Technical assistance in realisation of the 5th report on progress of renewable energy in the EU

Task 1-2

Update June 2021

Quantitative and qualitative analysis of Member States' progress in deploying renewable energy sources and projection at EU and Member State level of the expected 2020 renewable energy share in final energy consumption

ENER/C1/2019-478

June 2021

EUROPEAN COMMISSION

Directorate-General for Energy
Directorate C – Green Transition and Energy System Integration
Unit C1 — Renewables and Energy System Integration Policies

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Technical assistance in realisation of the 5th report on progress of renewable energy in the EU

Final update report Task 1 & 2

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Reference No.: N° ENER/C1/ 2019-478

Date: 17 June 2021

The analysis presented in this report is based on the policy landscape until February 2021. Modelling results are based on the progress reports submitted by the Member States and policy updates until February 2021.

Manuscript completed in June 2021

1st edition

LEGAL NOTICE

PDF	ISBN 978-92-76-41137-6	doi: 10.2833/559777	MJ-06-21-062-EN-N

Luxembourg: Publications Office of the European Union, 2021

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Abbreviations

CHP	Combined Heat and Power
CPI	Current Policy Initiatives
DH	District Heating
DNI	Direct normal irradiance
DSO	Distributed System Operator
EC	European Commission
ETBE	Ethyl Tert-butyl Ether
EV	Electric Vehicle
FIP	Feed-in premium
FIT	Feed-in tariff
GC	Green certificates
GHG	Greenhouse gas
ILUC Directive	DIRECTIVE (EU) 2015/1513
LCOE	Levelised cost of electricity
MS	Member State(s)
NECP	National energy and climate plans
NREAP	National Renewable Energy Action Plan
PPI	Planned Policy Initiatives
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

Progress in deploying renewable energy sources in the EU and the Member States

At an EU-level, the shares of renewable energy sources (RES) in total, electricity (RES-E), heating and cooling (RES-H&C), and to a lesser extent also transport (RES-T) have been continuously increasing over the past years. In 2019, the EU reached a share of 18.9% of RES in gross final energy consumption, the target for 2020 being 20% as defined in the RES Directive 2009/28/EC (RED).

Regarding the indicative trajectory set in the RES Directive, defined as the average values of 2011/2012, 2013/2014, 2015/2016, 2017/2018 and 2019/2020, respectively, the EU-28 has been comfortably above up to 2018 and the overall RES share in 2019 stays between the indicative RES Directive trajectories set for 2017/2018 and 2019/2020.

However, the EU as a whole was slightly below the aggregated more ambitious trajectory defined by the MS themselves in their NREAPs in 2018 (by 0.1%). In 2019, the difference between the actual deployment and planned NREAP trajectory increased to 0.4%. With regard to individual sectors, the RES-E and the RES-H&C sectors are well on track, resulting from the especially high contributions on the "higher than planned" generation of RES-E from photovoltaics and use of heat pumps in the RES-H&C sector. Meanwhile, the RES-T sector stays below the planned share (8.9% actual versus 9.04% planned) resulting from the "lower than planned" RES consumption for all energy sources.

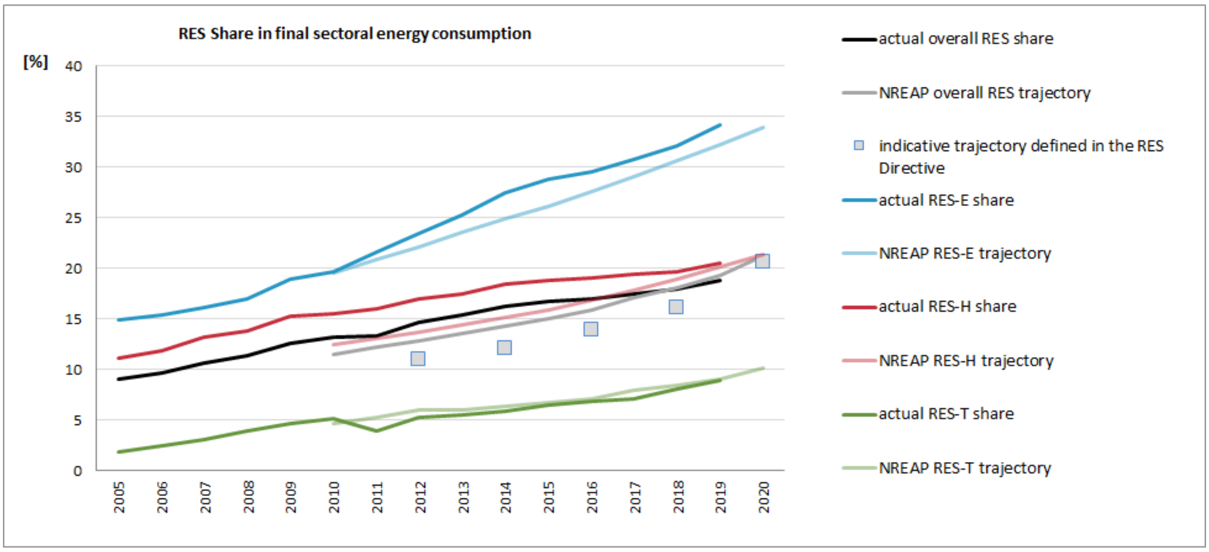

Figure 1. Actual and planned RES shares for the EU-28 (%). Source: Eurostat, NREAPs

When looking at RES deployment in 2018, 23 MS are above their indicative RED trajectory for 2017/2018. Only Ireland, France, the Netherlands, Poland and Slovenia are below their indicative RED trajectories. The largest positive deviations from their indicative RED trajectories can be observed in Croatia, Bulgaria, Czech Republic and Italy.

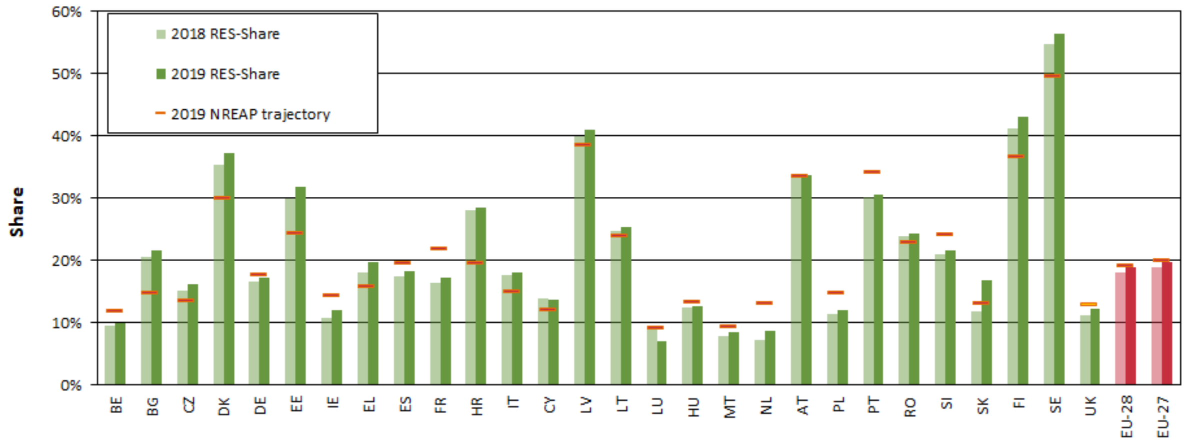

Figure 2. Actual renewable energy shares in 2017 and 2018 compared to indicative trajectories set in RES Directive and NREAP. Source: Eurostat[1]

For RES-E, in 2017 and 2018 the most common support schemes used by MS to stimulate RES deployment were premium and feed-in tariffs, the former often combined with tendering systems (auctions). However, also quota schemes, tax incentives, net-metering, investment grants and loans have been applied to support the development of renewable electricity generation. Almost all MS operate at least two support schemes to support different technologies, installation sizes and actors and provide needs-based support. In the period 2017/2018, the shift from administratively set feed-in tariffs to feed-in premiums continued. While many MS had already changed their remuneration for new installations between 2014 and 2016, Bulgaria and Slovakia followed in 2018 and 2019 respectively[2]. The most prominent trend in support schemes in 2017 to 2020 was the continuous shift towards RES auctions. By July 2020, 18 MS determine the support levels for (larger) RES-E installations in a competitive bidding process. Most MS chose to implement technology-specific auctions rather than technology-neutral or multi-technology auctions.

The most commonly applied form of support for RES-H&C are investment grants. This form of subsidy was available in 24 MS in 2017 and 2018. Other forms of commonly provided support for RES-H&C are tax deductions and feed-in premiums. The support instruments that are in place usually apply to a broad range of technologies. The most popular technology are biomass plants. In addition, commonly supported technologies are geothermal, aerothermal and hydrothermal heat pumps as well as solar thermal plants.

The predominant support scheme for RES-T in the EU is a biofuel quota obligation. By 2020, some form of obligation scheme has been the main RES-T policy measure in all MS. 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.

Most of the schemes applied by MS have an increasing quota, often targeting a 10% share by 2020. Germany and Sweden do not impose an increasing share of biofuel content, but demand increasing

[1] Quantitative assessments for Malta in this report are based on the National Renewable Energy Action Plan submitted in 2012. Malta submitted a new NREAP in June 2017.
[2] Please note that in the case of Slovakia, the planned tender scheme has been introduced by the new RES Act in 2019. However, the auctions have been postponed due to the COVID19 pandemic.

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[3] biofuels and a sub-target for advanced biofuels.

Feasibility of 2020 target achievement considering current progress

A comparison of expected with planned RES deployment by 2020 indicates that the EU would succeed in meeting its binding RED 2020 RES target: At EU-27 level, a RES share of 22.4% to 22.6% (EU-28: 21.5% to 21.8%) can be expected with currently implemented RES policy initiatives[4]. The majority of MS is expected to perform well in meeting their binding RED 2020 RES targets. When not including the statistical transfers, 21 of the assessed 27 MS, including Bulgaria, Czechia, Denmark, Germany, Estonia, Greece, Spain, Croatia, Italy, Cyprus, Latvia, Lithuania, Hungary, Malta, Austria, Portugal, Romania, Slovenia, Slovakia, Finland and Sweden, may succeed in (over)fulfilling their binding RED 2020 RES targets with implemented RES policies under the given special circumstances of today (2020) – i.e. the significant drop in energy consumption driven by the COVID-19 pandemic during the first half of 2020. The UK was also included in the assessment and will most likely reach its RED 2020 RES target. For the remaining 6 MS, Belgium, Ireland, France, Luxembourg, the Netherlands and Poland, currently implemented RES policy initiatives appear insufficient to trigger the required RES volumes to reach their binding 2020 RES targets purely domestically, despite the strong decline in energy consumption projected for 2020.

Planned 2020 RES deployment as indicated in the NECP baselines is in the majority of MS higher[5] than their binding RED 2020 RES targets. 22 MS are expected to meet their planned NECP baseline of RES in gross final consumption of energy in 2020. Belgium and Ireland are expected to overachieve their NECP baseline which is, however, lower than the respective country's RED 2020 RES target. On the contrary, for Denmark an achievement of its own NECP baseline planning concerning overall RES deployment appears unlikely under the given circumstances, despite its ability to meet its significantly lower binding national RES obligation.

Until now, seven cooperation agreements on the statistical transfer of renewable energy were signed. Five MS act as buyers of statistical transfers while three MS act as sellers. Including the details from the agreed statistical transfers, the picture changes for all affected MS that are at risk of not reaching their 2020 RED target. The gap in meeting their binding national 2020 RES target is significantly reduced for the offtaker countries Belgium, Ireland, Luxembourg, Malta and the Netherlands. For Belgium, the amount of statistical transfer agreed upon with Denmark (1.8 TWh) will not suffice to close the gap to its RED target RES share of 13%. It is expected that a gap of 1.5 to 1.9 TWh to its 2020 RED target will remain, depending on the gross final consumption of energy and renewable energy deployment in 2020. For Ireland, it is expected that the statistical transfer with Denmark and Estonia of 3.5 TWh will be sufficient to reach its RED target RES share of 16% in 2020. According to our assessment a statistical transfer of 0.9 to 1.4 TWh would suffice for Ireland to reach its 2020 RED target RES share. For Luxembourg it appears likely that the 2020 RES target can be met thanks to its proactive behaviour in setting these political agreements with Estonia (400 GWh plus 600 GWh optional) and Lithuania (700 GWh) under the assumption of strong cooperation[6] (of at least 1.63 TWh). For Malta it appears that, according to the results of our assessment, the country does not need any of the agreed statistical transfers to reach its RED 2020 RES target (due to the decline in energy consumption in 2020). For the Netherlands the projection appears less optimistic but still the 2020 RES target can be met under the assumption of strong cooperation with Denmark (i.e. a statistical

[3] Biofuels produced from 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.

[4] Note that the range indicates the uncertainty related to key input parameter for the model-based assessment of future RES progress. Remarkably, this year's (2020) energy demand drop as a consequence of the COVID-19 pandemic, and corresponding (comparatively small) changes in RES supply play a decisive role in this respect.

[5] Adding up planned performance as specified by MS's in their NECP baselines for 2020 leads to a RES share of 21.0% (21.7%) for the EU-28 (EU-27), similar to the binding RED 2020 RES target of 20% measured as RES share in gross final energy consumption.

[6] See section 3.2.1.2 for details on the assumptions of the strong cooperation scenario.

transfer of at least 13.6 TWh should suffice for that purpose, compared to 16 TWh possible according the contractual agreements taken in prior) in combination with both assumed energy demand projection for 2020.

A closer look at sectorial RES deployment is taken below, comparing expected RES deployment with NECP planning for 2020.

Within the electricity sector, by 2020 15 MS (out of the 21 MS that have transparently specified their NECP baseline RES-E shares in 2020) will be able to meet (and over-succeed) their RES-E deployment as planned in the NECPs under all assessed circumstances. Top of that list is Greece, followed by Estonia, Croatia, Bulgaria, Poland, Czechia, Germany, Ireland, Sweden, Luxembourg, Slovenia, Slovakia, Hungary, Spain, and Romania. The remaining six MS that have also specified their planned baseline RES-E share in their NECP can be classified as not successful in planning their 2020 progress with respect to renewable electricity. Top of that list (of negative ranking) is the Netherlands, followed by Lithuania, with deficits larger than 20%. The remainder of MS, i.e. Latvia, Malta, Portugal, and Belgium, shows a smaller deficit in expected vs (NECP) planned RES-E shares for 2020.

