-obligation-scheme/

[117] http://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/lag-2010598-om-hallbarhetskriterier-for_sfs-2010-598

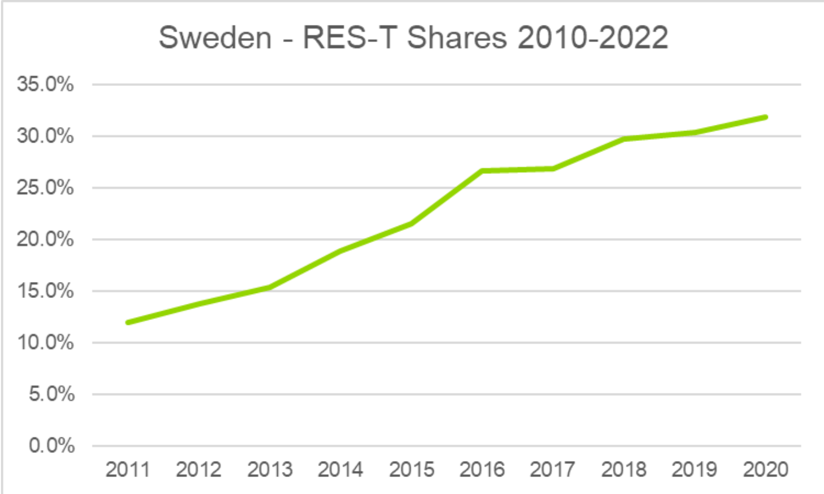


**Figure 32. RES-T Shares in 2011-2020 in Sweden**

The carbon tax was introduced in 1991 and continues to be a key energy and climate policy. Carbon taxes can have a purely revenue-raising purpose but if properly designed, these fiscal policies can send strong signals to the market and incentivize or deter certain polluting activities. In Sweden, the carbon and energy taxes were originally introduced with fiscal purposes and have evolved to become proper policy tools to reach renewable energy and energy efficiency goals[118]. The taxes have been adjusted over time to reflect inflation and economic developments, taking into account the changes in the Consumer Prices Index (CPI) and Gross Domestic Product (GDP)[119]. A timely adjustment of taxes allows them to continue to have an incentive effect. Besides, the tax as well as its exemptions have no reported end date which contributes to predictability.

On 1 July 2018, in addition to the tax exemptions, a reduction obligation was introduced regarding petrol and diesel (and from 2021 also kerosene). Fuel suppliers are obliged to reduce GHG emissions from the respective fuel by a certain percentage (reduction of 40% by 2030)[120]. The government argues that this policy provides a more long-term control tool compared to the tax reductions and also encourage the use of more sustainable biofuels[121].

As reported in its National energy and climate plan (NECP), biofuels blended into gasoline or diesel are covered by the reduction obligation and therefore subject to the same tax per litre as the fossil fuels they are blended with[122].

In 2018, a third policy targeting new light vehicles (passenger cars, light trucks and light buses) was adopted. Sweden introduced a bonus-malus system meaning that low carbon emissions can benefit from a bonus at purchase, whereas vehicles with higher emissions are taxed at a higher rate (malus) for the first three years[123].

RES-T in **Bulgaria** is mainly supported through a combination of a biofuel quota obligation with a fiscal incentive (reduced excise duty).

[118] https://energy.ec.europa.eu/system/files/2020-03/se_final_necp_main_en_0.pdf
[119] Ibid.
[120] http://www.energimyndigheten.se/fornybart/hallbarhetskriterier/reduktionsplikt/
[121] Ibid.
[122] https://energy.ec.europa.eu/system/files/2020-03/se_final_necp_main_en_0.pdf
[123] https://www.government.se/press-releases/2017/05/bonusmalus-system-for-new-vehicles/

The Energy from Renewable Sources Act (ZEVI) introduced an obligation[124] for economic operators placing petroleum-derived liquid fuels to blend them with a bio-component in a specific share, at the time of their release for consumption to achieve the RES-T target of 10 % share,[125]. In its MS Report, Bulgaria indicated that changes regarding the setting of the national mandatory RES-T target of 10 % were made, and a 7 % limit was introduced in the reporting of conventional biofuels to meet the target in the transport sector. A requirement was introduced when calculating the national mandatory RES-T target of 10 % to set a national target for new generation biofuels type "A", which is 0.05 percentage points of energy content of the mandatory share of renewable energy in all modes of transport. The multiplier factor used in determining the amount of electricity from renewable energy consumed by electric road vehicles was corrected - from 2.5 times to 5 times.

To enforce the obligation compliance, considerable financial penalties are in place. The penalties go between BGN 50,000 (approx. €25,564) and BGN 200,000 (approx. €102,298). In addition, non-compliance is also met with the prohibition of selling the respective fuels.

Bulgaria also introduced a fiscal incentive for biofuels in the form of a reduced excise duty rate. The fiscal measures targets petrol with blended bioethanol (of 4-5%) and gas oil blended with biodiesel. The reduced rate is applicable for two years.

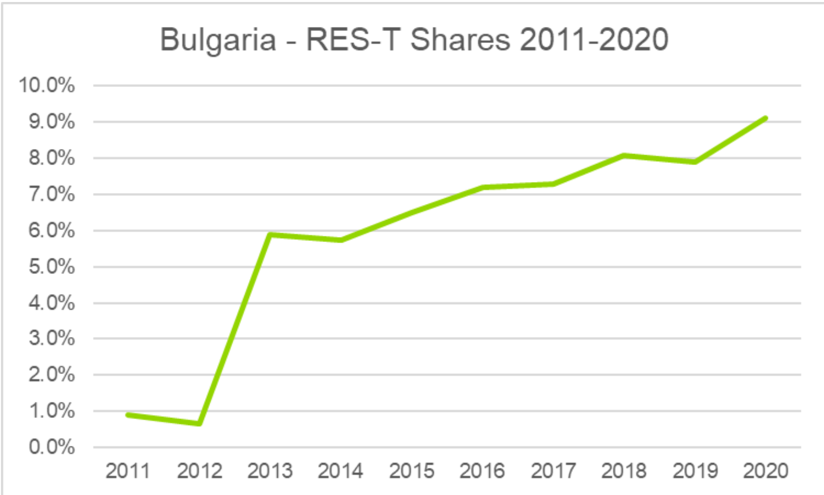


**Figure 33. RES-T Shares in 2011-2020 in Bulgaria**

#### *3.5.1.3 RES-H&C*

We assessed the evolution of the RES shares in the H&C sector in the last ten years (2011-2020) and we observed that the following countries present an interesting evolution worth exploring: Denmark, France and Lithuania.

A major pillar of **Denmark's** renewable energy policies has been the widely adoption of district heating and CHP. In the 1990s, district heating systems running on natural gas were converted to CHP and the systems without natural gas access were mandated to convert to

124 As of 1st of March 2019, the fuel for petrol engines shall contain at least 9% bioethanol produced from biomass. Furthermore, as of 1st of April 2019, diesel fuel shall have a minimum of 6% biodiesel, with at least 1% biodiesel being biofuel of a new generation, i.e., made from wastes such as straw, algae, grape marc, animal manure, sludge.

125 National Energy and Climate Plan: https://ec.europa.eu/energy/sites/ener/files/documents/bg_final_necp_main_en.pdf

biomass and the conversion was supported by subsides[126]. The long-term policy to extend district heating can be seen in the high connection share of households to such systems (64%), which is one of the highest shares in the EU.

Biomass is the dominating renewable energy carrier[127] followed by small shares of heat from solar thermal and waste. Heat pumps, on the contrary, only represented 1.1% of heat generated in 2018[128].

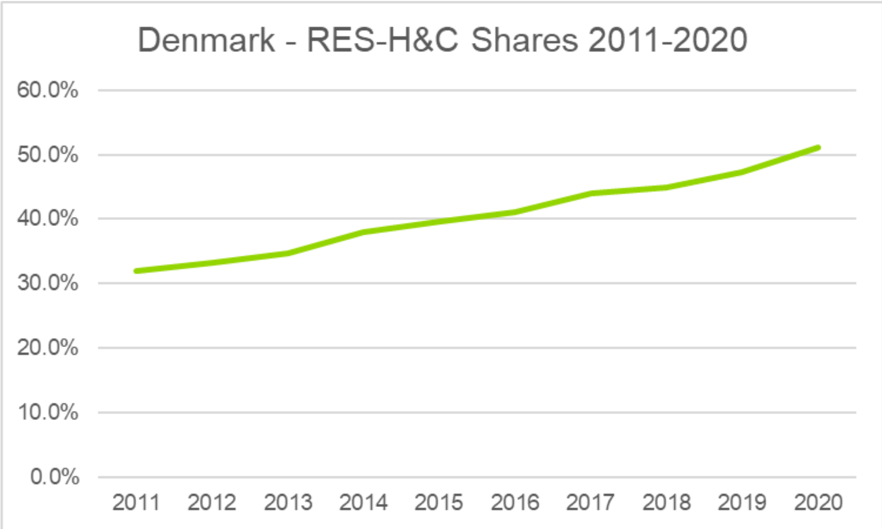


**Figure 34. RES-H&C Shares in 2011-2020 in Denmark**

Another piece of the policy framework is the energy savings initiative (in place until end of 2020). Under this policy, energy companies, such as district heating utilities, are obliged to realise energy savings each year or else buy credit from another entity that generated "extra energy saving points"[129]. This policy creates and incentive to develop district heating units operating with solar energy, heat pumps and electric boilers[130].

Between 2016 and 2020 Denmark offered a heat pump subscription known as "heat as a service". Under this scheme, the heat pump is not owned and serviced by the house owner but by a company[131]. The instrument provided a grant to enterprises that establish, maintain and operate heat pumps for the "heat as a service" scheme, while households pay an initial one-off payment, a fixed monthly subscription fee and a price for heat. As the enterprises are responsible for the operation, they have a strong incentive to run the heat pumps at high efficiency.

As informed in its MS report, in 2020 Denmark approved a set of measures that strengthen the policy framework to support the energy transition in the heating and cooling sector. It introduced a subsidy scheme to replace oil boilers with heat pumps in buildings located in

[126] https://www.ifri.org/sites/default/files/atoms/files/menu_denmark_climate_neutral_europe_2021.pdf
[127] https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccx/2020/The-state-of-renewable-energies-in-Europe-2019.pdf
[128] http://dx.doi.org/10.3390/en13061508
[129] https://www.ifri.org/sites/default/files/atoms/files/menu_denmark_climate_neutral_europe_2021.pdf
[130] Ibid.
[131] Jensen, S.Ø. and Svendsen, A., 2021. Heat as a Service – Evaluation of a Danish Support Scheme for Dissemination of a New Business Concept for Heat Pumps. Danish Energy Agency, Centre for Global Cooperation.

areas without access to district heating or the gas grid[132].It also approved a subsidy scheme to promote new areas for district heating[133], and added funds for a subsidy scheme to promote heat pumps in residential buildings[134].

Besides, Denmark also uses fiscal policies as a tool to reach its renewable energy targets. The energy tax does not apply to renewable energy fuels used for heating purposes. Furthermore, fossil fuels are taxed by their carbon content. In 2020, Denmark adjusted the tax on energy with a reduction in the tax on electricity for heating and an increase in energy taxes for gas and oil for heating[135].

Besides, the Act on the Promotion of Renewable Energy sets a premium tariff for biogas for heating (and transport and processing)[136]. The premium is annually adjusted, based on a transparent rule.

Overall, the support measures in the H&C sector have been in place for long time and with no major changes, which contributes to creating long-term stability of support in this sector.

**France** has different support measures in place to foster RES-H&C development. An energy transition income tax credit was implemented with the goal to increase the number and quality of energy performance works to obtain a stock of 10.2-11.3 million dwellings equipped with wood heating, 8.8 million with heat pumps, 4 million with solar thermal in 2028. The measure tries to reduce the energy consumption of buildings by 15% by 2023 and to renovate, over five years, half of the 1.5 million thermal dwellings inhabited by low-income owner households[137].

A reduced VAT is applied to urban heating network using more than 50% of renewable energy to encourage the development of biomass boilers, heat pumps, fireplace inserts and wood-burning stoves.

In addition, France has created a Heat Fund to provide investment support (subsidies) for the production of heat with RES. In 2018, the budget was estimated at €540 million, and the scheme only focuses on the national call for tenders for large biomass plants with a heat production over 1,000 toe per year[138]. An increase of the Heat Hund to 350 M€/MWh was reported in France's MS report.

France informed the creation in 2019 of the "Coup de pouce chauffage" as part of the energy saving certificates scheme (CEE), which encourages the replacement of inefficient fuel oil, coal or gas heating equipment with efficient or renewable equipment. Households are entitled to premiums (subsidies) to renew heating systems with heat pumps or other RE technologies. The premium varies according to their income level[139].

132 https://www.retsinformation.dk/eli/lta/2020/1415
133 https://www.retsinformation.dk/eli/lta/2020/2306
134 https://www.retsinformation.dk/eli/lta/2020/1467
135 https://www.retsinformation.dk/eli/lta/2020/2225
136 https://www.retsinformation.dk/eli/lta/2018/1194
137 https://www.legifrance.gouv.fr/loda/id/JORFTEXT000041400291
138 https://www.climatepolicydatabase.org/policies/heat-fund-fonds-chaleur
139 https://www.ecologie.gouv.fr/coup-pouce-chauffage-et-isolation

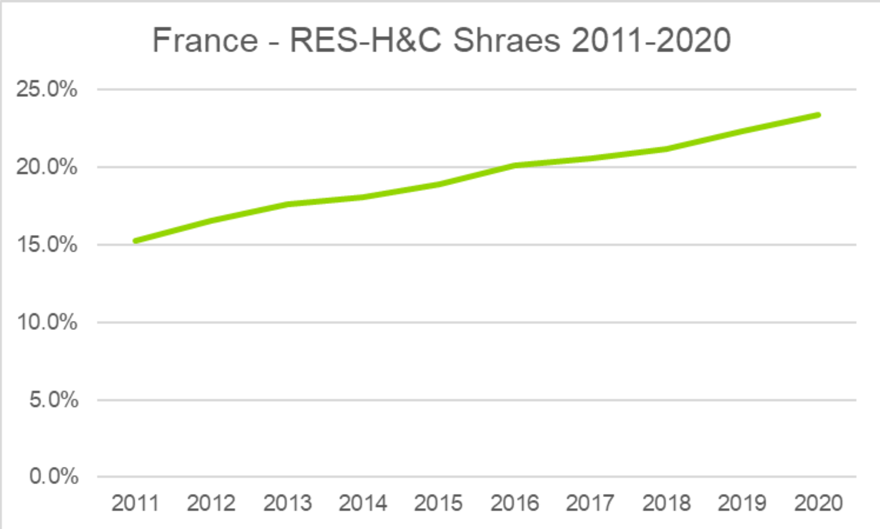


**Figure 35. RES-H&C Shares in 2011-2020 in France**

An important programme is the zero-rate eco-loan (éco-prêt à taux zéro) which funds different works such as: the installation or replacement of heating or domestic hot water production; the installation of heating using a renewable energy source; or the installation of domestic hot water production using a renewable energy source[140]. The maximum amount of the repayable loan cannot exceed the sum of 30,000 euros per dwelling[141]. The eco-loan was made more practical and was radically simplified, making it easy to understand for households, businesses and banks.

Finally, a key climate and energy policy in France is the carbon tax paid by individuals and businesses, added to the final price of petrol, diesel, heating oil or natural gas[142]. To mitigate negative distributional impacts, France has implemented social policies aiming to improve the energy efficiency of private housing stock through, for example, the "Habiter Mieux" program[143]. Measures aim at improving the energy efficiency of low- and middle-income households and providing financial support for social needs in lower- and middle- income households[144].

**Lithuania** shows a high share of renewables in the H&C sector (50.4% in 2020). The government has implemented a range of support measures to encourage the uptake of renewables.

Lithuania has in place a priority purchase policy of heat produced from RES that ensures the mandatory connection of heat energy production facilities to the heat transmission system and the buying-in of heat produced from RES on a priority basis[145]. The purchased heat from RES has to meet environmental and quality requirements as well as standards for the security of supply.

[140] https://www.economie.gouv.fr/cedef/eco-pret-a-taux-zero

[141] The maximum amount was increased up to 50,000 euros, for offers of loans issued as of 1 January 2022). The repayment period was extended from 15 years to 20 years in 2022.

[142] https://carbonpricingdashboard.worldbank.org/map_data

[143] https://guidehouse.com/insights/energy/2022/addressing-social-impacts-of-carbon-pricing-eu

[144] EIONET – Reporting Obligations Database (ROD) (European Environment Agency 2021).

[145] https://ec.europa.eu/energy/sites/ener/files/documents/lt_-_tr_into_eng_-_5th_progress_report_red_for_2017_and_2018.pdf

Regarding fiscal policies, Lithuania levies a general tax on environmental pollution with an exemption for the use of biogas, solid and liquid biomass for heating (and transport) uses[146]. The government plans to discontinue the exemption of bioenergy by 2028.

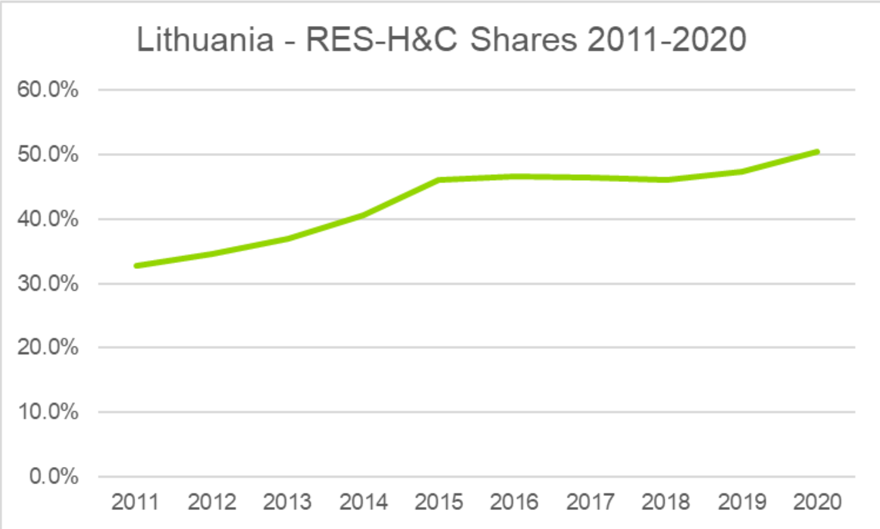


**Figure 36. RES-H&C Shares in 2011-2020 in Lithuania**

The biogas injected into the natural gas system is purchased at a FIT set by the National Commission for Energy Control and Prices[147]. Gas system operators must create conditions for the supply of biogas to gas systems and the connection of biogas production installations is subject to a discount of 40% of the connection price[148].

Through the Climate Change Programme, Lithuania promotes and funds measures to deploy RES (solar, wind, geothermal energy, etc., excluding biofuel) in public and residential buildings[149]. For example, the Programme grants non-refundable subsidies to replace inefficient biomass-based boilers with more efficient technologies using RES for heat production in households (such as heat pumps), which are not connected to the district heating system.

### 3.5.2 Policy recommendations

From the analysis of successful cases, we elaborated a general set of policy recommendations that can plausibly be associated with successful renewable energy development. However, it is important to highlight that there is no "one single policy" that can guarantee a successful development of renewables. On the contrary, we have observed that it is a combination of measures and policies coupled with market and political factors what determines the successful deployment of RES. Other framework conditions, such as site availability and streamlined administrative procedures also contributes to the success of a specific policy.

146 https://iea.blob.core.windows.net/assets/4d014034-0f94-409d-bb8f-193e17a81d77/Lithuania_2021_Energy_Policy_Review.pdf

147 https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/648259603c3b11e68f278e2f1841c088

148 https://ec.europa.eu/energy/sites/ener/files/documents/lt_-_tr_into_eng_-_5th_progress_report_red_for_2017_and_2018.pdf

149 Ibid.

An overarching recommendation is the provision of **long-term security of support** in the different sectors (RES-E, RES-T, RES-H&C). To build security, governments should put in place certain measures as described below.

**"Stakeholders' engagement** in decision-making processes is key to build trust and to ensure that sectoral issues and special features are taken into account in the policy design. By considering the comments and ideas of stakeholders, policies are more democratic and can enjoy greater legitimacy. For instance, Ireland held a public consultation to improve the biofuel quota applicable to the transport sector.

**Retroactive changes in regulation and policies should be avoided** as they erode long-term security of support. Abrupt legal changes can create long-lasting damage in the RE industry undermining the confidence of investors and slowing down RE development. As RES technologies are capital intensive, good funding conditions and lack of financial barriers are important factors for a positive RES development. To avoid major interruptions and the so-called "boom-and-bust cycles" (as seen for past PV deployment in several countries, e.g., Czech Republic, Spain, and Germany in the early 2010s), changes in funding programmes (e.g., support schemes) should be planned ahead and wisely.