For the H&C sector a comparatively similar picture occurs: The large majority of MS (i.e. 15 out of 19 MS that have specified their planned RES-H&C share for 2020) are on track or have even over-accomplished their planned 2020 RES-H&C share (as specified in their NECP baselines). The strongest progress ahead of the trajectory is expected for Slovakia, Portugal and Malta, all showing a deviation of more than 25% when comparing expected and planned RES-H&C shares. Other MS that clearly overfulfil their plans (i.e. with a deviation higher than 10% but below 25%) are Belgium, Bulgaria, Czechia, Spain and Croatia. The other MS (Germany, Estonia, Greece, Latvia, Lithuania, Hungary and Sweden) have planned realistic 2020 RES-H&C shares in their NECPs – i.e. here deviations between expected and planned deployment are smaller than 10%, but not below the planned contribution. Contrarily, Ireland, Luxembourg and Slovenia fall more than 5% short of their planned RES-H&C share in 2020. An insignificant deviation between planned and excepted deployment is expected for Romania, here the gap amounts to approximately 1%.

In transport, by 2020 13 of 27 MS are expected to meet (and exceed) the binding RED RES-T sector target under all assessed circumstances. On top of that list is Finland, followed by Sweden, Ireland, the Netherlands, Italy and Portugal, all showing a surplus larger than 20% compared to the given sector target of 10% by 2020. Other MS where RES-T target achievement appears likely are Belgium, Germany, Greece, Malta, Austria, Portugal, Romania and Slovenia. At EU-27 (EU-28) level a surplus of 28.6% to 30.4% (24.5% to 26.2%) can be expected. Of the remaining 14 MS, Bulgaria, Denmark, Spain, France and Hungary can be classified as maybe reaching their target in the low demand case or 'just' missing their 10% target. Their deviations from the binding national RED RES-T target of 10% reach from 0.0% to -2.7% depending on the final energy demand in the transport sector in 2020. All other 9 remaining MS are clearly not successful in meeting their binding RED RES-T sector target. Top of that list (of negative ranking) is Cyprus, followed by Lithuania, Luxembourg – all with deficits larger than 25%. Finally, a RES-T target achievement appears also unlikely for Czechia, Estonia, Latvia, Slovakia, Croatia and Poland – but here the gap to the given RES-T target is smaller in magnitude.

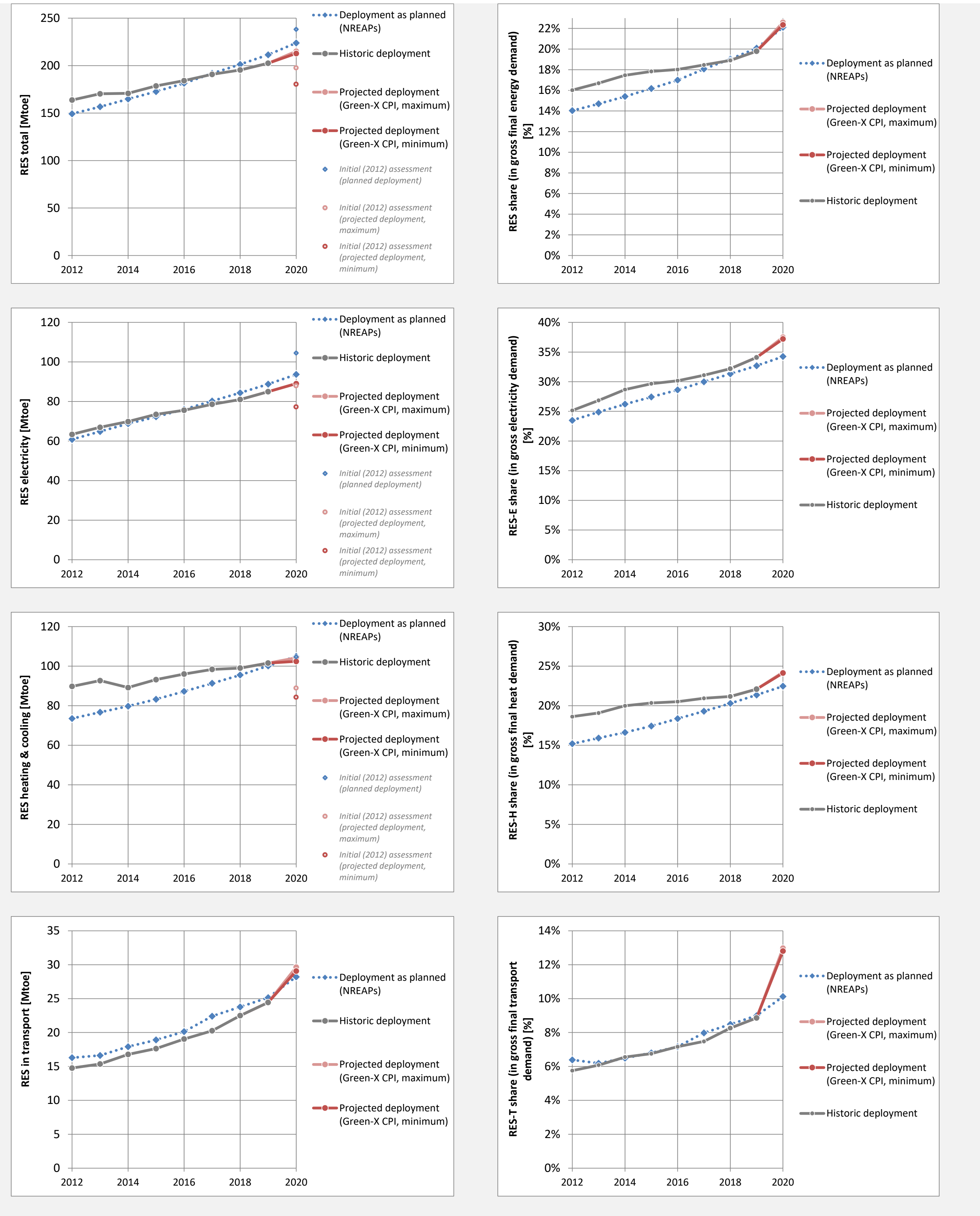

Figure 3. Historic, expected and planned sector-specific RES deployment at EU-level (EU-27) by 2018, 2019 and 2020 in absolute terms (Mtoe, left) and in relative terms (as RES share in corresponding demand, right)

1. INTRODUCTION

In 2009, the European Union 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 accordance with Article 4 of RES Directive each MS has submitted an NREAP to the European Commission in 2010 or later. In its NREAP, each MS provides a detailed roadmap describing how it will meet its legally binding national 2020 RES target. In addition, most MS define slightly more ambitious non-mandatory 2020 NREAP targets. The roadmaps contain indicative sectoral trajectories and the technology mix they expect to use. Every two years, each MS has to submit a report on the developments in RES compared with the trajectories in its NREAP ("Progress Reports"). RES Directive Article 23 requires the Commission to report on the progress in renewable energy every two years.

The goal of this report is to provide technical assistance to the Commission in realisation of the 2020 Progress Report on renewable energy. The 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 28[7] EU Member States.

The report not only analyses past progress, but also models future progress as to identify sectors and Member States (MS) where action is required to ensure target achievement. This analysis is based on MS National Renewable Energy Action Plans (NREAP), renewable energy Progress Reports submitted in 2019/2020 by MS, SHARES and Eurostat statistics, other reports and studies, and additional research. The main focus of this report is on 2017/2018, but results presented are based on the policy landscape up to July 2020.

In Chapter 2, we present an overview of the past progress of the 28 MS and the EU on deployment of renewable energy, also split by the three sectors electricity, heating & cooling and transport. We also present trends in policy measures planned and implemented and end the Chapter with an overview of MS progress in relation to the 2018 indicative trajectories.

In Chapter 3, we assess how feasible the achievement of the 2020 nationally binding RES targets appears under two different scenarios. We not only model the projected future progress of the renewable energy share overall, but also by energy sector and MS.

In Chapter 4, we present a set of recommendations for the MS projected not to achieve their binding national 2020 RES target on possible actions that could be taken to alter this path. Finally, in Chapter 5 we present a summary and conclusions.

In the annexes we additionally present detailed information on the quantitative progress of all MS per sector and per technology.

In the update of this report done in February 2021, no policy updates were identified that could still impact the 2020 RES deployment.

[7] Please note that the United Kingdom is included here due to the reporting period being 2017-2018.

2. PROGRESS IN DEPLOYING RENEWABLE ENERGY SOURCES IN THE EU AND THE MEMBER STATES

2.1. Introduction

Historic progress of RES from 2010 to 2019 per MS is based on the database SHARES of Eurostat[8]. Monitoring of progress by technology relies on database Eurostat Energy Balances[9], which includes data up to 2019.

In the following sections we provide main findings on EU-level and from the MS assessments on:

- Quantitative progress (overall, per sector and technology-specific findings).
- Trends in support schemes.
- Progress on policy commitments by the MS.

In Appendix A, we provide detailed descriptions of each MS and their progress regarding quantitative growth in sectors and technologies. Detailed descriptions with respect to policy measures and non-economic barriers can be found in Appendix B and C of the full report published in October 2020[10]. In the update of this report done in February 2021, no policy updates were identified that could still impact the 2020 RES deployment

2.2. Quantitative progress (overall, per sector and technology – specific findings)

In this chapter, we present MS' progress in deploying RES up to 2019. We compare the progress achieved by MS in 2018 with the indicative 2017/2018 trajectory defined by the RES Directive, as well as the progress achieved by MS in 2019 with the 2019 trajectory planned in the NREAPs. This reporting covers EU-28, since the UK was a full member of the EU for the reporting period 2017 to 2019. In line with the Eurostat practices the EU-28 totals are complemented with EU-27 totals excluding the contributions from the UK.

2.2.1. Approach and data sources

To monitor the progress in RES, shares and trends of overall RES and RES in sectors are depicted, for the EU and by MS. Furthermore, data on the development of RES technologies is provided. Specifically, this includes illustrations as listed below:

(1) Two overview graphs indicating the trend in overall EU renewables shares.

(2) MS-specific overview of 2018 and 2019 actual shares versus 2019 NREAP trajectories and 2017/2018 indicative trajectories as set in the RES Directive.

(3) MS-specific deviation from 2019 NREAP trajectory in %.

(4) Total generation, or consumption, and growth of RES by sector, technology and MS.

For the overall RES development, information is provided according to (1), (2) and (3). For each of the three separate RES sectors, i.e. RES-E, RES-H&C and RES-T, figures of type (2) and (3) are provided (shown in Appendix A), in addition to data tables on actual deployment and growth (4). Furthermore, the development of individual technologies is presented in Appendix A. It includes technologies as listed in Table 1. For these individual technologies, figures of type (3) are shown.

[8] http://ec.europa.eu/eurostat/web/energy/data/shares
[9] https://ec.europa.eu/eurostat/data/database
[10] https://op.europa.eu/en/publication-detail/-/publication/d557041f-11be-11eb-9a54-01aa75ed71a1/language-en/format-PDF/source-166348766

Table 1. Overview RES technologies presented in Appendix A

Renewable electricity (RES-E)	Renewable heating and cooling (RES-H&C)	Renewable energy in transport (RES-T)
Offshore Wind	Solar Thermal	Bioethanol/Bio-ETBE
Onshore Wind	Solid Biomass	Biodiesel
Solid Biomass	Biogas	Renewable Electricity in Transport
Biogas	Heat Pumps	Other biofuels
Photovoltaics	Geothermal Heating	Hydrogen
Hydro	Bioliquids	
Mixed Hydro		
Geothermal		
Bioliquids		
Concentrated Solar Power		
Tide, Wave and Ocean Energy		

The report is based on the following six data sources:

- The targets and the indicative trajectories are derived from three sources:
  - **RES Directive:** the indicative trajectories up to 2020 are defined in the RES Directive.
  - **NREAPs:** The trajectories planned for each RES technology until 2020 have been taken from the NREAPs that MS submitted to the EC in 2010.[11]
  - **NECPs**: The share of renewables in gross final energy consumption in 2020 as planned in the NECP baseline.[12]
- The past progress in RES deployment has been analysed on basis of three data sources:
  - **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-28. The latest shares are of 2019.
  - **Member State Progress Reports**: Used for comparison and verification purposes only. MS submitted their fifth Progress Reports to the Commission in early/mid 2020, to monitor compliance with their planned trajectories and measures. These latest reports cover the period 2017-2018.
  - **Eurostat energy balance, national data sources**: Eurostat technology data from energy balances and national data for selected MS, is used for those graphs and tables detailing technology-specific progress.

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

2.2.2. Overall trends EU

At an EU-level, the shares of RES in total, renewable electricity (RES-E) and renewables for heating and cooling (RES-H&C) have been continuously increasing over the past years. In 2019, the EU reached a share of 18.9% of RES in gross final energy consumption, the target for 2020 being 20%.

[11] https://ec.europa.eu/energy/topics/renewable-energy/national-renewable-energy-action-plans-2020_en?redir=1
[12] https://ec.europa.eu/energy/topics/energy-strategy/national-energy-climate-plans_en

Figure 4 shows a rise in shares since 2005 – with the exception of RES-T which decreased in 2011, due to the requirements on sustainability following from the transposition of the RES Directive[13]. The overall RES share increased by 0.9% from 2018 to 2019. On average, it has been increasing by about 0.6% per year since 2009 and by about 0.7% per year since 2005.