Moreover, **transparency** with respect to core elements of policies is fundamental, including duration of support, total budget of the measures, deadlines, among others. Stakeholders across the value chain need to know and understand the policies in place. For instance, when possible, auction rounds for RES-E should be announced well in advance so that there is enough time for the market to prepare for the tender and more competition is created. A clear auction timeline also sends signals to the value chain such as manufacturers, to have predictability in upcoming demand. When policies are aimed at households, transparency is also central, as it allows them easy access to the intended benefits, for example, subsidies for heat pumps or EV.

Besides, **increasing public acceptance** of energy policies is key to ensure a successful and sustained energy transition. Social phenomena such as NIMBY ("Not In My Back Yard") can halt the development of RE projects in entire regions. Social groups can express their discontent with solar or wind power plants being installed in their vicinity and offer strong opposition. Certain auction design elements can promote the participation of smaller actors or involve the local communities in the ownership of projects with the objective of increasing social acceptability of renewable investments. For instance, the financial prequalification for smaller bidders could be reduced and certain portion of auctioned volume be reserved for local communities projects[150]. As mentioned in section 3.5.1.1, Denmark introduced measures to increase social acceptance, such as a compensation scheme for citizens whose properties' value has decreased due to the installation of a wind farm.

The development of RES projects is not only capital intensive but also requires going through administrative procedures that in many countries tend to be lengthy, complex, not fully digitalized, and slow. These can include Environmental Impact Assessments (EIA), building permits, production license, prior administrative authorization, grid access and connection permits, among others. The complexity of some projects due to the scale, technology, or possible negative impacts on the environment justify a thorough assessment of project features before issuing permits. However, there are certain measures that MS can adopt to **simplify and shorten the duration of administrative procedures**.

[150] Steinhilber, S. and Soysal, E. R. (2016) Secondary objectives in auctions, AURES Policy Memo 1, October 2016

On the one side, establishing **one-stop-shops** or contact points, as required by RED II, are a good measure to facilitate and expedite administrative procedures. For instance, in the Netherlands most of the permits can be applied for together following a one-stop-shop approach called "All-in-one Permit for Physical Aspects"[151]. The one-stop shop is implemented through an online platform and there is only one responsible authority.

On the other side, as recommended by the EC in the REPower EU plan, MS should designate **dedicated "go-to-areas" for RES** with shortened and simplified permitting processes in areas with lower environmental risks[152]. Some MS have in place similar measures, such as maps indicating areas where RES could be developed, but with limited effect as they are not mandatory (further details in section 3.4.3).

Sectoral-specific policies to support renewables can have stronger positive impacts if coupled with **fiscal measures addressing carbon emissions**. By putting a price on carbon pollution to reflect the 'social cost of carbon', policymakers can incentivize businesses and consumers to internalize the economic costs of climate change and abate emissions and encourage the transition to RES in different end-uses[153]. Though an important and effective climate policy tool, carbon pricing can also have regressive distributional effects for households and society, whether through higher energy prices, higher costs for carbon intensive consumer goods and services or through income from work and investments that may decrease due to higher production costs for firms. Such negative effect can undermine the overall RES and climate policies by creating social opposition. Hence, the **use of carbon pricing revenues** generated is key, as a country's approach to make carbon pricing an effective, durable policy that contributes to a just transition[154].

Good practices from carbon tax and ETS in the EU (and around the world) have shown that using these revenues to both further decarbonization goals and address distributional outcomes can make carbon pricing policies progressive and better ensure their longevity. France's "Habiter Mieux" policy constitutes a good example of revenue recycling. The programme provides fundings for improving the energy efficiency of private housing stock of low- and middle-income households. Revenues are also used to lower the tax burden of low-income households and the elderly, and to support financial aid given to individuals replacing old diesel vehicles. Providing social support next to carbon pricing policies is fundamental to ensure a just energy transition as well as to assure the acceptance of the overall policy framework[155].

To conclude, it is not just one single policy but it is a combination of policies, market trends, framework conditions, and socioeconomic factors what drives growth in a sustained and orderly way. Although policymakers can only have a limited influence on exogenous and macro risk drivers, e.g., inflation or general country risk, they do have a direct influence on the design of policies, on the communication strategy, and on the successful implementation over time.

[151] https://www.eclareon.com/en/projects/res-simplify
[152] https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131
[153] https://guidehouse.com/insights/energy/2022/addressing-social-impacts-of-carbon-pricing-eu
[154] Ibid.
[155] Ibid.

# Appendix A: Additional quantitative overview of each Member States per sector and technology (2011-2020)

In this appendix we present the share of energy from renewable sources in each MS per sector (RES-E, RES-T, RES-H&C), per technologies, and over time (2011-2020).

### Belgium

**Table 13. Generation of electricity from RES-E technologies in Belgium (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Belgium | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 379 | 381 | 371 | 370 | 330 | 318 | 307 | 312 | 302 | 306 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 1.169 | 2.148 | 2.644 | 2.886 | 3.056 | 3.095 | 3.308 | 3.903 | 4.252 | 5.105 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 1.603 | 1.897 | 2.125 | 2.399 | 2.961 | 3.027 | 3.648 | 4.160 | 4.956 | 5.790 |
| Wind (not normalised) offshore | 709 | 854 | 1.540 | 2.216 | 2.613 | 2.390 | 2.870 | 3.411 | 4.794 | 6.974 |
| Biomass | 3.133 | 3.684 | 3.355 | 2.632 | 3.554 | 3.471 | 3.816 | 3.484 | 3.291 | 3.319 |
| Biogas | 564 | 664 | 774 | 872 | 959 | 993 | 938 | 945 | 947 | 1.017 |
| Bioliquids | 226 | 150 | 127 | 90 | 130 | 31 | 36 | 74 | 71 | 25 |

**Table 14. Production of heating and cooling from RES-H&C technologies in Belgium (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Belgium | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Solar | 14 | 15 | 18 | 22 | 24 | 23 | 24 | 26 | 26 | 27 |
| Solid biomass | 1.083 | 1.173 | 1.333 | 1.156 | 1.251 | 1.328 | 1.286 | 1.285 | 1.227 | 1.169 |
| Biogas | 48 | 66 | 93 | 100 | 109 | 107 | 103 | 106 | 109 | 119 |
| Bioliquids | 7 | 8 | 7 | 6 | 7 | 5 | 6 | 5 | 6 | 4 |
| Heat pumps | 22 | 26 | 33 | 39 | 50 | 64 | 75 | 94 | 113 | 130 |

**Table 15. Fuel used in transport (RES-T) in Belgium (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Belgium | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 56 | 54 | 54 | 39 | 41 | 43 | 97 | 113 | 129 | 130 |
| Biodiesels | 298 | 298 | 295 | 380 | 221 | 398 | 382 | 365 | 356 | 572 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 147 | 141 | 148 | 138 | 140 | 143 | 146 | 150 | 148 | 139 |

## Bulgaria

**Table 16. Generation of electricity from RES-E technologies in Bulgaria (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Bulgaria | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 4.003 | 4.126 | 4.190 | 4.248 | 4.222 | 4.170 | 4.281 | 4.339 | 4.272 | 4.099 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 101 | 814 | 1.361 | 1.252 | 1.383 | 1.386 | 1.403 | 1.343 | 1.442 | 1.481 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 0 | 0 | 0 | 0 | 0 | 0 | 1.504 | 1.318 | 1.317 | 1.477 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 37 | 65 | 95 | 139 | 151 | 163 | 180 | 1.280 | 1.546 | 1.472 |
| Biogas | 19 | 1 | 17 | 62 | 119 | 191 | 216 | 212 | 231 | 226 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 17. Production of heating and cooling from RES-H&C technologies in Bulgaria (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Bulgaria | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 33 | 33 | 33 | 33 | 33 | 35 | 35 | 35 | 35 | 36 |
| Solar | 14 | 15 | 19 | 20 | 22 | 22 | 23 | 25 | 26 | 27 |
| Solid biomass | 947 | 1.008 | 1.012 | 963 | 1.008 | 1.013 | 1.043 | 1.148 | 1.177 | 1.296 |
| Biogas | 1 | 0 | 1 | 2 | 4 | 26 | 11 | 13 | 13 | 11 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 42 | 47 | 64 | 65 | 75 | 81 | 87 | 92 | 106 | 112 |

**Table 18. Fuel used in transport (RES-T) in Bulgaria (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Bulgaria | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 0 | 0 | 8 | 15 | 32 | 33 | 27 | 29 | 32 | 27 |
| Biodiesels | 17 | 86 | 96 | 96 | 114 | 130 | 140 | 135 | 148 | 146 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 32 | 26 | 24 | 26 | 30 | 30 | 32 | 28 | 31 | 36 |

## Czechia

**Table 19. Generation of electricity from RES-E technologies in Czechia (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Czechia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 2.142 | 2.181 | 2.281 | 2.288 | 2.291 | 2.279 | 2.228 | 2.236 | 2.227 | 2.200 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 2.182 | 2.149 | 2.033 | 2.123 | 2.264 | 2.131 | 2.193 | 2.359 | 2.312 | 2.287 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 397 | 416 | 481 | 477 | 573 | 497 | 591 | 609 | 700 | 699 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 1.685 | 1.817 | 1.683 | 1.992 | 2.091 | 2.068 | 2.213 | 2.121 | 2.399 | 2.499 |
| Biogas | 929 | 1.468 | 2.294 | 2.583 | 2.611 | 2.589 | 2.639 | 2.607 | 2.528 | 2.596 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 20. Production of heating and cooling from RES-H&C technologies in Czechia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Czechia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 11 | 13 | 14 | 15 | 16 | 17 | 17 | 18 | 18 | 19 |
| Solid biomass | 2.030 | 2.122 | 2.270 | 2.335 | 2.404 | 2.438 | 2.446 | 2.486 | 2.695 | 2.796 |
| Biogas | 78 | 108 | 146 | 151 | 155 | 179 | 176 | 170 | 167 | 169 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 58 | 70 | 82 | 94 | 108 | 126 | 147 | 173 | 203 | 234 |