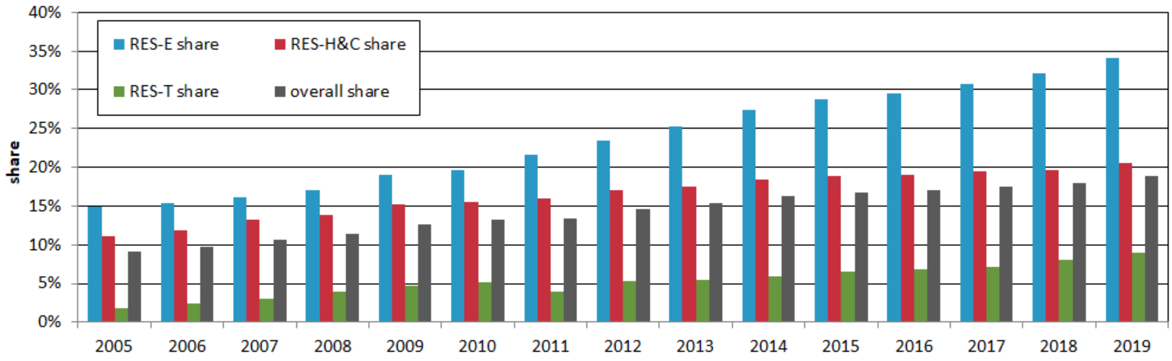

Figure 4. EU-28 RES shares from 2005-2019 (%). Source: Eurostat SHARES

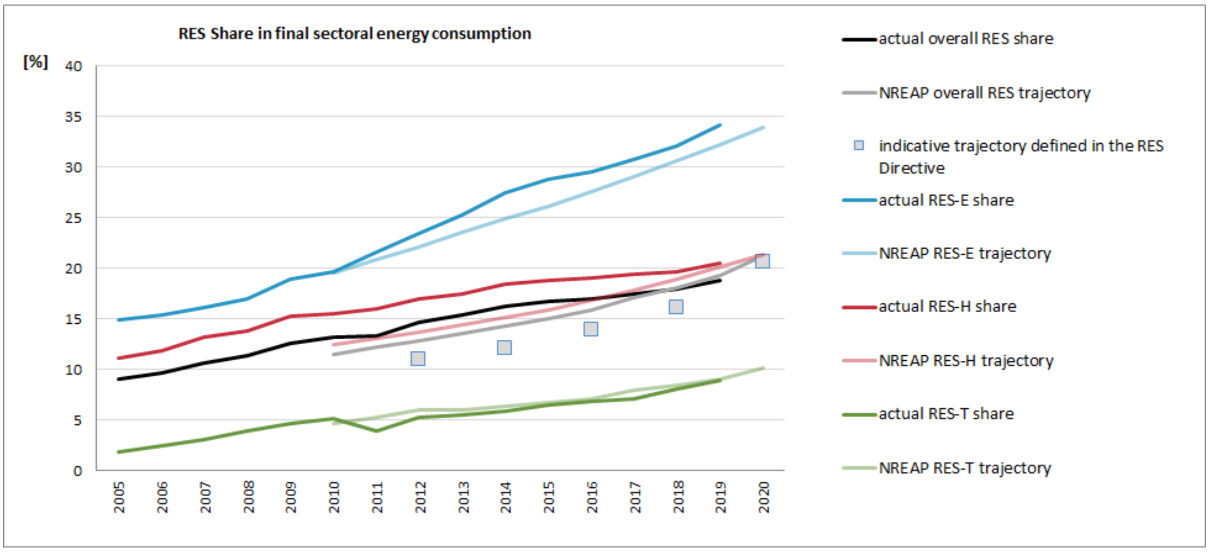

Figure 5. Actual and planned RES shares for the EU-28 (%). Source: Eurostat SHARES and NREAPs

Figure 5 compares historic shares up to 2019 to the trajectories set out in MS' NREAPs,as well as to the indicative trajectory defined in the RES Directive. Regarding the indicative trajectory set in the RES Directive, defined as the average values of 2011/2012, 2013/2014, 2015/2016, 2017/2018 and 2019/2020, respectively, the EU-28 has been comfortably above up to 2018 and the overall RES share in 2019 stays between the indicative RES Directive trajectories set for 2017/2018 and 2019/2020.

However, the EU as a whole was slightly below the aggregated more ambitious trajectory defined by the MS themselves in their NREAPs in 2018 (by 0.1%). In 2019, the difference between the actual

[13] Regarding the consumption of bioliquids and biofuels (as defined in Article 2 of RES Directive), there is a sudden decrease in consumption from 2010 to 2011, after which it rises again. This has an especially strong effect on the RES-T share. The issue is caused by a methodological break in the time series in statistics for biofuels due to the transposition and implementation of RES Directive by Member States, rather than by actual fluctuations in consumption: to be eligible for the RES target, biofuels and bioliquids must be compliant with sustainability criteria and verification procedures specified under Articles 17 and 18 of the RES Directive. This legislation was fully transposed only after 2010. Until then (until reference year 2010), all biofuels were counted towards the RES and RES-T shares. From 2011, Member States were allowed to report "as compliant only those biofuels and bioliquids for which compliance with Article 17 as well as Article 18 can be fully demonstrated". As Member States gradually improved the implementation of the RES Directive and also increased the quantity of compliant biofuels, the RES-T share rose again (and to smaller extent, overall RES also increased).

deployment and planned NREAP trajectory increased to 0.4%. With regard to individual sectors, the RES-E and the RES-H&C sectors are well on track, resulting from the especially high contributions on the "higher than planned" generation of RES-E from photovoltaics and use of heat pumps in the RES-H&C sector. Meanwhile, the RES-T sector continues to stay below the planned share (8.9% actual versus 9.04% planned) in 2019. As in 2018, this results from the "lower than planned" consumption for all energy sources, although the gap between actual and planned has been reduced due to the high increases in RES-T in several MS, especially in Croatia (+3.3%) and Finland (+3.6%). It is thus the 'higher than planned' shares of the RES-E and RES-H&C sectors, which lead to the overall RES sector being only slightly below the planned NREAP trajectory.

2.2.3. Overall trends by Member States

The RES shares in 2018 and 2019 varied greatly among the MS, largely reflecting the different starting positions and national targets defined in the RES Directive of each MS. In 2019, Sweden held the highest RES share (56%), while the lowest RES shares were seen in Luxembourg (7%) and the Netherlands (9%)[14]. Despite the low overall RES shares, Malta (+0.5%) and the Netherlands (+1.4%) both showed increases in RES share from 2018 to 2019, while Luxemburg (-1.9%) showed a decrease. **Figure 6** depicts actual RES shares by MS and compares them to the indicative trajectory set in the RES Directive for 2017/18 and the NREAP trajectory for 2019. **Figure 7** shows each MS' deviation from the 2019 NREAP trajectory as percentage of the value.

A comparison of actual RES shares to the indicative trajectories set in the RES Directive and the NREAPs shows that:

- In 2018, 23 MS are above their indicative RED trajectory for 2017/2018. Ireland, France, the Netherlands, Poland and Slovenia are below their indicative RED trajectories.
- In 2019, Ireland caught up with the indicative RED trajectory set for 2017/2018, while Luxembourg fell below its indicative RED trajectory set for 2017/2018 due to the decrease in RES share from 2018 to 2019.
- The largest positive deviations from their indicative NREAP trajectories for 2019 can be observed in Bulgaria, Croatia, Estonia and Slovakia, all of which show increases of RES share from 2018 to 2019 and Slovakia has the highest increase of RES share (+5%).

[14] Malta adapted its NREAP in the year 2017 specifying targets regarding overall RES and sectoral shares. For RES-E, Malta's 2017 NREAP does not contain specific trajectories on technological level. For RES-E, Malta focusses entirely on PV setting all other technologies to 0%. Therefore, the 2017 NREAP is only used for figures containing sectoral data and technological data for RES. For RES-H&C and RES-T, data from the previous NREAP is used.

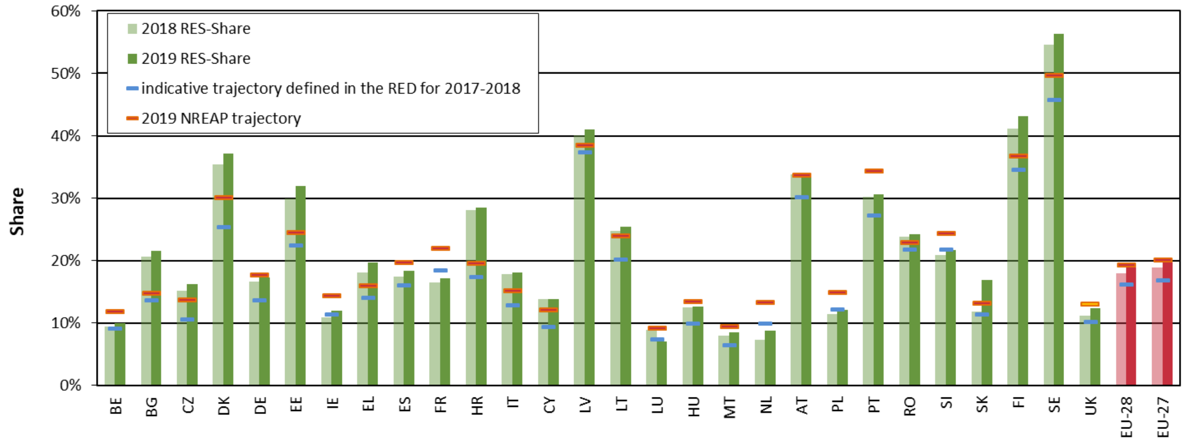

Figure 6. Actual renewable energy shares in 2018 and 2019 compared to indicative trajectories set in RES Directive and NREAP. Source: Eurostat[15]

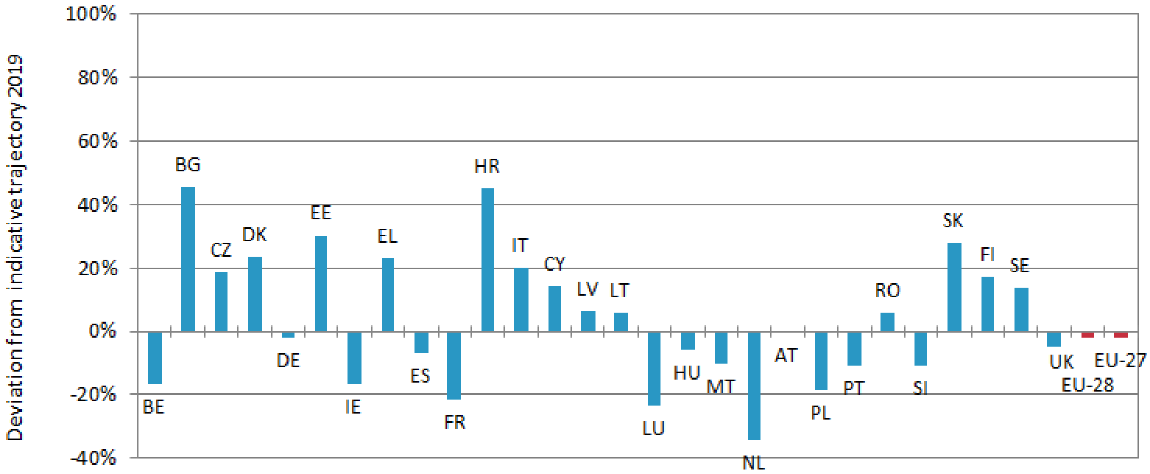

Figure 7. Deviation of actual RES shares in 2019 from indicative NREAP trajectory [change in %]. Source: Eurostat

The Netherlands showed the largest gap in 2018, with an actual share of 7.3% versus an indicative RED trajectory for 2017/2018 of 9.9%. The gap to their planned NREAP share of 12.1% RES in 2018 is even larger. Although +1.43% increase of RES share from 2018 to 2019 is observed in the Netherlands, the gap to the NREAP trajectory of 13.3% for 2019 remains the largest among all MS.

Table 2 summarises the results and shows the current and planned RES share according to the NREAP and the indicative trajectories from the RES Directive. In addition, Table 2 shows the 2020 targets of the MS according to the RES Directive, the NREAP as well as the 2020 baseline that was planned by the MS in their National Energy and Climate Plans (NECP), and thus allows a comparison among them.

[15] Quantitative assessments for Malta in this report are based on the National Renewable Energy Action Plan submitted in 2012. Malta submitted a new NREAP in June 2017.

Table 2. Actual (Eurostat) and planned RES shares according to the NREAPs and indicative trajectories from the RES Directive from the RES Directive and the 2020 baseline in the NECPs of the Member State

Member State	2017/2018 RES share (average of 2017/18) [%]	2017/2018 indicative trajectory according to RES Directive [%]	2019 RES Share [%]	2019 indicative RES trajectory according to NREAP [%]	2020 RES target according to RES Directive [%]	2020 RES target according to NREAP [%]	2020 RES share according to NECP baseline [%]
Belgium	9.3	9.2	9.9	11.9	13.0	13.0	**11.2**
Bulgaria	19.6	13.7	21.6	14.8	16.0	16.0	20.18
Czech Republic	15.0	10.6	16.2	13.7	13.0	14.0	15.6[16]
Denmark	35.0	25.5	37.2	30.1	30.0	30.4	41.0
Germany	16.1	13.7	17.4	17.7	18.0	19.6	18.8
Estonia	29.6	22.6	31.9	24.5	25.0	25.0	25.0
Ireland	10.7	11.5	12.0	14.4	16.0	16.0	**12.9**
Greece	17.7	14.1	19.7	16.0	18.0	18.0	19.7
Spain	17.5	16.0	18.4	19.7	20.0	20.8	20.0
France	16.2	18.6	17.2	22.0	23.0	23.0	23.0
Croatia	27.7	17.4	28.5	19.6	20.0	20.1	28.6
Italy	18.0	12.9	18.2	15.1	17.0	17.0	19.0
Cyprus	12.2	9.5	13.8	12.1	13.0	13.0	13.0
Latvia	39.5	37.4	41.0	38.5	40.0	40.0	40.0
Lithuania	25.4	20.2	25.5	24.0	23.0	24.0	26.8
Luxembourg	7.6	7.5	7.0	9.2	11.0	11.0	11.8[17]
Hungary	13.0	10.0	12.6	13.4	13.0	14.7	13.2
Malta	7.6	6.5	8.5	9.5	10.0	10.0	**7.7**
Netherlands	6.9	9.9	8.8	13.3	14.0	14.5	**11.4**
Austria	33.5	30.3	33.6	33.7	34.0	34.2	34.3
Poland	11.3	12.3	12.2	14.9	15.0	15.9	15.0

[16] The Czech NECP does not provide a baseline value for 2020. Chart 61 on page 209 provides the baseline values towards 2030. However, there is no value stated for 2020. As placeholder, the target value for 2020 from Table 14 on page 31 of the Czech NECP is used.
[17] The share of 11.8% includes cooperation mechanisms. Without cooperation mechanisms the value is 9.2%.

Portugal	30.4	27.3	30.6	34.3	31.0	34.5	31.0
Romania	24.2	21.8	24.3	22.9	24.0	24.0	27.8
Slovenia	21.0	21.9	21.7	24.3	25.0	25.3	25.0
Slovakia	11.7	11.4	16.9	13.2	14.0	14.0	14.0
Finland	41.0	34.7	43.1	36.8	38.0	38.0	38.0
Sweden	54.4	45.8	56.4	49.6	49.0	50.2	58.2
UK	10.5	10.2	12.3	13.0	15.0	15.0	-
EU-28 (calculated)	17.7 (Eurostat SHARES)	16.2[6]	18.9 (Eurostat SHARES)	19.3	20.7[7]	21.3	-
EU-27 (calculated)	18.7 (Eurostat SHARES)	16.9[6]	19.7 (Eurostat SHARES)	20.1	21.4[7]	22.1	-

(green)	Average 2017/2018 share is >1 percentage point above indicative RED trajectory	Highlighted in **red**, if the 2020 NECP baseline value is below the 2020 target according to RES Directive
(yellow)	Average 2017/2018 share is 0-1 percentage point above indicative RED trajectory	
(red)	Average 2017/2018 share is below indicative RED trajectory	

As shown in Table 2, Denmark, Bulgaria and Croatia have achieved their NREAP 2020 targets in 2018 and Greece as well in 2019, and specified their planned 2020 baseline in their NECPs (+10.6%-, +4.2%-, +8.5%- and +1.7%-points respectively) above their 2020 RES targets depicted in the RES Directive and their NREAPs. For almost all other MS the 2020 planned contribution according to the NECP (baseline) are in line with the 2020 RES Directive targets. Belgium, Ireland, Malta and Netherlands have set NECP baselines for 2020 which are below their respective 2020 RES Directive targets (see Table 2).

Figure 8 shows the overall over- and underperformance with regard to the sectoral trajectories defined in the NREAPs for 2018. A comparison of actual RES shares to the indicative NREAP targets and trajectories shows that 12 out of 28 EU MS had already reached or surpassed the level of their 2020 NREAP RES targets at the time of 2018 (however, this does not mean that these countries will automatically achieve their 2020 targets). Another five MS were above their 2018 NREAP trajectories. Nine MS are below their 2018 NREAP trajectories but within reach, with deviations smaller than 10%. Seven MS were lagging behind their 2018 NREAP trajectories for the overall RES share.

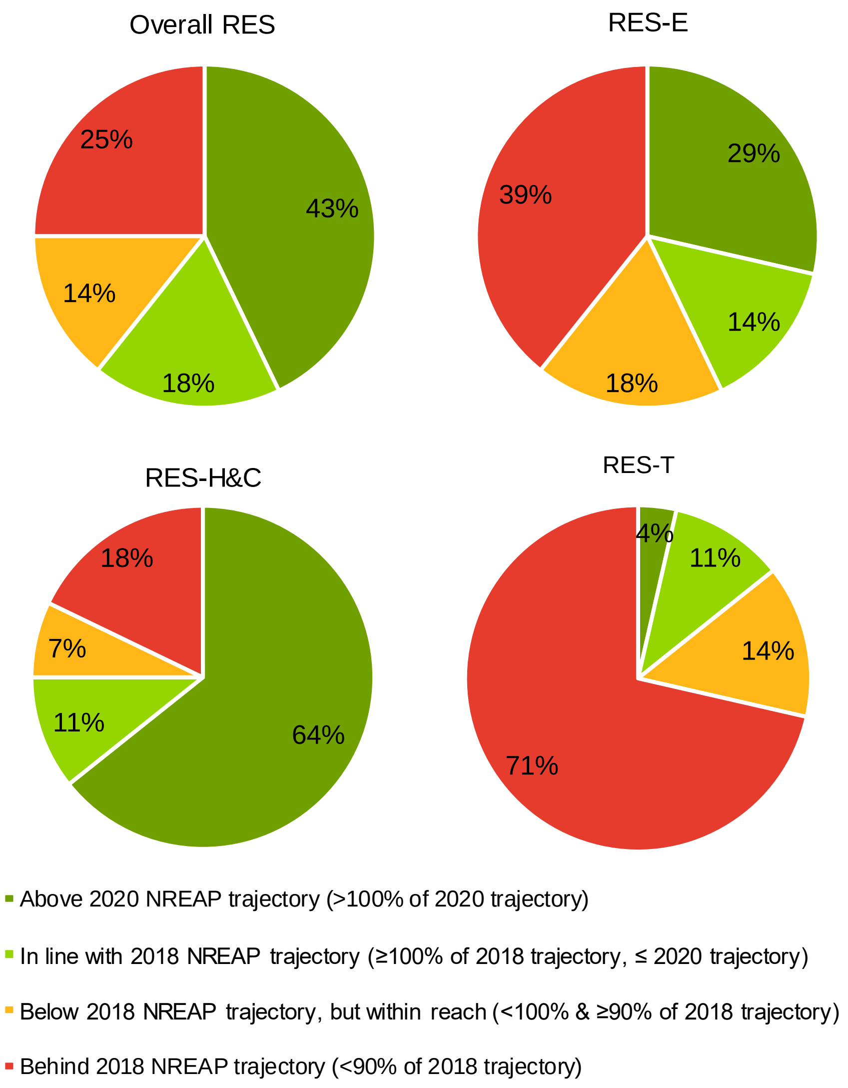

Figure 8. Overview of over- and underperformance compared to the 2018 NREAP trajectories

When looking at the different RES sectors, the picture becomes more differentiated:

Regarding RES-E, eight MS (29%) had already reached the level of the 2020 RES-E share planned in their NREAPs. Four MS were on track of their 2018 NREAP RES-E trajectory, while five MS were below, but within reach (deviations <10%). However, also 11 MS (39%) were not on track of their 2018 NREAP trajectory.

Regarding RES-H&C**,** 18 MS had already exceeded the 2020 RES-H&C share planned in their NREAPs, while three other MS were in line with their 2018 NREAP trajectory. Two MS are below but within reach of their trajectories and five MS were behind their 2018 NREAP trajectory.

The progress regarding RES-T is less advanced. Sweden is already above its 2020 NREAP trajectory and another three MS are on track of their 2018 NREAP trajectories, while four MS are below but within reach of their RES-T trajectories. However, a total of 20 MS (71%) is lagging behind their trajectories, in many cases substantially.

2.2.4. *Estimated potential for cooperation mechanisms*

In section 11 of the Progress Reports, MS are required to report on their actual and estimated excess and/or deficit production of energy from RES compared to the indicative RED trajectory which could be transferred to or imported from other MS. Table 3 shows these actual and estimated excess and/or deficit production of RES in ktoe as reported by the MS. Lithuania, France and the UK report the excess of energy from RES in %, not in ktoe. They are therefore listed in separate **Table 4**.

Overall, 12,177 ktoe excess production of RES are estimated for 2020 by the MS listed in Table 3. The main contributors to this excess are Germany, Italy, Finland and Sweden, each estimating an excess of more than 1,000 ktoe for 2020. Six MS (Belgium, Spain, Malta, Austria, Romania and Slovakia) report no excess or deficit production, thereby indicating that they estimate to exactly reach their target. Croatia, France, Latvia, Hungary, Lithuania, Netherlands, Portugal, Slovenia and the UK do not provide an estimation for 2020. A deficit production in 2020 is only estimated by Ireland (-366 ktoe).

Bulgaria, Cyprus, Denmark, Netherlands, Estonia and Romania indicate that they consider cooperation mechanisms as an option to transfer to other MS or from other MS to themselves. In addition, Slovakia reports it is discussing with other MS on statistical transfers and Hungary reports it is open to cooperating with other MS to transfer excess renewables production statistically and to establish common support schemes.

Currently, Sweden, Germany, Denmark, Luxembourg, Estonia, Lithuania, Netherlands and Malta are already making use of cooperation mechanisms. Sweden and Norway have agreed upon a joint support scheme for renewable electricity production by means of a common market for electricity certificates, which was introduced on 1 January 2012. In late 2016, Germany and Denmark held pilot calls for a tender for ground-mounted PV installations that were open to participation by both MS. PV installations in both Germany and Denmark were able to participate in these first cross-border tenders in Europe. In Germany, an open tender with a volume of 50 MW was conducted, in which five projects situated in Denmark submitted successful bids. Denmark tendered a total capacity of 20 MW, of which up to 2.4 MW were open for competition from bidders in Germany. Only Danish projects were awarded. In 2017, Luxembourg signed agreements for statistical transfer with Lithuania and Estonia. The agreements stipulate that Luxembourg will be provided statistical transfers for the period 2018 - 2020 in order to meet its 2020 RED target. In 2020 both the Netherlands and Denmark as well as Malta and Estonia agreed on statistical transfers, to help the Netherlands and Malta to meet their respective 2020 RED targets.

According to the modelling performed for this report, the currently implemented RES policies of several MS appear insufficient to trigger the required domestic RES volumes to reach their minimum binding 2020 targets as defined in the RED (see chapter 3.2): Belgium, Ireland, France, Luxembourg, Netherlands and Poland. Of these MS, Belgium (Flanders), Ireland, Luxembourg and Netherlands have signed agreements on statistical transfers with other MS to fill their gaps. France and Poland give no indication as to whether they consider making use of statistical transfer in case they fall short of their 2020 target.

Table 3. Actual and estimated excess and/or deficit production of RES in MS compared to the indicative RED trajectory which could be transferred to/from other MS and/or third countries (ktoe). Source: Table 7 of the Progress Reports

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Belgium			0	0	0	0	0	0	0	0	0	0
Bulgaria		362	348	520	630	593	602	638	579	767	411	341
Croatia												
Czech Republic		0	0	0	0	1,146	1,040	947	863	892	678	643
Denmark			694	834	1,123	1,106	833	928	552	619		63
Germany			9,236	11,831	9,816	1,066	7,967	8,069	3,945	6,141		3,065
Estonia			191	206	177	197	230	243	243	300	344	397
Ireland				93	-14	111	79	26	-142	-12	-239	-366
Greece		196	260	380	306	266	211	-81	-189	-377	683	529
Spain			2,026	2,866	2,704	3,326	2,040	3,106	1,323	1,220		0
Italy	8,324	8,613	7,405	10,011	10,936	9,344	9,456	7,803	7,555	5,148	3,805	2,462
Cyprus							29	29	4	72	18	51
Latvia[18]									-37	16		
Luxembourg	0	0	0	0	0	0	0	0	0	95		86
Hungary		968	1150	1213	1295	883	970	803	470	271		
Malta									3	4		0
Netherlands									0	0	-	-
Austria	0	0	0	0	0	0	0	0	0	0	0	0

[18] Please note that Latvia is ahead of their indicative RED and planned NREAP trajectory for 2015/2016, but this is due to a lower energy consumption. They have (as indicated in their progress report) not reached the levels of gross RES consumption as planned, shown by the negative numbers in this table.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Poland		543	729	929	530	93	174	-26,019	-544	790		345
Portugal												
Romania	1,207	1,296	824	974	1,114	1,210	1,091	1,122	858	684	439	0
Slovenia												
Slovakia									45	84		00
Finland	0	0	0	0	0	0	0	0	1,179	1,420	1,420	1,420
Sweden[20]	2,407	2,141	2,482	3,318	3,214	3,335	3,347	3,475	3,215	3,610	3,428	3,241
Total sum	**11,938**	**14,119**	**25,345**	**33,175**	**31,831**	**22,676**	**28,069**	**27,108**	**19,922**	**21,744**	**10,987**	**12,177**

[19] Poland reported actual gross RES consumption negative compared to the planned value for 2016. Percentage wise they are also below their NREAP planned trajectory. However their achievement in percentages shows that they are above the indicative trajectory as specified in the RED for 2015/2016. A cause could be a lower overall energy consumption then planned.

[20] The values still refer to the 4th Progress Report. Sweden didn't provide updated values in the 5th Progress Report, but only referred to the estimates of the Swedish Energy Agency.

Table 4. Actual and estimated excess and/or deficit production of RES in MS compared to the indicative RED trajectory which could be transferred to/from other MS and/or third countries (in %)[21]. Source: Table 7 of the Progress Reports

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Lithuania		3.72%	3.23%	3.72%	3.95%	3.86%	4.77%	3.46%	2.04%	1.03%		
UK			0.20%	0.70%	0.60%	1.00%	1.50%	1.20%	0.9%	±0%		
France									-3.4	-4%		

2.3. Trends in support schemes

This chapter outlines the most important trends in the RES support schemes in all three sectors: electricity, heating & cooling and transport[22].

Trends have been identified based on regulatory changes as well as the implementation of new support schemes as reported in the MS' 5th Progress Reports. Additional sources were taken into account to complement the information provided in each of the Progress Reports, for example official government websites and legal texts as well as assessments thereof[23]. The work builds upon previous reports, mainly the Technical assistance in realisation of the 4th report on progress of renewable energy in the EU[24]. The analysis focused on the main support schemes in the individual sectors. As specific support volumes are often not reported, the analysis is rather qualitative than quantitative.

2.3.1. Policy trends RES-E

A variety of support scheme combinations for RES-E is implemented in the EU-28, see **Figure 9**. The most common schemes in 2017 and 2018 were premium and feed-in tariffs, the former often combined with tendering systems (auctions). However, also quota schemes, tax incentives, net-metering, subsidies and loans have been applied to support the development of renewable electricity generation. Almost all Member States operate at least two support schemes to support different technologies, installation sizes and actors more specifically and needs-based.

[21] This table constitutes an addition to the previous table 3, as three Member States have not reported absolut values but percentage values.

[22] For more detail on the individual MS' policies and support instruments, please see Appendix B of the final report published in October 2020, available at https://op.europa.eu/en/publication-detail/-/publication/d557041f-11be-11eb-9a54-01aa75ed71a1/language-en/format-PDF/source-166348766.

[23] I.a., Eclareon (2019) RES LEGAL Europe, available at http://www.res-legal.eu/home/.

[24] Koper, M., Klessmann, C., von Blücher, F., Sach, T., Brückmann R., Najdawi, C., Spitzley, J. B., Banasik, J., Breitschopf, B., Kühnbach, M., Steinhilber, S., Ragwitz, M., Resch, G., Liebmann, L., Schöniger, F. (2019) Technical assistance in realisation of the 4th report on progress of renewable energy in the EU – Final report, Ecofys - A Navigant Company, available at https://ec.europa.eu/energy/sites/ener/files/documents/technical_assistance_in_realisation_of_the_4th_report_on_progress_of_renewable_energy_in_the_eu-final_report.pdf.