**Table 21. Fuel used in transport (RES-T) in Czechia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Czechia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 61 | 56 | 54 | 66 | 63 | 48 | 59 | 61 | 74 | 66 |
| Biodiesels | 239 | 219 | 224 | 251 | 233 | 253 | 255 | 247 | 267 | 307 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Renewable electricity | 138 | 139 | 137 | 134 | 138 | 141 | 146 | 151 | 152 | 141 |

## Denmark

**Table 22. Generation of electricity from RES-E technologies in Denmark (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Denmark | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 23 | 23 | 21 | 20 | 16 | 21 | 16 | 16 | 16 | 16 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 15 | 104 | 518 | 596 | 604 | 744 | 751 | 953 | 963 | 1.181 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 6.370 | 6.798 | 6.772 | 7.913 | 9.300 | 8.132 | 9.600 | 9.272 | 9.952 | 9.727 |
| Wind (not normalised) offshore | 3.405 | 3.472 | 4.351 | 5.165 | 4.833 | 4.650 | 5.180 | 4.630 | 6.198 | 6.603 |
| Biomass | 3.078 | 3.176 | 3.056 | 2.959 | 2.796 | 3.483 | 4.797 | 4.417 | 4.353 | 4.302 |
| Biogas | 346 | 378 | 382 | 457 | 476 | 555 | 651 | 733 | 809 | 852 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 23. Production of heating and cooling from RES-H&C technologies in Denmark (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Denmark | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 1 |
| Solar | 18 | 21 | 25 | 31 | 37 | 47 | 56 | 66 | 71 | 78 |
| Solid biomass | 1.927 | 1.955 | 2.018 | 1.997 | 2.193 | 2.326 | 2.521 | 2.479 | 2.460 | 2.465 |
| Biogas | 44 | 51 | 52 | 64 | 75 | 123 | 146 | 186 | 243 | 343 |
| Bioliquids | 0 | 0 | 10 | 7 | 4 | 2 | 2 | 2 | 2 | 3 |
| Heat pumps | 124 | 134 | 144 | 151 | 168 | 188 | 193 | 218 | 246 | 353 |

**Table 24. Fuel used in transport (RES-T) in Denmark (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Denmark | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 47 | 50 | 46 | 45 | 44 | 44 | 44 | 43 | 44 | 80 |
| Biodiesels | 83 | 156 | 162 | 169 | 170 | 173 | 172 | 171 | 183 | 172 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 1 | 2 |
| Renewable electricity | 34 | 33 | 33 | 33 | 34 | 38 | 38 | 38 | 40 | 45 |

## Germany

**Table 25. Generation of electricity from RES-E technologies in Germany (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Germany | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 22.061 | 21.971 | 22.008 | 21.731 | 21.447 | 21.211 | 20.922 | 19.673 | 19.809 | 19.919 |
| Geothermal | 19 | 25 | 80 | 98 | 133 | 175 | 163 | 178 | 197 | 231 |
| Solar PV | 19.599 | 26.380 | 31.010 | 36.056 | 38.726 | 38.098 | 39.401 | 43.459 | 44.383 | 48.641 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 49.281 | 50.948 | 51.819 | 57.026 | 72.340 | 67.650 | 88.018 | 90.484 | 101.150 | 104.796 |
| Wind (not normalised) offshore | 577 | 732 | 918 | 1.471 | 8.284 | 12.274 | 17.675 | 19.467 | 24.744 | 27.306 |
| Biomass | 10.516 | 10.693 | 10.555 | 10.798 | 11.034 | 10.798 | 10.644 | 11.068 | 11.039 | 11.227 |
| Biogas | 21.237 | 27.314 | 29.255 | 31.086 | 33.098 | 33.711 | 33.879 | 33.181 | 32.952 | 33.495 |
| Bioliquids | 382 | 246 | 279 | 325 | 416 | 453 | 405 | 371 | 324 | 302 |

**Table 26. Production of heating and cooling from RES-H&C technologies in Germany (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Germany | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geo-thermal | 62 | 69 | 74 | 90 | 83 | 99 | 100 | 117 | 122 | 122 |
| Solar | 549 | 571 | 576 | 620 | 663 | 661 | 675 | 763 | 729 | 749 |
| Solid biomass | 10.404 | 11.68 0 | 11.817 | 10.042 | 10.147 | 9.825 | 9.969 | 10.295 | 10.411 | 10.148 |
| Biogas | 1.026 | 1.025 | 1.149 | 1.322 | 1.481 | 1.561 | 1.603 | 1.695 | 1.726 | 1.773 |
| Bioliquids | 213 | 180 | 159 | 173 | 167 | 162 | 166 | 185 | 192 | 268 |
| Heat pumps | 570 | 653 | 737 | 816 | 892 | 970 | 1.057 | 1.152 | 1.253 | 1.374 |

**Table 27. Fuel used in transport (RES-T) in Germany (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Germany | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 782 | 792 | 765 | 779 | 744 | 745 | 733 | 747 | 719 | 690 |
| Biodiesels | 1.994 | 2.117 | 1.890 | 1.954 | 1.793 | 1.792 | 1.831 | 1.915 | 1.902 | 2.580 |
| Other biofuels | 20 | 40 | 41 | 42 | 30 | 34 | 40 | 34 | 58 | 77 |
| Renewable electricity | 1.041 | 1.034 | 1.025 | 991 | 959 | 1.009 | 1.028 | 1.039 | 998 | 958 |

## Estonia

**Table 28. Generation of electricity from RES-E technologies in Estonia (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Estonia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 13 | 23 | 25 | 17 | 22 | 25 | 32 | 33 | 26 | 34 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 0 | 0 | 0 | 0 | 0 | 10 | 14 | 31 | 74 | 123 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 369 | 434 | 529 | 604 | 715 | 594 | 723 | 636 | 687 | 844 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 766 | 985 | 645 | 731 | 710 | 840 | 996 | 1.223 | 1.260 | 1.746 |
| Biogas | 15 | 16 | 20 | 27 | 50 | 45 | 42 | 38 | 39 | 31 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 29. Production of heating and cooling from RES-H&C technologies in Estonia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Estonia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solid biomass | 665 | 657 | 665 | 654 | 692 | 711 | 711 | 737 | 691 | 763 |
| Biogas | 1 | 1 | 4 | 6 | 7 | 12 | 8 | 10 | 5 | 6 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 25 | 30 | 36 | 42 | 48 | 53 | 61 | 69 | 78 | 88 |

**Table 30. Fuel used in transport (RES-T) in Estonia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Estonia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 4 | 4 | 3 | 5 | 3 | 2 | 1 | 5 | 7 | 6 |
| Biodiesels | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 13 | 20 | 33 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 7 |
| Renewable electricity | 7 | 7 | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 6 |

## Ireland

**Table 31. Generation of electricity from RES-E technologies in Ireland (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Ireland | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 752 | 759 | 737 | 728 | 725 | 731 | 717 | 724 | 741 | 761 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 1 | 1 | 1 | 2 | 4 | 6 | 12 | 22 | 40 | 64 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 4.380 | 4.010 | 4.542 | 5.140 | 6.573 | 6.147 | 7.444 | 8.640 | 10.019 | 11.549 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 136 | 179 | 227 | 265 | 197 | 395 | 381 | 334 | 346 | 433 |
| Biogas | 200 | 197 | 185 | 204 | 205 | 208 | 203 | 184 | 186 | 179 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 32. Production of heating and cooling from RES-H&C technologies in Ireland (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Ireland | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 9 | 9 | 10 | 11 | 11 | 12 | 13 | 14 | 14 | 14 |
| Solid biomass | 164 | 157 | 169 | 196 | 194 | 193 | 198 | 202 | 185 | 180 |
| Biogas | 9 | 9 | 7 | 8 | 9 | 9 | 10 | 10 | 10 | 13 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 17 | 19 | 20 | 23 | 27 | 32 | 39 | 44 | 52 | 57 |

**Table 33. Fuel used in transport (RES-T) in Ireland (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Ireland | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 24 | 29 | 28 | 25 | 24 | 27 | 30 | 27 | 26 | 19 |
| Biodiesels | 68 | 56 | 74 | 90 | 98 | 86 | 131 | 127 | 162 | 155 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 4 | 4 | 4 | 3 | 4 | 4 | 5 | 5 | 7 | 8 |

## Greece

**Table 34. Generation of electricity from RES-E technologies in Greece (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Greece | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 4.446 | 4.469 | 4.615 | 4.806 | 4.942 | 5.154 | 5.210 | 5.267 | 5.190 | 5.147 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 610 | 1.694 | 3.648 | 3.792 | 3.900 | 3.930 | 3.991 | 3.791 | 4.429 | 4.358 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 0 | 0 | 0 | 0 | 0 | 0 | 5.537 | 6.300 | 7.266 | 9.321 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 0 | 0 | 0 | 0 | 1 | 5 | 10 | 12 | 24 | 21 |
| Biogas | 207 | 204 | 216 | 220 | 230 | 270 | 300 | 302 | 378 | 310 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 35. Production of heating and cooling from RES-H&C technologies in Greece (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Greece | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 16 | 13 | 11 | 12 | 10 | 10 | 9 | 9 | 10 | 5 |
| Solar | 242 | 243 | 247 | 253 | 259 | 264 | 271 | 277 | 286 | 293 |
| Solid biomass | 1.078 | 1.178 | 969 | 969 | 1.056 | 896 | 904 | 884 | 834 | 859 |
| Biogas | 15 | 15 | 17 | 15 | 16 | 14 | 18 | 21 | 35 | 39 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 83 | 102 | 132 | 178 | 218 | 256 | 290 | 324 | 355 | 411 |

**Table 36. Fuel used in transport (RES-T) in Greece (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Greece | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 68 |
| Biodiesels | 103 | 103 | 121 | 134 | 142 | 149 | 166 | 159 | 161 | 132 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 16 | 16 | 23 | 29 | 33 | 16 | 16 | 17 | 17 | 17 |