Figure 9. Overview of the support schemes in the RES-E sector between 2015 and 2020. Source: Guidehouse elaboration based on previous work

While the specific RES-E support landscape differs for each Member State, there are some general trends that can be observed. Among other developments, the shift from administratively set feed-in tariffs to feed-in premiums continued. While many MS had already changed their remuneration for new installations between 2014 and 2016, Bulgaria and Slovakia followed in 2018 and 2019 respectively[25].

The most prominent trend in 2017 to 2020 was the continuous shift towards RES auctions. By July 2020, 18 MS determine the support levels for (larger) RES-E installations in a competitive bidding process, see **Figure 10**. The trend towards auctioning has multiple causes. With the implementation of competition-based schemes for the allocation of support, MS thrive 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 European Commission's Guidelines on state aid for environmental protection and energy (2014/C 200/01) adopted in 2014.

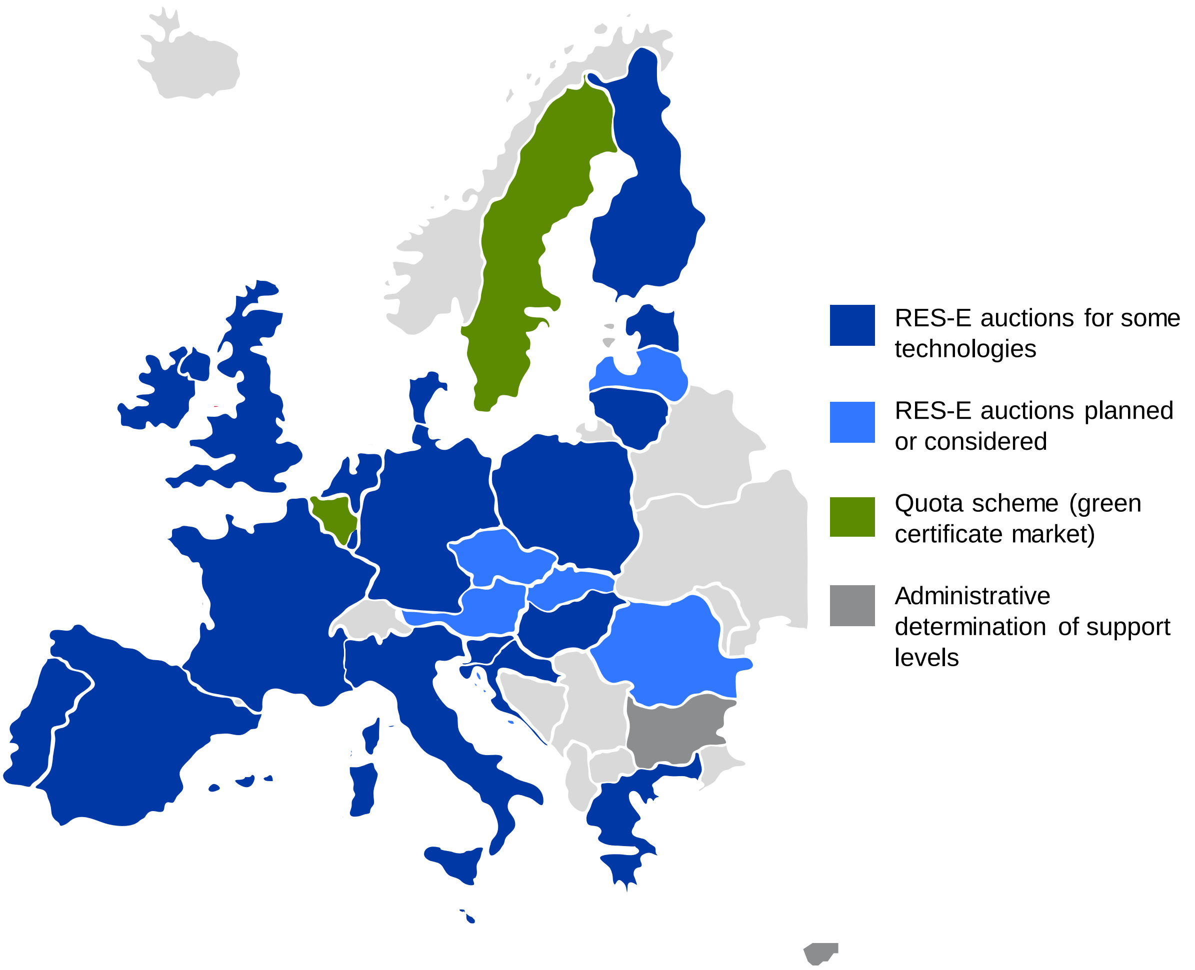

Figure 10. Overview of RES-E auction implementation status in the EU in 2020. Source: Guidehouse

[25] Please note that in the case of Slovakia, the planned tender scheme has been introduced by the new RES Act in 2019. However, the auctions have been postponed due to the COVID19 pandemic.

Most MS chose to implement technology-specific auctions rather than technology-neutral or multi-technology auctions. Estonia’s and Hungary’s schemes feature technology-neutral auctions, while 8 MS operate technology-specific support schemes. This is the case in Germany, Greece, France, Italy, Lithuania, the Netherlands, Poland, Portugal and Finland. Other support schemes feature elements of technology-neutral auctions by applying multi-technology auctions partly with additional differentiating elements (Denmark, Germany, Ireland, Spain, France, Croatia, Malta, Poland, Slovenia, Slovakia and the UK).

Some MS are combining technology-specific with multi-technology auctions that have additional elements. This is, for example, the case in Germany, France, the Netherlands and Poland. In some MS, multi-technology auctions have a pilot character (e.g. Germany). The need for technology diversification was mentioned in most cases as reason to make an exception from the principle of technology-neutrality. It remains to be seen whether multi-technology auctions will be implemented at a larger scale and in more MS in the coming years.

During the reporting period, interruptions in the RES-E support occurred in several MS (e.g. Ireland, Greece, Croatia, Hungary and Latvia). Latvia’s RES-E support has been on hold from 2011 to the end of 2019. Croatia introduced a new support scheme in 2016. However, necessary by-laws did not enter into force until 2019 which led to an interruption of support in the reporting period. Hungary introduced a new support scheme in early 2017, however, no tenders for larger installations took place until November 2019. Ireland is a similar case. From January 2016 to June 2018 there was no support scheme available. Greece also faced challenges regarding its new support scheme and had to postpone tendering rounds that were planned for 2018[26]. On the other hand, the support in other MS (e.g. Spain, Portugal and Slovenia) was reestablished.

Regarding the evolution of support schemes, two development trends become visible. While some MS like Germany and France maintain a set of differentiated support formats tailored to support different technologies, installation sizes and actors, other MS like the Netherlands, Denmark, Estonia and Hungary merge and group their support. The extreme example for the merger of support are the Netherlands, who will replace the current support scheme SDE+ by the SDE++ in fall 2020. The SDE++ no longer focuses solely on the production of RES, but on the avoidance of CO_2 emissions, also allowing industrial decarbonisation technologies to compete for SDE++-budget.

In most MS that introduced auctions, support levels decreased, which reflects increased competitive pressure (with some exceptions) but also falling technology costs and low-interest rates (financing costs). For example, support levels for PV in Germany fell by almost 50% between 2015 and 2019. Offshore tenders in the Netherlands and Germany resulted in subsidy-free offshore bids. However, the downward trend in competitively determined support levels can also reverse as a result of changes in financing and technology costs, the competitive landscape as well as the auction design. Average bid levels in onshore wind auctions in Germany, for example, fell from 5.71 ct/kWh in May 2017 to 3.82 ct/kWh in November 2017 and increased again to 6.16 ct/kWh in August 2018. While the 2017 price decrease was mainly due to strong competition in a special setting in the first year of the German onshore wind auctions[27], the price increase in 2018 was caused by a lack of competition resulting from

[26] In Greece, the Ministry of Environment and Energy publishes each year the timeline of (maximum) capacities of RES to be auctioned in each year up to 2020. Based on those maximum capacities, as well as the current status of the market (e.g. estimate of eligible and developed projects), the auctioneer (the Greek regulator RAE) calculates the auctioned volume for each respective auction. This can deviate from the amounts foreseen in the Ministerial Decree which can/should be regarded as the main framework, while RAE decided on the "details". Therefore, RAE sometimes decides to not conduct certain auctions which were actually foreseen in the Ministerial Decree (such as the joint auction in 2018). As RAE does not publish any reasons for not conducting these auctions, it can only be speculated if it is due to the market environment or simply due to internal capacity issues. Nevertheless, RAE tries to use the non-auctioned capacities in the next years (e.g. instead of only auctioning 400 MW in the joint auction in 2019, RAE used 200 MW of capacity from the auction in 2018 that did not occur, thus auctioning 600 MW in 2019). Furthermore, it should be noted that the December 2018 auction for large-scale PV was cancelled, since several projects that were prequalified did not submit any bid in the dynamic auction procedure. As it can be assumed that those projects merely prequalified to circumvent the 75%-rule (which ensures enough competition in the dynamic auction procedure), RAE decided to cancel the auction, as sufficient competition could not be ensured in the auction.

[27] The German onshore wind auctions in 2017 provided preferential rules for community energy projects. Through special shareholder constructions, larger players were able to develop projects that fell under the EEG definition of community energy projects. The main preferential rules were the following:

missing bid volume. There were multiple reasons for the missing bids. A major factor was that the announced change of the support mechanism towards auctions which 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.

There is a risk that the transition towards an auction-based RES-E support might temporarily slow down RES-E deployment in individual cases. Such an effect may only be visible in the coming years, depending on the transition phase towards the scheme. The deployment gap can occur for two reasons. First, in some MS, the transition phase itself – the time between closing the old scheme and implementing the new scheme – is taking time, which leaves investors with no possibilities to receive support for new installations and hence little incentive to finalize new installations in that period. Croatia is one of the MS 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 with a RES ACT in 2016. The support scheme was not operational throughout this reporting period as most of the by-laws necessary to enforce the RES Act were adopted only several years after the publication of the RES Act. Second, bidders that succeed in an auction need time to realise the project (usually two or more years, depending on the technology and auction design). In addition, some MS have implemented an auction scheme but have not yet held auctions. 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.

The trend towards auctions as the main instrument of allocating support is expected to continue. However, quota schemes continue being the main support instrument in Sweden and Belgium, whereas Italy, Poland and the UK have closed their certificate scheme to the award of new capacities in 2016 and 2017 respectively.

Next to feed-in tariffs or premiums, some MS grant additional support options, e.g. in the form of net metering, which is in place in Denmark, Greece, Spain, Italy, Latvia, Lithuania, Cyprus, Hungary and Slovenia. Net metering is a billing arrangement that allows electricity consumers who also generate electricity, e.g. households with a solar PV installation, to 'virtually' consume their self-generated electricity at any time. This means, for example, that a household is able to feed excess solar power of the midday back into the distribution grid and receive a credit for it which is then offset with electricity consumed form the grid, e.g. in the evening when the own solar installation does not generate electricity. There are various sorts of net metering schemes which vary in the details.

- Lower material pre-qualification requirement: community energy projects did not have to submit a BImSchG permit at the time of bidding and could thus participate in the auction at earlier stages of project planning.
- A reduced penalty in case of non-realization (15 instead of 30 € per kW of installed capacity)
- A realization period increased by 24 months compared to other projects (54 months in total)
- Community energy projects are awarded with the highest awarded bid instead of their own bid price (uniform pricing rule)

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.

2.3.2. Policy Trends RES – H&C

Figure 11 presents an overview of support schemes for RES-H&C in the EU-28 for the period of 2016 to 2020. In comparison with the electricity sector and its strong focus on operational support, the support in the heating & cooling sector is concentrated on investments. The overview also highlights the continuity of support schemes in the RES-H&C sector. Although additional support schemes have been introduced in some MS, 26 Member States have maintained their main support scheme. Furthermore, a concentration on fewer support schemes per MS compared to RES-E can be observed.

The most commonly applied form of support for RES-H&C are investment grants. This form of subsidy was available in 24 MS during 2017 to 2018. In 8 MS investment grants were the sole RES-H&C support scheme, while 5 MS provided the option to choose between a grant or comparable loan. Other forms of commonly provided support are tax deductions and feed-in premiums. The support instruments that are in place usually apply to a broad range of technologies. The most popular technology are biomass plants. In addition, commonly supported technologies are geothermal, aerothermal and hydrothermal heat pumps as well as solar thermal plants.

While several MS (e.g. Belgium, Bulgaria, Ireland, Greece, Malta, Poland, Romania) implemented complementary support schemes, mostly investment grants, Spain and Croatia had no operational support scheme for RES-H&C in 2017 and 2018. Also in Portugal the support is very limited. Only one call for investment grants has been published in 2018. However, both Spain and Croatia, are above their 2018 RES-H&C NREAP sectoral trajectory. Also Portugal is only lagging slightly. In an increasing number of cases RES-H&C is already competitive to conventional solutions in these countries. Thus, a support scheme does not seem to be necessary for these countries.

Figure 11. Overview of the support schemes in the RES-H&C sector between 2015 and 2020. Source: Guidehouse elaboration on previous work

2.3.3 Policy trends RES-T

The RES-T sector stands out by a limited set of support instruments implemented by EU MS. As depicted in **Figure 12**, the predominant support scheme for RES-T in the EU is a biofuel quota obligation. By 2020, some sort of obligation scheme has been the main RES-T policy measure in all MS. Additionally, the majority of the MS is characterised by the longevity of their support schemes. 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.

The quota schemes differ in detail, but they generally oblige fuel suppliers to include a certain share of biofuels in their fuel. Most of the schemes have an increasing quota, often targeting a 10% share by 2020. The required shares for 2018 range from 2.4% in Cyprus to 15% in Finland. The minimum and maximum required shares in 2020 apply in the same countries, with 2.5% in Cyprus and 20% in Finland.

Germany and Sweden do 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 are adjusted their quota schemes after the implementation of the ILUC Directive in 2015 which had to be transposed by September 2017. It introduced a cap on conventional biofuels and a sub-target for advanced biofuels.

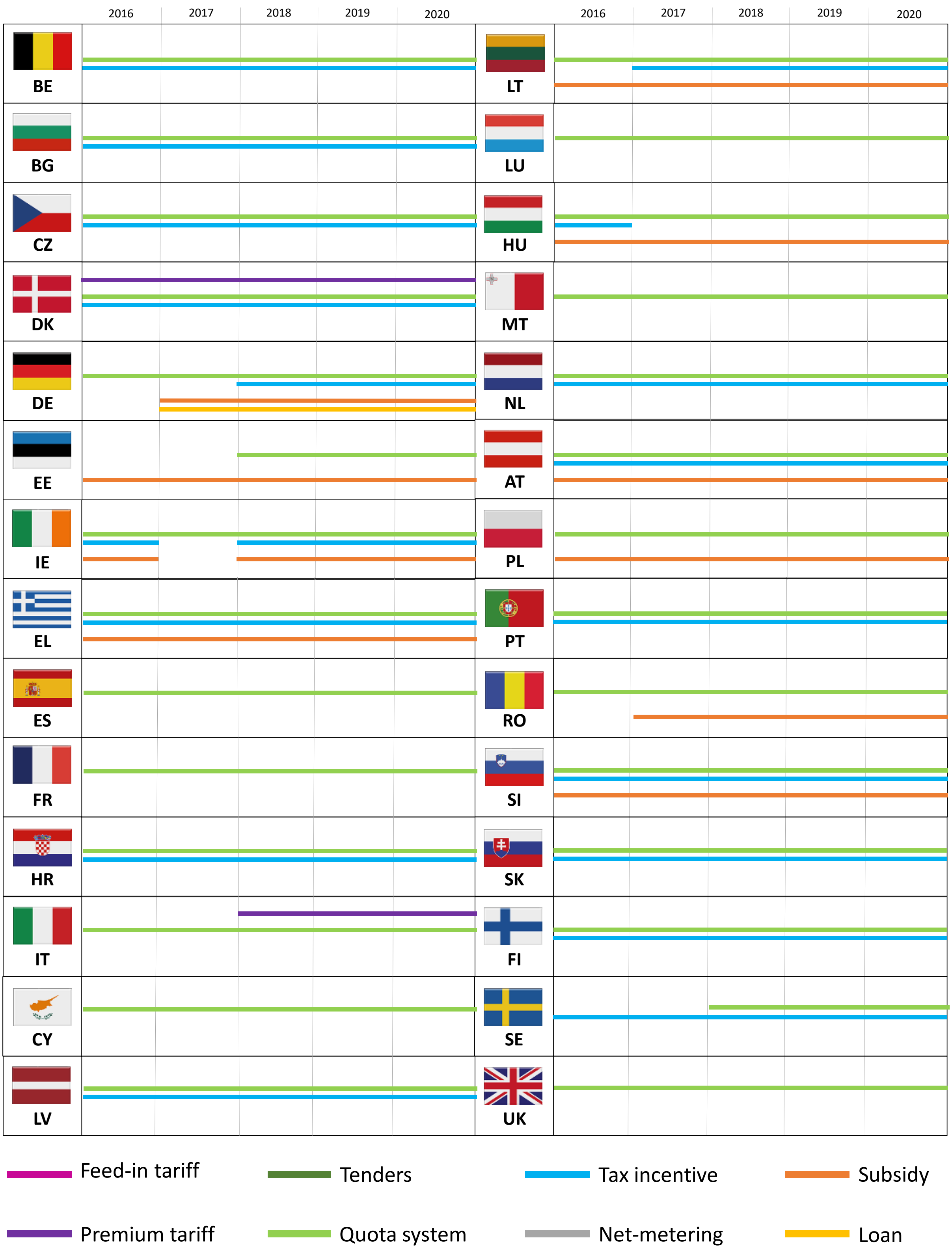

Figure 12. Overview of the support schemes in the RES-T sector between 2015 and 2020. Source: Guidehouse elaboration on previous work

In addition to biofuel quota systems as main RES-T instruments in all MS, tax incentives and/or subsidies are the most common complementary support instruments, see **Figure 12**. While five Member States (Spain, France, Cyprus, Luxembourg and Malta) rely soley on a biofuel obligation[28], 17 Member States also grant tax deductions or exemptions. The incentives are granted for various taxes, such as consumption tax, CO_2 tax, income tax (for biofuel producers), excise and environmental pollution taxes. Some MS also have subsidies in place to support the uptake of electric vehicles and the expansion of electric charging as well as biofuel infrastructure. Some MS also have subsidies in place to support biofuel infrastructure, such as Estonia, which provides support for the supply of biomethane in fuel filling stations. Denmark and Italy are the only MS having a premium tariff, which is paid for the use of biogas in transportation.

In addition to the instruments supporting the use of biofuels, MS are increasingly promoting e-mobility options or are currently planning to implement subsidies for e-mobility. Among those Member States that already have support instruments in place are Denmark, Germany, Ireland, Croatia, Italy, Latvia, Malta, Austria, Romania, Sweden and the UK. Most MS incentivise the purchase of electric or plug-in vehicles through grants or tax exemptions and support the development of charging infrastructure.

2.4. Overview of policy commitment of Member States

This section presents an overview of MS fulfilment of earlier policy commitments as well as an assessment of the long-term security of support instruments for each sector.

The overview in **Table 5** indicates for each MS, whether it has adopted the planned measures as indicated in its NREAP and 1st, 2nd, 3rd and 4th Progress Report. The evaluation of the fulfilment of earlier commitments (yes/no/partial) is based on the implementation of measures, not on the progress made in terms of renewables deployment and thus likeliness of target achievement. The evaluation therefore deviates significantly from the assessment of target progress. Interestingly, the number of instances of fulfilling the policy commitments while still not meeting the sectoral trajectory has increased compared to the previous round of progress reporting in 2018, especially for RES-T.

Reasons for not or only partially fulfilling earlier commitments can be manifold, e.g. the non-implementation, non-enforcement, change or cancellation of related policies or allocated budget. Some MS are already overshooting their binding overall 2020 RES targets as defined in the RES Directive and have reduced their policy commitments (e.g. Bulgaria, Czech Republic and Croatia). More details can be found in Appendix B of the final report published in October 2020[29], which contains descriptions of each MS policy framework.

The evaluation of the long-term stability of the support instruments (High/Low/Moderate) reflects the continuity and reliability of support policies and budgets. More specifically it reflects whether MS provide a clear outlook for future deployment, e.g. by defining credible long-term policy goals and providing a schedule for the allocation of support over the coming years. Such schedules increase the planning certainty for investors. As a main source for this evaluation the measures described in the NECPs are considered. In order to provide 'moderate' or 'high' long-term security of support, a clear schedule for the allocation of support beyond 2020 had to be provided. 'High' also implies that there is some sort of longer-term support perspective towards 2030. In addition, it is taken into consideration whether MS RES support framework has seen many regulatory changes in the past, which can impact regulatory and market stability. In cases where retroactive changes occurred, investor confidence and long-term security of support schemes is significantly undermined.

[28] Note: Out of these five only Luxembourg reached its RES-T NREAP sectoral trajectory. While France and Malta are only lagging slightly, Spain and Cyprus are significantly behind trajectory. However, also Member States with additional support schemes are lagging behind their trajectories.

[29] https://op.europa.eu/en/publication-detail/-/publication/d557041f-11be-11eb-9a54-01aa75ed71a1/language-en/format-PDF/source-166348766

The evaluation of policy commitments and long-term security for RES-T is largely based on the implementation of a quota scheme. By 2018, some sort of quota has been implemented in all MS, thus basically fulfilling their commitment. However, some MS only partially fulfilled their RES-T commitments as their implementation of the quota is either belated, ineffective (e.g. quota too low or lack of enforcement) or they have failed on the implementation of other RES-T policy commitments. Most MS define target quotas only until end of 2020, creating uncertainty for post-2020. However, MS should ideally publish blending obligations for several years in advance and provide clarity, especially in the surrounding system of options to demonstrate compliance and types of biofuel allowed to reach the quota in order to create a stable outlook to fuel suppliers.

Table 5. Overview of Member States' fulfilment of NREAP policy commitments and evaluation of long-term stability of support

	RES-E		RES-H&C		RES-T	
Country	**Fulfilment of policy commitments**	**Long-term security of support**	**Fulfilment of policy commitments**	**Long-term security of support**	**Fulfilment of policy commitments**	**Long-term security of support**
BE	Yes	Moderate	Yes*	Moderate	Yes*	Moderate
BG	Partial	Moderate	Yes	High	Yes	High
CZ	Partial	Moderate	Yes	Moderate	Yes*	Moderate
DK	Yes	High	Yes	High	Yes*	Moderate
DE	Yes	High	Yes	High	Yes*	Moderate
EE	Yes	High	Yes	Moderate	Yes	High
IE	No	High	Partial	Moderate	Yes*	High
EL	Partial	High	Yes	High	Yes*	Moderate
ES	No	Moderate	Partial	Moderate	Partial	Moderate
FR	Yes*	High	Yes*	High	Yes	High
HR	Partial	Moderate	No**	Low	Partial	Moderate
IT	Yes	High	Yes	Moderate	Yes*	High
CY	Partial	Moderate	Yes	Moderate	Partial	Moderate
LV	Partial	Low	Partial	Moderate	Partial	Moderate
LT	Yes*	High	Yes	High	Yes*	High
LU	Yes*	High	Yes	High	Yes	High
HU	Partial	Moderate	Partial	Moderate	Yes	High
MT	Partial	Moderate	Partial	Moderate	Yes	Moderate
NL	Yes*	Moderate	No	High	Yes	Moderate
AT	Yes	High	Yes	High	Yes	High
PL	Yes*	Moderate	Yes*	Moderate	Yes*	Moderate
PT	Partial	High	Partial	Low	Partial	Moderate
RO	Partial	Low	Partial	Moderate	Yes*	Moderate
SI	Partial	High	Yes	High	Yes*	High
SK	Partial	High	Partial	High	Partial	High
FI	Yes	Moderate	Yes	Moderate	Yes*	High
SE	Yes	High	Yes	High	Yes	High
UK	Yes	Moderate	Yes	Moderate	Yes*	High

*Fulfillment of policy commitments, but below NREAP sectoral trajectory
**No fulfillment of policy commitments, but above NREAP sectoral trajectory

3. FEASIBILITY OF 2020 TARGET ACHIEVEMENT CONSIDERING CURRENT PROGRESS

This chapter provides a model-based assessment to what extent currently implemented RES policies (Current Policy Initiatives (CPI)) appear sufficient to trigger the targeted RES deployment in 2020 at the MS level. The scenario calculation is done by application of the Green-X model, a well-established simulation tool for policy instruments in the European RES market indicating consequences of policy choices on deployment and cost of RES technologies in a comprehensive manner. Additionally, within the analysis the RES contributions to/from MS based on the use of cooperation mechanisms, e.g. joint projects, joint support schemes and statistical transfers are incorporated to the extent that these are included in the MS current policies as of February 2021.

The modelling work performed is closely linked to other parts of this study. Thus, the assessment of future progress builds on the analysis of past progress (Chapter 2) and reflects findings gained with respect to achieved progress in mitigating non-economic barriers. Obviously, this quantitative assessment is also closely linked to the overall qualitative RES policy assessment, building on the collected policy information and providing input to the overall policy analysis.

Apart from policy information a key determinant for the achievement of 2020 RES targets at EU and at MS level is the actual market development, both concerning RES supply and overall energy demand. A closer look at recent market data (as of February 2021) indicates that the current COVID-19 pandemic shows significant impacts on our overall society, the economy and, in consequence, also the energy system including renewable energy deployment.

***Impact of COVID crisis*: Our approach of how we incorporated the potential impact of the COVID crisis into our analysis is described in Box 1. The final results derived demonstrate the application of this concept within our modelling practices, incorporating assumptions on the year's 2020 energy demand trends and the expected impacts on RES supply.**

Box 1. Incorporating COVID-19 impacts on the energy system into the 2020 RES progress analysis

The ongoing (as of February 2021) COVID-19 pandemic has shown severe impacts on society, the economy and the energy system globally and across Europe. Below we describe our approach on how to cope with these impacts within the 2020 RES progress analysis, distinguishing between impacts on energy consumption and on RES supply.

Energy demand impacts: Within the first quarter of 2020 energy demand in the EU declined by over 5% compared to the corresponding time period in 2019 (IEA, 2020). The decline in activity and energy demand was strong in March 2020 after lockdowns were implemented in response to the COVID-19 pandemic. Economic output and the related energy demand declined in 2020, with most of the contraction taking place in the second quarter (European Commission, 2020). Demand fell most in regions that implemented lockdowns early, imposed more stringent lockdowns and where tourism represents a significant part of the economy. The energy demand bounced back by October 2020, as containment measures were gradually lifted, and the unprecedented monetary and fiscal measures implemented by MS and the EU were effective at cushioning the immediate economic impact of the crisis as well as at limiting permanent damage to the economic tissue (European Commission, 2021).

To reflect for this substantial change in energy demand and its dynamics, various sources are used to reflect for the exceptional situation. Uncertainty however remains on how strong the COVID-19 pandemic affected energy consumption in 2020 since complete statistical data on energy consumption covering all energy sectors and the whole year 2020 are not yet available. To account for this uncertainty, two distinct demand trends (low and high demand) are derived that appear likely as lower and upper boundaries of what is classified as feasible concerning demand trends from today's perspective (February 2021).

In general terms, the most up-to-date demand structure of Eurostat Shares (as of 2 February of 2021) is included (Eurostat, 2021b) in the underlying demand data set. For the electricity sector – where most up-to-date information is generally available – two sources are used to assess in further detail changes in electricity demand in 2020 when compared to 2019:

- On the one hand, monthly Eurostat data "Electricity available to internal market" (Eurostat, 2021a) indicates for the whole year 2020 an electricity demand reduction of 4.45% at EU level compared to 2019 levels.
- On the other hand, McWilliams and Zachmann (2021) is used. In this work Entso-E and other transmission system operators' data is processed. The weeks not covered by the study are complimented by using Eurostat (2021a) data. This evaluation shows a reduction of 3.62% in electricity demand in 2020 when compared to 2019 for the whole EU.

The lower and the upper boundary of electricity demand reductions of both sources at MS level are used for the establishment of a Low- and a High Demand scenario.

With making use of more data sources at Eurostat available at a monthly basis, for some countries even until December 2020, the demand reductions in the sector of heat and cooling and in transport are evaluated. According to that information, the decline in gross heat demand from 2019 to 2020 is in the range between 6.6% (High Demand) and 8.7% (Low Demand).