## Spain

**Table 37. Generation of electricity from RES-E technologies in Spain (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Spain | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 31.346 | 30.027 | 29.363 | 30.318 | 31.937 | 31.480 | 31.162 | 30.532 | 30.018 | 30.668 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 7.440 | 8.193 | 8.326 | 8.218 | 8.266 | 8.064 | 8.514 | 7.877 | 9.420 | 15.675 |
| Solar thermal | 1.959 | 3.775 | 4.770 | 5.455 | 5.593 | 5.579 | 5.883 | 4.867 | 5.683 | 4.992 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 27 |
| Wind (not normalised) onshore | 42.918 | 49.472 | 55.646 | 52.013 | 49.325 | 48.905 | 49.127 | 50.896 | 55.647 | 56.444 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 3.011 | 3.396 | 4.143 | 3.821 | 4.014 | 4.048 | 4.365 | 4.221 | 3.885 | 4.541 |
| Biogas | 803 | 866 | 973 | 907 | 982 | 906 | 958 | 939 | 925 | 902 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 38. Production of heating and cooling from RES-H&C technologies in Spain (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Spain | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 183 | 201 | 218 | 237 | 255 | 270 | 285 | 300 | 315 | 328 |
| Solid biomass | 3.817 | 3.876 | 3.771 | 3.761 | 3.953 | 3.606 | 3.657 | 3.691 | 3.821 | 3.658 |
| Biogas | 55 | 55 | 125 | 101 | 59 | 83 | 88 | 89 | 89 | 125 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 0 | 0 | 0 | 314 | 407 | 503 | 613 | 729 | 849 | 960 |

**Table 39. Fuel used in transport (RES-T) in Spain (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Spain | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 227 | 200 | 168 | 188 | 190 | 134 | 138 | 154 | 130 | 86 |
| Biodiesels | 1.515 | 1.952 | 740 | 790 | 795 | 987 | 1.152 | 1.528 | 1.501 | 1.316 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 343 | 337 | 328 | 336 | 342 | 336 | 343 | 348 | 339 | 287 |

## France

**Table 40. Generation of electricity from RES-E technologies in France (2011 – 2020) in GWh. Source: Eurostat SHARES**

| France | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 62.316 | 62.008 | 62.549 | 61.884 | 61.033 | 60.161 | 59.546 | 59.886 | 59.787 | 60.661 |
| Geothermal | 62 | 57 | 90 | 83 | 92 | 98 | 133 | 127 | 128 | 133 |
| Solar PV | 2.334 | 4.428 | 5.194 | 6.392 | 7.754 | 8.660 | 9.586 | 10.891 | 12.227 | 13.398 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 477 | 458 | 414 | 481 | 487 | 500 | 522 | 480 | 479 | 482 |
| Wind (not normalised) onshore | 12.372 | 15.178 | 16.127 | 17.324 | 21.421 | 21.381 | 24.609 | 28.599 | 34.787 | 39.792 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 1.810 | 1.855 | 2.014 | 2.309 | 2.665 | 3.408 | 3.462 | 3.806 | 3.882 | 3.959 |
| Biogas | 1.152 | 1.297 | 1.545 | 1.594 | 1.838 | 2.006 | 2.147 | 2.416 | 2.689 | 2.916 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 41. Production of heating and cooling from RES-H&C technologies in France (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| France | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 105 | 117 | 134 | 131 | 132 | 145 | 174 | 183 | 195 | 201 |
| Solar | 121 | 135 | 145 | 154 | 160 | 166 | 172 | 181 | 187 | 195 |
| Solid biomass | 7.781 | 8.919 | 9.829 | 8.366 | 8.957 | 9.639 | 9.360 | 9.258 | 9.342 | 8.821 |
| Biogas | 55 | 78 | 96 | 133 | 161 | 211 | 270 | 307 | 361 | 462 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 125 | 199 | 259 | 260 | 267 |
| Heat pumps | 1.286 | 1.429 | 1.578 | 1.734 | 1.902 | 2.083 | 2.280 | 2.511 | 2.845 | 3.180 |

**Table 42. Fuel used in transport (RES-T) in France (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| France | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 393 | 403 | 395 | 413 | 432 | 476 | 538 | 586 | 653 | 555 |
| Biodiesels | 2.048 | 2.275 | 2.311 | 2.530 | 2.565 | 2.515 | 2.594 | 2.547 | 2.537 | 2.081 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Renewable electricity | 905 | 921 | 931 | 907 | 920 | 905 | 910 | 868 | 867 | 717 |

## Croatia

**Table 43. Generation of electricity from RES-E technologies in Croatia (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Croatia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 6.671 | 6.591 | 6.907 | 6.997 | 7.016 | 6.952 | 6.891 | 7.050 | 6.897 | 6.771 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 92 | 94 |
| Solar PV | 0 | 2 | 11 | 35 | 57 | 66 | 79 | 75 | 83 | 96 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 201 | 329 | 517 | 730 | 796 | 1.014 | 1.204 | 1.335 | 1.467 | 1.721 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 18 | 37 | 48 | 50 | 89 | 194 | 216 | 313 | 477 | 559 |
| Biogas | 36 | 56 | 78 | 114 | 176 | 237 | 310 | 355 | 401 | 419 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 44. Production of heating and cooling from RES-H&C technologies in Croatia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Croatia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 7 | 7 | 7 | 8 | 9 | 9 | 8 | 8 | 7 | 4 |
| Solar | 6 | 7 | 8 | 9 | 10 | 12 | 13 | 14 | 15 | 16 |
| Solid biomass | 1.207 | 1.213 | 1.204 | 1.062 | 1.212 | 1.176 | 1.167 | 1.140 | 1.126 | 1.150 |
| Biogas | 1 | 3 | 3 | 3 | 5 | 7 | 8 | 11 | 12 | 13 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 14 | 15 | 15 | 12 | 15 | 16 | 16 | 15 | 14 | 15 |

**Table 45. Fuel used in transport (RES-T) in Croatia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Croatia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Biodiesels | 3 | 36 | 31 | 30 | 24 | 1 | 0 | 27 | 62 | 65 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 22 | 21 | 20 | 20 | 21 | 22 | 23 | 24 | 23 | 23 |

## Italy

**Table 46. Generation of electricity from RES-E technologies in Italy (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Italy | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 44.012 | 44.140 | 44.984 | 45.765 | 45.933 | 46.191 | 46.047 | 46.800 | 47.052 | 47.988 |
| Geothermal | 5.654 | 5.592 | 5.659 | 5.916 | 6.185 | 6.289 | 6.201 | 6.105 | 6.075 | 6.026 |
| Solar PV | 10.796 | 18.862 | 21.589 | 22.306 | 22.942 | 22.104 | 24.378 | 22.654 | 23.689 | 24.942 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 9.848 | 13.407 | 14.897 | 15.178 | 14.844 | 17.689 | 17.742 | 17.716 | 20.202 | 18.762 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 2.522 | 2.582 | 3.679 | 3.823 | 3.947 | 4.125 | 4.232 | 4.191 | 4.240 | 4.470 |
| Biogas | 3.405 | 4.620 | 7.448 | 8.198 | 8.212 | 8.259 | 8.316 | 8.350 | 8.277 | 8.166 |
| Bioliquids | 2.698 | 2.977 | 3.628 | 4.290 | 4.865 | 4.627 | 4.389 | 4.217 | 4.610 | 4.592 |

**Table 47. Production of heating and cooling from RES-H&C technologies in Italy (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Italy | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 139 | 134 | 135 | 130 | 133 | 144 | 150 | 149 | 152 | 141 |
| Solar | 140 | 155 | 168 | 180 | 190 | 200 | 209 | 219 | 228 | 236 |
| Solid biomass | 5.114 | 7.247 | 7.431 | 6.646 | 7.380 | 7.175 | 7.764 | 7.264 | 7.260 | 7.034 |
| Biogas | 330 | 183 | 246 | 283 | 250 | 252 | 272 | 270 | 311 | 310 |
| Bioliquids | 22 | 21 | 21 | 31 | 42 | 42 | 43 | 49 | 53 | 54 |
| Heat pumps | 2.270 | 2.415 | 2.519 | 2.580 | 2.584 | 2.609 | 2.650 | 2.596 | 2.498 | 2.475 |

**Table 48. Fuel used in transport (RES-T) in Italy (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Italy | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 114 | 105 | 74 | 10 | 25 | 33 | 33 | 33 | 30 | 20 |
| Biodiesels | 1.287 | 1.263 | 1.178 | 1.055 | 1.142 | 1.008 | 1.029 | 1.217 | 1.246 | 1.245 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41 | 164 |
| Renewable electricity | 5 | 5 | 6 | 6 | 6 | 6 | 7 | 9 | 12 | 16 |

## Cyprus

**Table 49. Generation of electricity from RES-E technologies in Cyprus (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Cyprus | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 12 | 22 | 47 | 84 | 127 | 146 | 172 | 199 | 218 | 296 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 115 | 185 | 231 | 183 | 222 | 227 | 211 | 221 | 239 | 240 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biogas | 52 | 50 | 49 | 50 | 51 | 52 | 52 | 57 | 58 | 61 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 50. Production of heating and cooling from RES-H&C technologies in Cyprus (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Cyprus | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 63 | 64 | 66 | 67 | 68 | 69 | 70 | 72 | 73 | 74 |
| Solid biomass | 24 | 20 | 18 | 20 | 26 | 26 | 32 | 31 | 34 | 37 |
| Biogas | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 7 | 6 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 46 | 47 | 47 |

**Table 51. Fuel used in transport (RES-T) in Cyprus (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Cyprus | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Biodiesels | 16 | 16 | 15 | 10 | 10 | 9 | 9 | 9 | 11 | 25 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Latvia

**Table 52. Generation of electricity from RES-E technologies in Latvia (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Latvia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 3.097 | 3.140 | 3.056 | 2.998 | 2.924 | 2.856 | 2.980 | 2.989 | 2.957 | 2.901 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 5 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 71 | 114 | 120 | 140 | 147 | 128 | 150 | 122 | 154 | 177 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 13 | 64 | 215 | 319 | 378 | 427 | 525 | 570 | 575 | 520 |
| Biogas | 105 | 223 | 287 | 350 | 392 | 397 | 405 | 374 | 352 | 345 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 53. Production of heating and cooling from RES-H&C technologies in Latvia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Latvia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Solid biomass | 1.049 | 1.167 | 1.143 | 1.198 | 1.108 | 1.123 | 1.234 | 1.308 | 1.315 | 1.243 |
| Biogas | 8 | 18 | 22 | 27 | 30 | 31 | 32 | 30 | 27 | 27 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 54. Fuel used in transport (RES-T) in Latvia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Latvia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 8 | 6 | 6 | 6 | 8 | 8 | 8 | 8 | 7 | 13 |
| Biodiesels | 17 | 13 | 12 | 16 | 15 | 3 | 1 | 29 | 28 | 32 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 11 | 11 | 11 | 10 | 9 | 9 | 9 | 9 | 9 | 8 |