Table 6. Energy demand projections for different sectors for 2019 and 2020 in the EU28. (Eurostat, 2020a, 2020b; IEA, 2020)

	Historic	Projections			% change compared to previous year		
EU-27	2018	2019	2020 High Demand	2020 Low Demand	2019	2020 High Demand	2020 Low Demand
Energy demand sector	ktoe	ktoe	ktoe	ktoe	%	%	%
Electricity generation from all sources	251,732	249,075	229,791	224,809	-1.1%	-7.7%	-9.7%
All fuel consumed for heating and cooling	466,884	467,201	419,984	410,856	0.1%	-10.1%	-12.1%
Fuel used in transport (as defined in Article 3)	272,028	272,811	243,383	238,057	0.3%	-10.8%	-12.7%
Gross final energy consumption adjusted	1,029,360	1,027,683	927,798	907,604	-0.2%	-9.7%	-11.7%

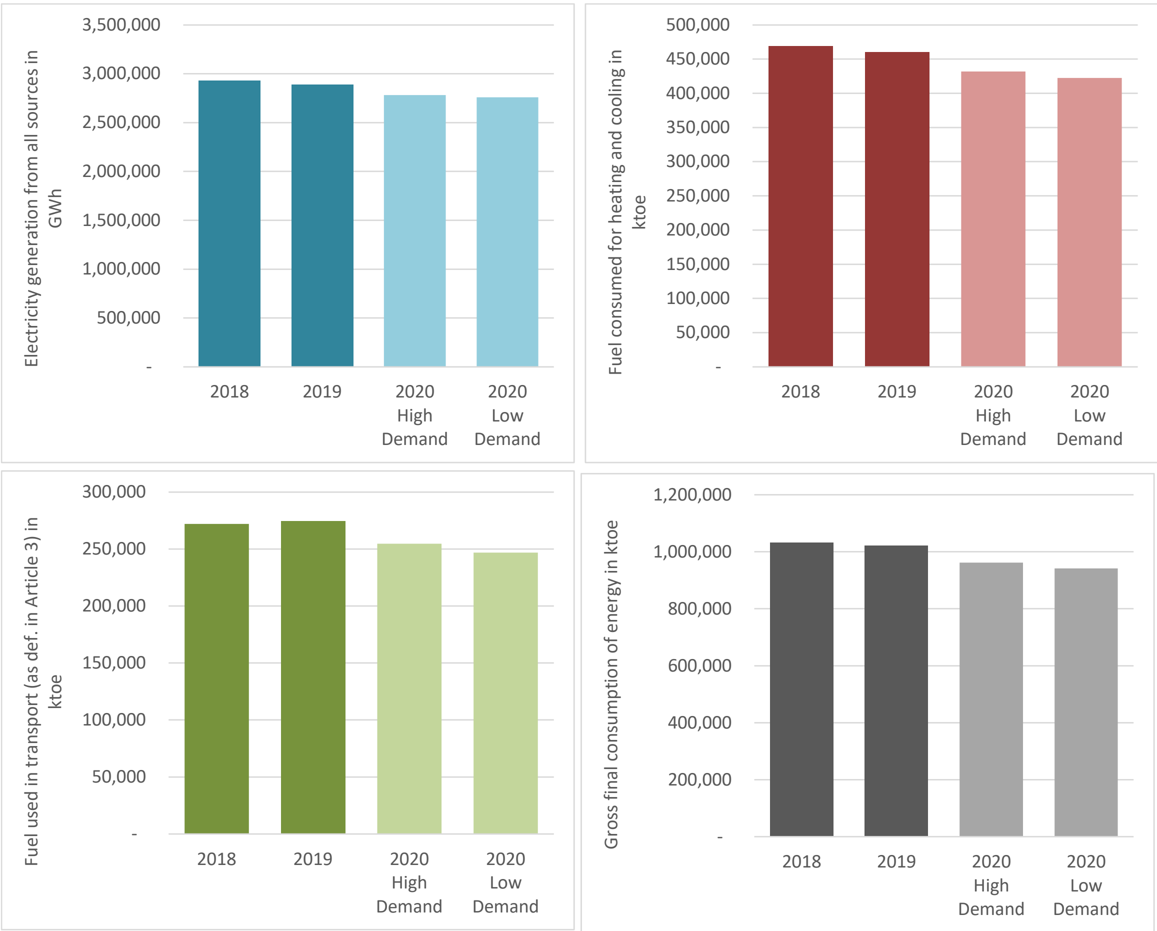

Figure 13. Energy demand projections for different sectors for 2019 and 2020 in the EU-27. (Eurostat, 2021a, 2021b; IEA, 2020, own calculations)

The reduction of gross transport demand ranges from 7.2% (High Demand) to 10.1% (Low Demand). In consequence, at EU level gross final energy consumption (after reduction for aviation limit) in the year 2020 in the High Demand scenario is assumed to be 961.9 Mtoe and 941.5 Mtoe in the Low Demand scenario, respectively. A graphical illustration of these trends is provided by Figure 13 for the whole EU. Table 8 complements the above with details at MS level, indicating apart from assumed scenario-specific demand data for 2020 also relative changes compared to 2019 levels.

Impacts on RES supply: Generally, we expect that RES generation is less affected than overall energy demand. For RES plants that have been installed in previous years, it can be expected that their operation is hardly affected. This statement appears valid for variable RES like wind, solar and hydropower since their ability to generate electricity depends on weather and not on demand. Similarly, electricity production from dispatchable RES like biomass appears also to be hardly affected since their operation is largely driven by RES support (which has not been affected by the COVID-19 pandemic). For biofuels in transport or biomass used for heating purposes, however, one can expect certain impacts of the crisis that come along with the changes in demand.

3.1. Methodology and data sources

The method of approach and the related key assumptions for the assessment undertaken are discussed in detail subsequently. As starting point, the modelling tool used for performing the quantitative assessment is described, followed by a clear characterisation of the approach applied for evaluating on RES progress. Finally, data sources and key assumptions are listed.

3.1.1. The applied energy system model Green-X

As in previous projects, such as FORRES 2020, OPTRES, PREBS 2012, PREBS 2014 or PREBS 2018, the Green-X model was applied to perform a detailed quantitative scenario assessment of the future deployment of renewable energies on country and sector level. The core strength of this tool lies in the detailed RES and technology representation accompanied by a thorough energy policy description, which allows assessing various policy options with respect to resulting costs and benefits. A short characterisation of the model is given below (cf. Box 2), while for a detailed description of the model and its database we refer to www.green-x.at.

A quick overview of all technologies covered is given in **Table 7** which follows largely the same categorisation as in the assessment of past progress (Chapter 2). A few deviations were however necessary due to differences in accounting between the Green-X model and its database versus the historic record:

- “Bioliquids” are summarised under “Biomass”, including solid and liquid fuels as well as the biodegradable fraction of municipal solid waste.

- For the transport sector, Green-X is only capable to model biofuel deployment but not electro-mobility. However, electricity in transport is included in the target achievement calculation as a subtask by statistical means. Regression techniques are used to estimate the impact of electro-mobility on the RES-T share by 2020.

Please note that for renewable heating, cooling and electricity, our final analysis of future progress will also incorporate to the extent necessary the possible contribution of the building sector in exporting renewable energy generated on buildings (as defined in article 13.4. of the RED) to the energy system.

Table 7. Overview on RES technologies in Green-X modelling

RES-E	RES-H&C	Biofuels in transport
Offshore wind	Solar thermal	First generation biofuels
Onshore wind	Biomass (i.e. solid and liquid, incl. biowaste)	Second generation biofuels
Biomass (i.e. solid and liquid, incl. biowaste)	Biogas	
Biogas	Heat pumps	
Photovoltaics	Geothermal	
Hydro		
Geothermal		
Concentrated solar power		
Tide, wave and ocean energy		

Box 2. Short characterization of the Green-X model

The Green-X model was developed by TU Wien within the research project "Green-X – Deriving optimal promotion strategies for increasing the share of renewable electricity in a dynamic European electricity market", a joint European research project funded within the 5th framework program of the European Commission, DG Research (Contract No. ENG2-CT-2002-00607). It allows for performing a detailed quantitative assessment of RE deployment until 2030 in a real-world policy context. This tool has been successfully applied for the European Commission within several tenders and research projects on renewable energies and corresponding energy policies, e.g. FORRES 2020, OPTRES, RE-Shaping, EMPLOYRES, RES-FINANCING and has been used by Commission Services in the "20% RE by 2020" target discussion. It fulfils all requirements to explore the prospects of renewable energy technologies and:

- Currently covers geographically the EU-28 (all sectors), the Contracting Parties of the Energy Community and Turkey as well as selected North African countries (limited to renewable electricity) and can in principle be extended to other countries or regions.
- Allows investigating the future deployment of RES as well as accompanying generation costs and transfer payments (due to the support for RES) within each energy sector (electricity, heat and transport) at country- and technology-level on a yearly basis up to a time-horizon of 2050.

The modelling approach to describe supply-side generation technologies derives dynamic cost-resource curves by RES option, allowing a suitable representation of dynamic aspects such as technological learning and technology diffusion (besides the formal description of potentials and costs). It is suitable to investigate the impact of applying different energy policy instruments (e.g. quota obligations based on tradable green certificates, (premium) feed-in tariffs, tax incentives, investment subsidies) and non-cost diffusion barriers.

Within the Green-X model, the allocation of biomass feedstock to feasible technologies and sectors is fully internalised into the overall calculation procedure, allowing an appropriate representation of trade and competition between sectors, technologies and countries. Moreover, Green-X was extended to allow an endogenous modelling of sustainability regulations for the energetic use of biomass.

Within Green-X a broad set of results can be gained for each simulated year on a country-, sector and technology-level:

- RES generation and installed capacity.
- RES share in total electricity / heat / transport / final energy demand.
- Generation costs of RES.
- Capital expenditures for RES.
- Impact of RES support on transfer costs for society / consumer (support expenditures).
- Impact of enhanced RES deployment on climate change (i.e. avoided CO_2 emissions).
- Impact of enhanced RES deployment on supply security (i.e. avoided primary energy).

3.1.2. *General approach and scenario definition*

The general approach used for this analysis of expected MS' future progress is to conduct a model-based quantitative assessment of future RES deployment in absolute (i.e. GWh produced, MW installed) and relative terms (i.e. RES shares on gross demands), reflecting assumptions also on future energy demand, comprising short-term trend expectations for 2020.

The assessed *Current Policy Initiatives (CPI) scenario* assumes a continuation of currently implemented RES support policies, commonly specified also as "business-as-usual" case. Note that it also reflects a "business-as-usual" world with respect to non-economic RES barriers as currently applicable in the different MS. In order to illustrate uncertainty adequately, a sensitivity analysis on key input parameters (and related uncertainties within these) is conducted.

The sensitivity analysis focuses specifically on the COVID-19 pandemic, and the uncertainty caused by that on the various parts of the (renewable) energy market. In this context we focus on the demand side, indicating the uncertainty in the year's 2020 energy demand caused by the pandemic and the corresponding impacts on the society and the economy. In practical terms, we show two distinct demand trends (low and high demand) that appear likely as lower and upper boundaries of what is classified as feasible concerning demand trends from today's (February 2021) perspective.

Complementary to the above, a brief sensitivity analysis is also performed on the intended use of cooperation mechanisms and its impact on 2020 RES target achievement by MS (cf. section 3.2.1.2). Based on the agreements taken at bilateral basis, two distinct scenarios are derived for the use of RES cooperation by means of statistical transfers: a "strong cooperation" and a "weak cooperation" scenario.

The results from the assessment of past and current RES progress (Task 2) have been combined with the outcomes of the projections done in this subtask (Task 3), as to present the total result, including a split per sector. For the historic part, the RES development and energy demand data for years 2010 to 2019 is generally consistent with the ESTAT shares tool as outlined in Chapter 2 of this report. Please note further that a cross-check of modelled RES deployment with recent draft statistics on 2020 capacity additions has been undertaken for wind and solar PV (based on WindEurope, 2021 and SolarPowerEurope, 2020).

3.1.3. *Data sources and key assumptions*

The data sources as used in this assessment are the following:

- Information on *Current (RE) Policy Initiatives (CPI)* was taken from the RES-legal database and various national sources, especially the MS's Progress Reports from several reporting periods. This information was updated with the most recent information on the outcomes of auctions for renewable electricity (derived from the H2020 project AURES II[30]). Where necessary, this was complemented via the consortium's network of national experts with bottom-up policy information collected at country level. The policy information and related background sources were retrieved in the period April to November 2020.

- To ensure maximum consistency with existing EU scenarios and projections, the key input parameters of the scenarios presented in this assessment have been derived from PRIMES modelling regarding fossil fuel price developments and from the Green-X database with respect to the potentials and cost of RES technologies.

- Assumptions on the year's 2020 energy demand trends are listed in **Table 8** while the underlying assumptions are described in Box 1, informing on our approach taken to incorporate impacts of the COVID-19 pandemic.