## Lithuania

**Table 55. Generation of electricity from RES-E technologies in Lithuania (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Lithuania | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 425 | 430 | 432 | 430 | 427 | 433 | 446 | 452 | 445 | 435 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 0 | 2 | 45 | 73 | 73 | 66 | 68 | 87 | 91 | 129 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 475 | 540 | 603 | 639 | 810 | 1.136 | 1.364 | 1.144 | 1.499 | 1.552 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 121 | 176 | 279 | 293 | 318 | 269 | 303 | 355 | 331 | 373 |
| Biogas | 36 | 42 | 59 | 78 | 86 | 123 | 127 | 140 | 154 | 149 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 56. Production of heating and cooling from RES-H&C technologies in Lithuania (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Lithuania | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solid biomass | 867 | 931 | 939 | 991 | 1.067 | 1.111 | 1.158 | 1.165 | 1.152 | 1.146 |
| Biogas | 4 | 4 | 6 | 9 | 10 | 10 | 10 | 11 | 11 | 11 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 19 | 23 |

**Table 57. Fuel used in transport (RES-T) in Lithuania (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Lithuania | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 10 | 8 | 6 | 6 | 10 | 6 | 8 | 8 | 10 | 16 |
| Biodiesels | 35 | 52 | 51 | 57 | 58 | 50 | 63 | 70 | 65 | 87 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 6 | 6 | 6 | 5 | 6 | 6 | 6 | 7 | 7 | 6 |

## Luxembourg

**Table 58. Generation of electricity from RES-E technologies in Luxembourg (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Luxembourg | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 104 | 105 | 105 | 106 | 104 | 104 | 104 | 104 | 104 | 104 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 26 | 38 | 74 | 95 | 104 | 100 | 108 | 119 | 130 | 161 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 64 | 77 | 83 | 80 | 102 | 101 | 235 | 255 | 281 | 351 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 0 | 0 | 2 | 21 | 24 | 25 | 52 | 95 | 160 | 266 |
| Biogas | 57 | 66 | 62 | 68 | 67 | 74 | 74 | 77 | 72 | 64 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 59. Production of heating and cooling from RES-H&C technologies in Luxembourg (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Luxembourg | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| Solid biomass | 42 | 43 | 46 | 59 | 60 | 63 | 67 | 75 | 83 | 124 |
| Biogas | 6 | 8 | 8 | 8 | 9 | 11 | 12 | 12 | 9 | 9 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |

**Table 60. Fuel used in transport (RES-T) in Luxembourg (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Luxembourg | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 6 | 1 | 1 | 3 | 7 | 9 | 7 | 10 | 17 | 14 |
| Biodiesels | 40 | 47 | 54 | 67 | 76 | 81 | 107 | 113 | 113 | 129 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 11 | 11 | 12 | 11 | 12 | 12 | 12 | 13 | 14 | 13 |

## Hungary

**Table 61. Generation of electricity from RES-E technologies in Hungary (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Hungary | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 215 | 217 | 223 | 228 | 230 | 232 | 232 | 234 | 237 | 237 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 12 | 18 | 16 |
| Solar PV | 1 | 8 | 25 | 67 | 141 | 244 | 349 | 629 | 1.497 | 2.459 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 626 | 770 | 718 | 657 | 693 | 684 | 758 | 607 | 729 | 655 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 1.527 | 1.333 | 1.429 | 1.702 | 1.661 | 1.493 | 1.645 | 1.798 | 1.769 | 1.664 |
| Biogas | 213 | 211 | 267 | 288 | 293 | 333 | 352 | 340 | 326 | 329 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 62. Production of heating and cooling from RES-H&C technologies in Hungary (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Hungary | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 104 | 107 | 112 | 86 | 96 | 115 | 127 | 127 | 136 | 129 |
| Solar | 7 | 9 | 9 | 10 | 11 | 11 | 12 | 13 | 13 | 15 |
| Solid biomass | 2.007 | 2.144 | 2.261 | 1.880 | 2.027 | 2.015 | 1.935 | 1.680 | 1.605 | 1.614 |
| Biogas | 12 | 9 | 16 | 21 | 16 | 17 | 23 | 20 | 19 | 20 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 0 | 2 | 3 | 4 | 5 | 5 | 7 | 8 | 13 | 11 |

**Table 63. Fuel used in transport (RES-T) in Hungary (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Hungary | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 55 | 51 | 31 | 60 | 43 | 44 | 45 | 51 | 46 | 84 |
| Biodiesels | 105 | 103 | 106 | 128 | 133 | 143 | 119 | 142 | 157 | 195 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 96 | 85 | 106 | 99 | 101 | 101 | 104 | 104 | 103 | 104 |

## Malta

**Table 64. Generation of electricity from RES-E technologies in Malta (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Malta | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 5 | 17 | 29 | 68 | 95 | 128 | 162 | 190 | 195 | 237 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biogas | 5 | 9 | 6 | 6 | 7 | 8 | 10 | 9 | 6 | 6 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 65. Production of heating and cooling from RES-H&C technologies in Malta (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Malta | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Solid biomass | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| Biogas | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 0 | 2 | 6 | 6 | 6 | 7 | 9 | 11 | 13 | 14 |

**Table 66. Fuel used in transport (RES-T) in Malta (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Malta | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biodiesels | 2 | 3 | 5 | 7 | 7 | 7 | 7 | 10 | 11 | 14 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Netherlands

**Table 67. Generation of electricity from RES-E technologies in the Netherlands (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Netherlands | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 100 | 100 | 101 | 102 | 99 | 98 | 94 | 94 | 93 | 90 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 104 | 191 | 410 | 725 | 1.109 | 1.602 | 2.208 | 3.709 | 5.401 | 8.765 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 4.298 | 4.193 | 4.856 | 5.049 | 6.420 | 5.901 | 6.869 | 6.918 | 7.935 | 9.856 |
| Wind (not normalised) offshore | 802 | 789 | 771 | 748 | 1.130 | 2.269 | 3.700 | 3.630 | 3.573 | 5.484 |
| Biomass | 3.977 | 3.960 | 2.899 | 2.099 | 1.901 | 1.907 | 1.772 | 1.512 | 2.838 | 5.785 |
| Biogas | 1.045 | 1.030 | 1.027 | 1.075 | 1.127 | 1.094 | 1.051 | 1.025 | 1.092 | 1.143 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 68. Production of heating and cooling from RES-H&C technologies in the Netherlands (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Netherlands | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 8 | 12 | 24 | 36 | 58 | 68 | 73 | 89 | 133 | 148 |
| Solar | 25 | 26 | 26 | 27 | 27 | 27 | 27 | 28 | 28 | 28 |
| Solid biomass | 586 | 579 | 581 | 616 | 643 | 659 | 757 | 825 | 931 | 1.025 |
| Biogas | 97 | 112 | 133 | 145 | 155 | 156 | 159 | 177 | 186 | 213 |
| Bioliquids | 0 | 20 | 19 | 24 | 22 | 17 | 24 | 90 | 102 | 74 |
| Heat pumps | 78 | 91 | 104 | 119 | 134 | 155 | 181 | 216 | 260 | 313 |

**Table 69. Fuel used in transport (RES-T) in the Netherlands (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Netherlands | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 149 | 124 | 125 | 128 | 142 | 121 | 129 | 171 | 199 | 226 |
| Biodiesels | 172 | 188 | 174 | 221 | 156 | 119 | 178 | 331 | 418 | 302 |
| Other biofuels | 8 | 8 | 7 | 7 | 4 | 4 | 6 | 7 | 19 | 35 |
| Renewable electricity | 150 | 152 | 150 | 148 | 157 | 158 | 159 | 172 | 186 | 186 |

## Austria

**Table 70. Generation of electricity from RES-E technologies in Austria (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Austria | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 40.229 | 40.797 | 41.193 | 41.230 | 41.154 | 41.302 | 40.832 | 42.177 | 42.277 | 42.218 |
| Geothermal | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 174 | 337 | 626 | 785 | 937 | 1.096 | 1.269 | 1.455 | 1.702 | 2.043 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 1.936 | 2.463 | 3.152 | 3.846 | 4.840 | 5.235 | 6.572 | 6.030 | 7.450 | 6.792 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 3.711 | 3.797 | 3.818 | 3.603 | 3.712 | 3.783 | 3.935 | 3.966 | 3.686 | 3.634 |
| Biogas | 625 | 642 | 623 | 613 | 634 | 666 | 670 | 628 | 629 | 643 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 71. Production of heating and cooling from RES-H&C technologies in Austria (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Austria | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 19 | 22 | 22 | 19 | 21 | 21 | 26 | 25 | 23 | 24 |
| Solar | 165 | 173 | 176 | 181 | 183 | 183 | 182 | 181 | 179 | 182 |
| Solid biomass | 3.851 | 4.056 | 4.095 | 3.785 | 3.933 | 4.061 | 4.157 | 3.918 | 3.961 | 3.978 |
| Biogas | 31 | 39 | 41 | 41 | 43 | 47 | 50 | 39 | 37 | 30 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 173 | 192 | 212 | 233 | 254 | 276 | 303 | 334 | 365 | 394 |

**Table 72. Fuel used in transport (RES-T) in Austria (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Austria | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 77 | 77 | 66 | 63 | 60 | 57 | 56 | 58 | 57 | 55 |
| Biodiesels | 421 | 414 | 436 | 534 | 593 | 486 | 422 | 436 | 428 | 354 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 269 | 263 | 267 | 264 | 272 | 276 | 281 | 282 | 282 | 266 |

## Poland

**Table 73. Generation of electricity from RES-E technologies in Poland (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Poland | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 2.231 | 2.250 | 2.273 | 2.302 | 2.302 | 2.317 | 2.316 | 2.337 | 2.333 | 2.322 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 0 | 1 | 1 | 7 | 57 | 124 | 165 | 300 | 711 | 1.958 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 3.205 | 4.747 | 6.004 | 7.676 | 10.858 | 12.588 | 14.909 | 12.799 | 15.107 | 15.800 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 7.148 | 9.529 | 7.932 | 9.160 | 9.027 | 6.913 | 5.309 | 5.333 | 6.441 | 6.933 |
| Biogas | 451 | 565 | 690 | 816 | 906 | 1.028 | 1.096 | 1.128 | 1.135 | 1.234 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 74. Production of heating and cooling from RES-H&C technologies in Poland (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Poland | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 13 | 16 | 19 | 20 | 22 | 22 | 23 | 24 | 25 | 26 |
| Solar | 12 | 15 | 25 | 35 | 45 | 52 | 54 | 57 | 72 | 80 |
| Solid biomass | 4.788 | 4.912 | 5.112 | 4.771 | 4.896 | 5.170 | 5.222 | 8.316 | 8.073 | 7.892 |
| Biogas | 61 | 72 | 74 | 78 | 88 | 102 | 105 | 105 | 116 | 114 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 56 | 68 | 87 | 109 | 133 | 157 | 184 | 214 | 255 | 298 |

**Table 75. Fuel used in transport (RES-T) in Poland (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Poland | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 161 | 138 | 144 | 133 | 153 | 168 | 176 | 173 | 187 | 183 |
| Biodiesels | 755 | 669 | 603 | 573 | 500 | 290 | 429 | 740 | 838 | 857 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 285 | 275 | 271 | 259 | 267 | 283 | 286 | 298 | 293 | 273 |

## Portugal

**Table 76. Generation of electricity from RES-E technologies in Portugal (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Portugal | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 12.118 | 11.537 | 11.315 | 11.845 | 12.071 | 12.666 | 12.620 | 12.091 | 11.910 | 12.296 |
| Geothermal | 210 | 146 | 197 | 205 | 204 | 172 | 217 | 230 | 215 | 217 |
| Solar PV | 280 | 393 | 479 | 627 | 796 | 871 | 992 | 1.006 | 1.342 | 1.691 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 9.162 | 10.256 | 12.010 | 12.108 | 11.603 | 12.474 | 12.248 | 12.617 | 13.667 | 12.247 |
| Wind (not normalised) offshore | 0 | 3 | 5 | 4 | 4 | 0 | 0 | 0 | 0 | 51 |
| Biomass | 2.467 | 2.496 | 2.516 | 2.530 | 2.518 | 2.481 | 2.573 | 2.558 | 2.749 | 3.206 |
| Biogas | 161 | 209 | 250 | 277 | 294 | 285 | 287 | 271 | 264 | 259 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 77. Production of heating and cooling from RES-H&C technologies in Portugal (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Portugal | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 |
| Solar | 59 | 67 | 73 | 77 | 80 | 84 | 88 | 94 | 96 | 101 |
| Solid biomass | 2.162 | 1.801 | 1.868 | 1.771 | 1.749 | 1.798 | 1.799 | 1.791 | 1.835 | 1.823 |
| Biogas | 0 | 1 | 1 | 8 | 8 | 9 | 8 | 8 | 7 | 7 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 0 | 0 | 0 | 595 | 601 | 604 | 624 | 650 | 681 | 633 |

**Table 78. Fuel used in transport (RES-T) in Portugal (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Portugal | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 0 | 1 | 2 | 2 | 21 | 25 | 3 | 6 | 8 | 6 |
| Biodiesels | 289 | 268 | 255 | 255 | 302 | 238 | 240 | 257 | 264 | 237 |
| Other biofuels | 4 | 4 | 4 | 5 | 3 | 2 | 0 | 0 | 0 | 0 |
| Renewable electricity | 35 | 34 | 26 | 26 | 26 | 37 | 42 | 42 | 43 | 37 |

## Romania

**Table 79. Generation of electricity from RES-E technologies in Romania (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Romania | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 17.210 | 16.949 | 16.109 | 16.126 | 16.477 | 16.689 | 16.405 | 16.663 | 16.470 | 16.019 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 1 | 8 | 420 | 1.616 | 1.982 | 1.820 | 1.856 | 1.771 | 1.778 | 1.733 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 0 | 0 | 0 | 0 | 0 | 0 | 7.407 | 6.322 | 6.773 | 6.945 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 188 | 192 | 202 | 453 | 462 | 466 | 458 | 367 | 450 | 494 |
| Biogas | 9 | 19 | 50 | 51 | 61 | 65 | 67 | 70 | 54 | 53 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 80. Production of heating and cooling from RES-H&C technologies in Romania (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Romania | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 22 | 22 | 25 | 25 | 26 | 32 | 32 | 31 | 31 | 12 |
| Solar | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Solid biomass | 3.470 | 3.658 | 3.513 | 3.495 | 3.375 | 3.465 | 3.512 | 3.424 | 3.451 | 3.432 |
| Biogas | 12 | 8 | 13 | 9 | 7 | 10 | 10 | 11 | 12 | 8 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 81. Fuel used in transport (RES-T) in Romania (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Romania | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 48 | 59 | 56 | 42 | 61 | 81 | 91 | 90 | 98 | 92 |
| Biodiesels | 148 | 128 | 148 | 125 | 141 | 176 | 206 | 207 | 315 | 392 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 122 | 106 | 97 | 91 | 93 | 90 | 94 | 91 | 91 | 93 |

## Slovenia

**Table 82. Generation of electricity from RES-E technologies in Slovenia (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Slovenia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 4.197 | 4.160 | 4.325 | 4.378 | 4.290 | 4.271 | 4.463 | 4.529 | 4.528 | 4.585 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 66 | 163 | 215 | 257 | 274 | 267 | 284 | 255 | 303 | 368 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 0 | 0 | 4 | 4 | 6 | 6 | 6 | 6 | 6 | 6 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 125 | 114 | 119 | 125 | 131 | 137 | 155 | 142 | 151 | 155 |
| Biogas | 127 | 153 | 141 | 130 | 132 | 142 | 130 | 119 | 94 | 113 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 83. Production of heating and cooling from RES-H&C technologies in Slovenia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Slovenia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 18 | 14 | 14 | 15 | 12 | 12 | 14 | 14 | 14 | 11 |
| Solar | 9 | 10 | 10 | 10 | 10 | 11 | 11 | 11 | 11 | 10 |
| Solid biomass | 633 | 611 | 638 | 564 | 624 | 626 | 599 | 534 | 516 | 502 |
| Biogas | 8 | 12 | 11 | 11 | 9 | 8 | 7 | 7 | 6 | 7 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 11 | 16 | 20 | 21 | 29 | 34 | 36 | 38 | 40 | 47 |

**Table 84. Fuel used in transport (RES-T) in Slovenia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Slovenia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 5 | 6 | 8 | 8 | 7 | 4 | 3 | 8 | 4 | 8 |
| Biodiesels | 32 | 46 | 53 | 36 | 23 | 14 | 21 | 66 | 91 | 85 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 14 | 14 | 13 | 12 | 13 | 14 | 20 | 20 | 20 | 18 |

## Slovakia

**Table 85. Generation of electricity from RES-E technologies in Slovakia (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Slovakia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 4.381 | 4.390 | 4.444 | 4.440 | 4.402 | 4.365 | 4.294 | 4.312 | 4.324 | 4.319 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 397 | 424 | 588 | 597 | 506 | 533 | 506 | 585 | 589 | 663 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 4 |
| Wind (not normalised) offshore | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Biomass | 682 | 724 | 677 | 916 | 1.099 | 1.129 | 1.080 | 1.070 | 1.130 | 1.120 |
| Biogas | 113 | 190 | 213 | 479 | 541 | 576 | 594 | 539 | 534 | 510 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 86. Production of heating and cooling from RES-H&C technologies in Slovakia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Slovakia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 6 | 5 |
| Solar | 5 | 5 | 6 | 6 | 5 | 6 | 7 | 7 | 8 | 8 |
| Solid biomass | 525 | 493 | 461 | 481 | 564 | 513 | 530 | 583 | 1.124 | 1.027 |
| Biogas | 23 | 22 | 8 | 12 | 51 | 44 | 45 | 44 | 37 | 41 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 52 |

**Table 87. Fuel used in transport (RES-T) in Slovakia (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Slovakia | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 20 | 18 | 18 | 25 | 23 | 16 | 20 | 18 | 20 | 26 |
| Biodiesels | 78 | 73 | 81 | 109 | 121 | 129 | 130 | 132 | 137 | 129 |
| Other biofuels | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Renewable electricity | 46 | 48 | 49 | 49 | 52 | 52 | 50 | 51 | 46 | 43 |

## Finland

**Table 88. Generation of electricity from RES-E technologies in Finland (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Finland | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 13.649 | 13.894 | 13.794 | 13.867 | 13.927 | 14.038 | 14.361 | 14.550 | 14.343 | 14.476 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 5 | 6 | 6 | 8 | 11 | 22 | 49 | 90 | 147 | 218 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 472 | 485 | 764 | 1.098 | 2.312 | 3.056 | 4.693 | 5.601 | 5.754 | 7.645 |
| Wind (not normalised) offshore | 9 | 10 | 10 | 10 | 16 | 12 | 102 | 238 | 271 | 293 |
| Biomass | 10.819 | 10.706 | 11.307 | 10.967 | 10.588 | 10.603 | 10.890 | 11.821 | 12.317 | 10.760 |
| Biogas | 159 | 161 | 315 | 358 | 372 | 410 | 421 | 437 | 378 | 313 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 89. Production of heating and cooling from RES-H&C technologies in Finland (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Finland | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| Solid biomass | 5.907 | 6.309 | 6.393 | 6.530 | 6.432 | 6.922 | 7.014 | 7.115 | 7.228 | 6.841 |
| Biogas | 26 | 35 | 34 | 38 | 38 | 40 | 97 | 108 | 119 | 108 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 276 | 315 | 353 | 388 | 408 | 426 | 439 | 463 | 490 | 521 |

**Table 90. Fuel used in transport (RES-T) in Finland (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Finland | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 88 | 91 | 66 | 70 | 66 | 68 | 81 | 84 | 89 | 93 |
| Biodiesels | 109 | 103 | 156 | 426 | 430 | 109 | 310 | 281 | 339 | 301 |
| Other biofuels | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 5 | 7 | 10 |
| Renewable electricity | 63 | 63 | 63 | 62 | 61 | 61 | 67 | 72 | 74 | 70 |

## Sweden

**Table 91. Generation of electricity from RES-E technologies in Sweden (2011 – 2020) in GWh. Source: Eurostat SHARES**

| Sweden | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hydro | 68.509 | 68.506 | 67.863 | 65.428 | 66.668 | 66.145 | 66.145 | 66.381 | 66.837 | 66.572 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar PV | 11 | 19 | 35 | 47 | 97 | 143 | 230 | 407 | 679 | 1.051 |
| Solar thermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind (not normalised) onshore | 5.622 | 6.707 | 9.374 | 10.566 | 15.608 | 14.871 | 16.939 | 16.073 | 19.241 | 26.893 |
| Wind (not normalised) offshore | 485 | 457 | 468 | 669 | 714 | 608 | 670 | 550 | 606 | 633 |
| Biomass | 9.641 | 10.507 | 9.609 | 9.007 | 8.977 | 9.749 | 10.250 | 10.195 | 11.220 | 9.496 |
| Biogas | 33 | 20 | 20 | 14 | 11 | 11 | 11 | 10 | 17 | 10 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 92. Production of heating and cooling from RES-H&C technologies in Sweden (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Sweden | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 10 |
| Solid biomass | 7.360 | 7.779 | 7.622 | 7.427 | 7.647 | 7.822 | 7.768 | 7.576 | 7.660 | 8.130 |
| Biogas | 41 | 43 | 49 | 50 | 51 | 57 | 46 | 37 | 61 | 66 |
| Bioliquids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat pumps | 1.163 | 1.218 | 1.225 | 1.213 | 1.220 | 1.388 | 1.379 | 1.451 | 1.557 | 1.571 |

**Table 93. Fuel used in transport (RES-T) in Sweden (2011 – 2020) in ktoe. Source: Eurostat SHARES**

| Sweden | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Biogasoline | 201 | 194 | 169 | 155 | 129 | 101 | 95 | 119 | 93 | 97 |
| Biodiesels | 191 | 256 | 358 | 538 | 691 | 914 | 1.170 | 1.245 | 1.208 | 1.220 |
| Other biofuels | 80 | 88 | 93 | 100 | 114 | 110 | 119 | 124 | 100 | 91 |
| Renewable electricity | 227 | 231 | 236 | 225 | 223 | 229 | 213 | 221 | 235 | 237 |

# Appendix B: Additional detailed information per Member States on food/feed crops

This appendix provides more details per MS for the information provided in section 2.3 on food and feed crops as consumed in transport for the period 2016-2020. The period 2016-2020 is chosen because of the ILUC directive, stating the 2020 target specifics for the MS.

**Table 94. Food and feed crops-based biofuels and bioliquids as consumed in transport (ktoe). Data from SHARES, Eurostat.**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| BE | 428 | 453 | 432 | 441 | 504 |
| BG | 160 | 163 | 89 | 98 | 104 |
| CZ | 301 | 314 | 309 | 287 | 286 |
| DK | 236 | 195 | 194 | 192 | 222 |
| DE | 1784 | 1818 | 1728 | 1921 | 2464 |
| EE | 0 | 0 | 17 | 18 | 16 |
| IE | 33 | 29 | 25 | 22 | 10 |
| EL | 23 | 133 | 115 | 117 | 138 |
| ES | 1159 | 1367 | 1737 | 1561 | 984 |
| FR | 2847 | 2981 | 2979 | 2975 | 2253 |
| HR | 1 | 0 | 27 | 25 | 30 |
| IT | 264 | 187 | 177 | 293 | 358 |
| CY | 0 | 0 | 0 | 0 | 0 |
| LV | 10 | 9 | 36 | 34 | 34 |
| LT | 57 | 72 | 78 | 75 | 93 |
| LU | 67 | 101 | 109 | 100 | 78 |
| HU | 119 | 64 | 99 | 83 | 134 |
| MT | 1 | 1 | 0 | 0 | 0 |
| NL | 114 | 129 | 152 | 132 | 161 |
| AT | 520 | 439 | 471 | 470 | 394 |

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| PL | 457 | 605 | 899 | 1009 | 1005 |
| PT | 138 | 103 | 116 | 106 | 102 |
| RO | 257 | 297 | 297 | 412 | 483 |
| SI | 0 | 15 | 52 | 51 | 28 |
| SK | 141 | 146 | 145 | 122 | 117 |
| FI | 30 | 57 | 168 | 309 | 303 |
| SE | 371 | 361 | 393 | 425 | 507 |
| EU27 | 9518 | 10038 | 10843 | 11278 | 10808 |

# Appendix C: Additional detailed information per Member States on Annex IX Part A feedstocks

This appendix provides more details per MS for the information provided in section 2.4 on Annex IX Part A feedstocks as consumed in transport for the period 2016-2020. There was no consumption of Annex IX A biofuels in the following countries: Croatia, Greece, Hungary, Cyprus, Lithuania, Luxembourg, Malta, Romania, Slovenia.

**Table 95 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Belgium. Data from SHARES, Eurostat.**

| Annex IX A | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 1 | 5 | 6 | 17 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 5 | 6 | 14 |
| (e) | 0 | 0 | 0 | 0 | 1 |
| (f) | 0 | 0 | 0 | 0 | 0 |
| (g) | 0 | 0 | 0 | 0 | 1 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 1 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 96 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Bulgaria. Data from SHARES, Eurostat.**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 0 | 11 | 6 | 17 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 4 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 11 | 2 | 15 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |
| (g) | 0 | 0 | 0 | 0 | 1 |

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 97 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Czechia. Data from SHARES, Eurostat.**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 0 | 0 | 0 | 6 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 0 | 0 | 6 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |
| (g) | 0 | 0 | 0 | 0 | 0 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 98 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Denmark. Data from SHARES, Eurostat.**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 14 | 9 | 7 | 13 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 12 | 4 | 2 | 6 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 2 | 4 | 4 | 7 |
| (g) | 0 | 0 | 0 | 0 | 0 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 99 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Germany. Data from SHARES, Eurostat.**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 7 | 5 | 8 | 18 | 114 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 2 | 2 | 5 | 3 | 2 |
| (d) | 1 | 1 | 1 | 11 | 27 |
| (e) | 0 | 0 | 0 | 0 | 3 |
| (f) | 0 | 0 | 0 | 0 | 4 |
| (g) | 3 | 2 | 1 | 0 | 54 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 1 | 1 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| (o) | 0 | 0 | 0 | 0 | 23 |
| (p) | 0 | 0 | 1 | 3 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 100 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Estonia. Data from SHARES, Eurostat.**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 0 | 3 | 6 | 22 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 0 | 1 | 8 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 3 | 5 | 15 |
| (g) | 0 | 0 | 0 | 0 | 0 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 101 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Ireland. Data from SHARES, Eurostat.**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 3 | 4 | 5 | 11 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 3 | 4 | 10 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| (g) | 0 | 2 | 1 | 1 | 1 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 102 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Spain. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 0 | 0 | 9 | 67 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 2 |
| (d) | 0 | 0 | 0 | 0 | 28 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |
| (g) | 0 | 0 | 0 | 4 | 38 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 1 | 0 |
| (k) | 0 | 0 | 0 | 4 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 103 Consumed amounts of Annex IX Part A feedstocks (ktoe) in France. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 17 | 22 | 21 | 37 | 46 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 0 | 0 | 1 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |
| (g) | 0 | 0 | 0 | 3 | 15 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 15 | 19 | 21 | 34 | 30 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 3 | 0 | 0 | 1 |
| (p) | 1 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 104 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Italy. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 9 | 7 | 65 | 403 | 408 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 37 | 68 |
| (d) | 8 | 7 | 33 | 173 | 180 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 4 |
| (g) | 0 | 0 | 30 | 186 | 147 |
| (h) | 0 | 0 | 1 | 1 | 2 |
| (i) | 0 | 0 | 0 | 5 | 1 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 1 | 0 | 0 | 1 | 3 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 2 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 105 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Latvia. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 0 | 0 | 0 | 10 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 0 | 0 | 0 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |
| (g) | 0 | 0 | 0 | 0 | 10 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 106 Consumed amounts of Annex IX Part A feedstocks (ktoe) in The Netherlands. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 6 | 42 | 89 | 98 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 4 | 4 | 11 | 4 |
| (c) | 0 | 0 | 0 | 0 | 2 |
| (d) | 0 | 0 | 7 | 45 | 58 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 1 | 2 | 5 | 9 |

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| (g) | 0 | 1 | 16 | 18 | 18 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 2 |
| (j) | 0 | 0 | 0 | 0 | 3 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 1 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 13 | 8 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 107 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Austria. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 0 | 0 | 12 | 10 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 0 | 0 | 0 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |
| (g) | 0 | 0 | 0 | 0 | 0 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 12 | 10 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 108 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Poland. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 0 | 13 | 16 | 35 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 13 | 16 | 35 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 0 | 0 | 0 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |
| (g) | 0 | 0 | 0 | 0 | 0 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 109 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Portugal. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 0 | 0 | 0 | 7 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 0 | 0 | 7 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |
| (g) | 0 | 0 | 0 | 0 | 0 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 110 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Slovenia. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 0 | 0 | 0 | 0 | 16 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 0 | 0 | 0 | 0 | 16 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |
| (g) | 0 | 0 | 0 | 0 | 0 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 111 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Finland. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 142 | 330 | 193 | 115 | 87 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 0 | 0 |
| (c) | 0 | 0 | 0 | 0 | 0 |
| (d) | 142 | 330 | 193 | 115 | 87 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 0 | 0 | 0 | 0 | 0 |

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| (g) | 0 | 0 | 0 | 0 | 0 |
| (h) | 0 | 0 | 0 | 0 | 0 |
| (i) | 0 | 0 | 0 | 0 | 0 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 0 | 0 | 0 | 0 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 0 | 0 | 0 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

**Table 112 Consumed amounts of Annex IX Part A feedstocks (ktoe) in Sweden. Data from SHARES, Eurostat**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Part A | 415 | 222 | 223 | 245 | 240 |
| (a) | 0 | 0 | 0 | 0 | 0 |
| (b) | 0 | 0 | 0 | 1 | 0 |
| (c) | 19 | 22 | 19 | 21 | 21 |
| (d) | 309 | 34 | 34 | 56 | 48 |
| (e) | 0 | 0 | 0 | 0 | 0 |
| (f) | 33 | 41 | 56 | 49 | 45 |
| (g) | 0 | 0 | 0 | 0 | 0 |
| (h) | 0 | 0 | 0 | 0 | 122 |
| (i) | 1 | 2 | 1 | 3 | 4 |
| (j) | 0 | 0 | 0 | 0 | 0 |
| (k) | 0 | 0 | 0 | 0 | 0 |
| (l) | 0 | 0 | 0 | 0 | 0 |
| (m) | 0 | 0 | 0 | 0 | 0 |
| (n) | 0 | 0 | 0 | 0 | 0 |
| (o) | 52 | 123 | 112 | 114 | 0 |
| (p) | 0 | 0 | 0 | 0 | 0 |
| (q) | 1 | 0 | 1 | 0 | 0 |
| (r) | 0 | 0 | 0 | 0 | 0 |
| (s) | 0 | 0 | 0 | 0 | 0 |
| (t) | 0 | 0 | 0 | 0 | 0 |

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