[30] http://aures2project.eu/

Table 8. Projections of gross final energy consumption at MS level and for EU-28/EU-27. Source: Eurostat, 2021a, Eurostat 2021b, own calculations

Gross final energy consumption adjusted (after reduction for aviation limit)	Historic values		Projections		% change compared to previous year		
	2018	2019	2020 High Demand	2020 Low Demand	2019	2020 High Demand	2020 Low Demand
Member State	ktoe	ktoe	ktoe	ktoe	%	%	%
Belgium	36,915	36,366	34,294	33,562	-1.5%	-5.7%	-7.7%
Bulgaria	10,864	10,767	10,311	10,139	-0.9%	-4.2%	-5.8%
Czechia	26,950	26,863	25,480	25,043	-0.3%	-5.1%	-6.8%
Denmark	15,645	15,299	14,878	14,658	-2.2%	-2.8%	-4.2%
Germany	224,220	222,055	209,926	206,168	-1.0%	-5.5%	-7.2%
Estonia	3,295	3,187	3,024	2,948	-3.3%	-5.1%	-7.5%
Ireland	12,375	12,275	11,752	11,426	-0.8%	-4.3%	-6.9%
Greece	16,687	16,160	14,955	14,586	-3.2%	-7.5%	-9.7%
Spain	89,074	88,234	80,949	78,858	-0.9%	-8.3%	-10.6%
France	155,160	154,058	143,624	140,583	-0.7%	-6.8%	-8.7%
Croatia	7,125	7,175	6,662	6,501	0.7%	-7.1%	-9.4%
Italy	121,556	120,451	111,671	108,610	-0.9%	-7.3%	-9.8%
Cyprus	1,682	1,729	1,632	1,599	2.8%	-5.7%	-7.5%
Latvia	4,373	4,268	4,084	4,023	-2.4%	-4.3%	-5.7%
Lithuania	5,810	5,786	5,541	5,435	-0.4%	-4.2%	-6.1%
Luxembourg	4,048	4,107	3,907	3,825	1.4%	-4.9%	-6.8%
Hungary	19,090	19,168	18,278	17,890	0.4%	-4.6%	-6.7%
Malta	558	596	555	543	6.8%	-6.9%	-8.9%
Netherlands	50,875	50,196	48,202	47,412	-1.3%	-4.0%	-5.5%
Austria	28,858	29,295	27,467	26,711	1.5%	-6.2%	-8.8%
Poland	75,088	73,870	70,566	69,029	-1.6%	-4.5%	-6.6%
Portugal	17,636	17,806	16,669	16,336	1.0%	-6.4%	-8.3%
Romania	24,964	25,117	23,793	23,400	0.6%	-5.3%	-6.8%

Gross final energy consumption adjusted (after reduction for aviation limit)	Historic values		Projections		% change compared to previous year		
	2018	2019	2020 High Demand	2020 Low Demand	2019	2020 High Demand	2020 Low Demand
Slovenia	5,188	5,087	4,776	4,679	-1.9%	-6.1%	-8.0%
Slovakia	11,342	11,534	10,886	10,668	1.7%	-5.6%	-7.5%
Finland	27,023	26,452	24,915	24,356	-2.1%	-5.8%	-7.9%
Sweden	34,789	34,322	33,091	32,480	-1.3%	-3.6%	-5.4%
United Kingdom	134,554	133,252	123,412	120,434	-1.0%	-7.4%	-9.6%
EU-27	1,031,190	1,022,221	961,891	941,467	-0.9%	-5.9%	-7.9%
EU-28	1,165,744	1,155,473	1,085,303	1,061,902	-0.9%	-6.1%	-8.1%

For the year 2020 we had to cope with special circumstances since the COVID-19 pandemic has shown severe impacts on the society, the economy and on the energy system across all EU MS. Box 1 (above) indicates the approach taken to cope with these impacts within the RES progress analysis.

3.1.4. Approach for evaluating RES progress

Complementary to Chapter 2, this section indicates expectations on the MS progress in deploying RES-E, RES-H&C and RES-T in 2020. More precisely, we are comparing trend expectations for 2020 with two targets set out in the RED (i.e. binding national targets on RES overall and RES-T) and the baseline of planned contribution as specified in MS's NECPs.

For RES overall, two figures will be presented for 2020:

- Overview figure comparing MS' and the EU's expected RES deployment with binding RED 2020 RES targets and 2020 planned contribution as in the NECP baselines.

- MS' and the EU's deviation from planned deployment, comparing again expected 2020 RES deployment with both the binding RED 2020 RES targets and the 2020 planned contribution as in the NECP baselines.

All data on expected RES deployment stems from Green-X modelling, i.e. the "Current Policy Initiatives (CPI)" scenario. To illustrate uncertainty adequately, the policy variation is complemented by a set of sensitivity investigations as discussed above. For each of the three sectors, we present the deviation from the planned contributions as specified in the NECP baselines for 2020.

3.2. Results from the modelling feasibility of 2020 targets

3.2.1. Projected future progress in RESS overall

3.2.1.1. Cross-country comparison excluding cooperation mechanisms

Overview of expected 2020 RES deployment vs. binding 2020 RES target (set out in the RED)

Below we provide a comparison of the expected and the planned RES deployment by 2020, and we analyse the achievement of nationally binding RED 2020 RES targets. Please note that the impact of RES cooperation on RES target achievement is neglected in this section. Data on country-specific RES deployment indicates the default statistical accounting practices but ignores intergovernmental agreements taken between MS concerning (virtual) statistical transfers of RES volumes or other forms of RES cooperation. The impact of RES cooperation on RES target achievement is discussed in section 3.2.1.2.

Figure 14, indicating expected and planned RES deployment in relative terms (i.e. RES share in gross final energy demand), and 15, showing the deviation of expected 2020 RES shares from the binding RED 2020 RES targets, provide a graphical illustration of the expected progress up to 2020 according to currently implemented RES policy initiatives. For addressing the uncertainty in 2020 energy demand developments, impacted by the COVID-19 pandemic, we analysed a low and high energy demand trend for 2020. Complementary to the graphical illustrations, **Table 9** lists all data on expected and planned 2020 RES shares (presenting binding RED 2020 RES targets as well as planned contributions specified in the MS's NECP baselines).

Table 9. Expected, planned and required RES shares in 2020 excluding cooperation mechanisms

RES share in gross final energy demand by 2020 - without impact of RES cooperation	**Expected RES share 2020 (CPI scenario)**		**RED target RES share 2020**	**NECP baseline share 2020**	**Deviation of expected from RED target RES share (CPI scenario)**		**Deviation of expected from NECP baseline share (CPI scenario)**	
	Min.	**Max.**			**Min.**	**Max.**	**Min.**	**Max.**
Member State	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
Belgium	12.1%	12.1%	13.0%	11.2%	-7.3%	-6.6%	7.6%	8.4%
Bulgaria	23.4%	23.6%	16.0%	20.2%	46.5%	47.6%	16.1%	17.0%
Czechia	17.4%	17.4%	13.0%	15.6%	33.6%	34.1%	11.3%	11.7%
Denmark	39.5%	39.9%	30.0%	41.0%	31.6%	32.9%	-3.7%	-2.7%
Germany	19.9%	20.1%	18.0%	18.8%	10.7%	11.9%	6.0%	7.1%
Estonia	34.2%	34.6%	25.0%	25.0%	36.6%	38.3%	36.6%	38.3%
Ireland	15.1%	15.4%	16.0%	12.9%	-5.6%	-3.6%	17.1%	19.6%
Greece	24.3%	24.7%	18.0%	19.7%	35.1%	37.1%	23.4%	25.2%
Spain	21.5%	21.8%	20.0%	20.0%	7.3%	8.9%	7.3%	8.9%
France	19.3%	19.5%	23.0%	23.0%	-16.2%	-15.4%	-16.2%	-15.4%
Croatia	33.0%	33.2%	20.0%	28.6%	64.8%	66.2%	15.2%	16.3%
Italy	20.8%	21.2%	17.0%	19.0%	22.5%	24.5%	9.6%	11.4%

RES share in gross final energy demand by <u>2020 - without</u> impact of RES cooperation	**Expected RES share 2020 (CPI scenario)**		**RED target RES share 2020**	**NECP baseline share 2020**	**Deviation of expected from RED target RES share (CPI scenario)**		**Deviation of expected from NECP baseline share (CPI scenario)**	
	Min.	**Max.**			**Min.**	**Max.**	**Min.**	**Max.**
Member State	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
Cyprus	14.7%	14.9%	13.0%	13.0%	13.2%	15.0%	13.2%	15.0%
Latvia	42.2%	42.4%	40.0%	40.0%	5.5%	5.9%	5.5%	5.9%
Lithuania	28.2%	28.3%	23.0%	26.8%	22.7%	23.1%	5.3%	5.7%
Luxembourg	7.4%	7.5%	11.0%	9.2%	-32.5%	-31.8%	-19.3%	-18.5%
Hungary	13.8%	13.9%	13.0%	13.2%	6.1%	7.0%	4.5%	5.4%
Malta	11.3%	11.4%	10.0%	7.7%	12.6%	14.1%	46.3%	48.2%
Netherlands	11.7%	11.8%	14.0%	11.4%	-16.6%	-15.8%	2.4%	3.4%
Austria	36.7%	37.4%	34.0%	34.3%	8.0%	9.9%	7.1%	9.0%
Poland	14.2%	14.3%	15.0%	15.0%	-5.7%	-4.9%	-5.7%	-4.9%
Portugal	34.4%	34.8%	31.0%	31.0%	10.9%	12.1%	10.9%	12.1%
Romania	26.8%	26.9%	24.0%	27.8%	11.6%	12.1%	-3.6%	-3.2%
Slovenia	25.0%	25.2%	25.0%	25.0%	-0.1%	0.7%	-0.1%	0.7%
Slovakia	18.2%	18.3%	14.0%	14.0%	29.8%	30.7%	29.8%	30.7%
Finland	49.3%	49.6%	38.0%	38.0%	29.7%	30.5%	29.7%	30.5%
Sweden	59.6%	60.2%	49.0%	58.2%	21.6%	22.8%	2.4%	3.4%
United Kingdom	15.0%	15.2%	15.0%	15.0%	0.0%	1.4%	0.0%	1.4%
EU-27	22.4%	22.6%	20.0%	21.6%	11.8%	13.0%	3.4%	4.5%
EU-28	21.5%	21.8%	20.0%	20.9%	7.6%	8.8%	3.1%	4.3%

*The NECPs of Czechia, Greece, France, Cyprus and Slovenia do not specify a baseline share for 2020. For these MS we use the 2020 target share instead. For UK, which did not publish a final NECP, the RED target RES share 2020 is used.

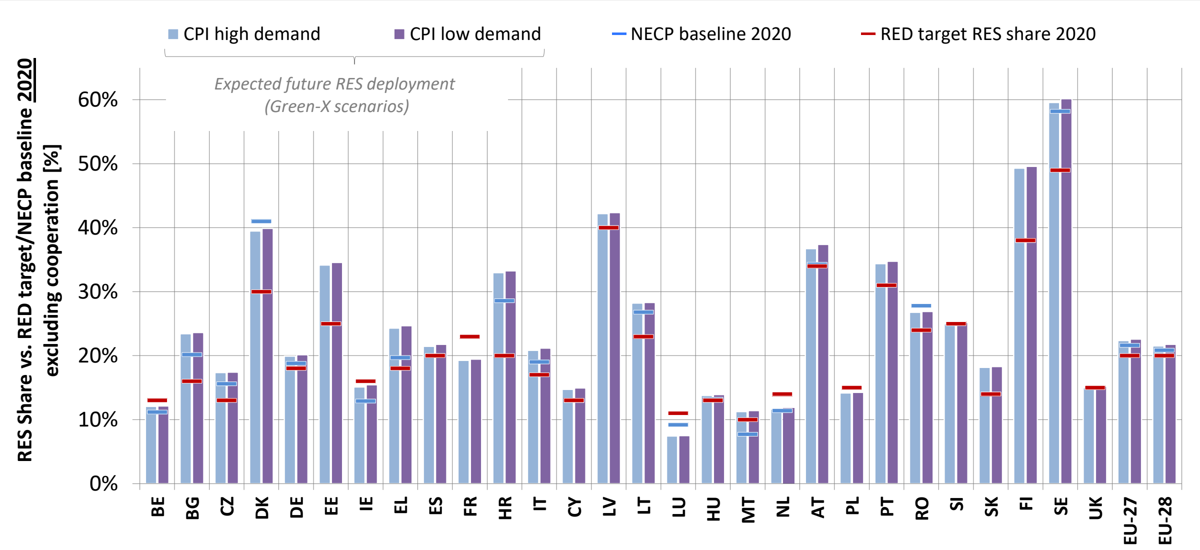

Figure 14. Expected RES share in 2020 vs. 2020 RED target RES share and 2020 NECP baseline (%) excluding cooperation mechanisms

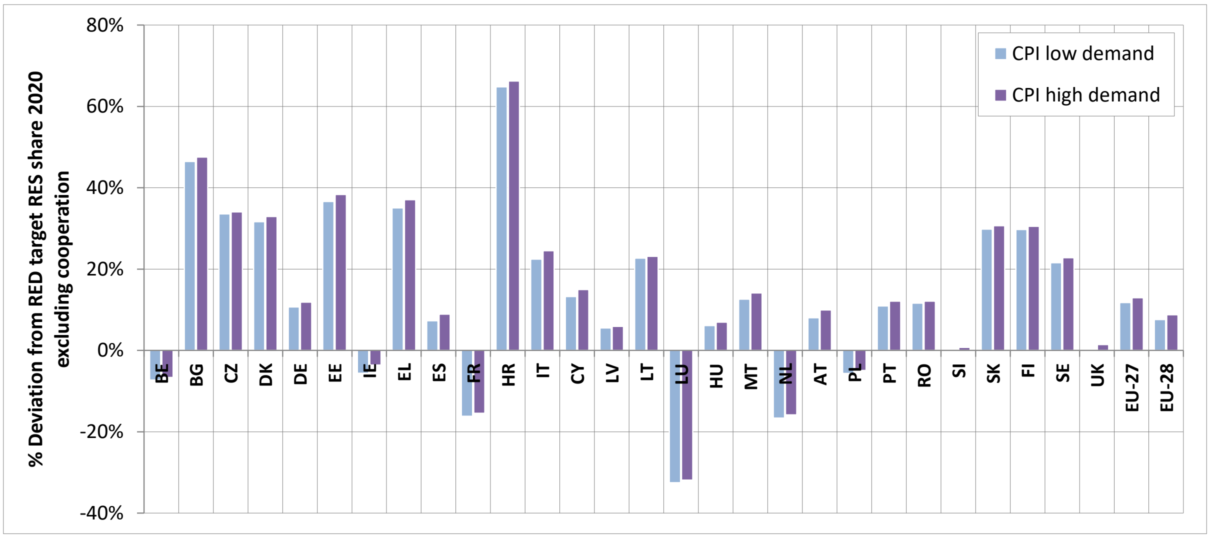

Figure 15. Deviation of expected RES shares (Green-X scenarios) from binding RED 2020 RES targets excluding cooperation mechanisms

A comparison of expected with targeted RES deployment by 2020 indicates that the EU is likely to succeed in meeting its binding RED 2020 RES target: At EU-27 (EU-28) level a RES share of 22.4% to 22.6% (21.5% to 21.8%) can be expected with currently implemented RES policy initiatives[31]. The majority of MS is expected to perform well with meeting the indicative trajectory, not only in the past (2018, 2019) but also in meeting their binding RED 2020 RES targets. 22 of the assessed 27 MS, including Bulgaria, Czechia, Croatia, Denmark, Germany, Estonia, Greece, Spain, Croatia, Italy, Cyprus, Latvia, Lithuania, Hungary, Malta, Austria, Portugal, Romania, Slovenia, Slovakia, Finland and Sweden may succeed in (over)fulfilling their binding RED 2020 RES targets with implemented

[31] Note that the range indicates the uncertainty related to key input parameter for the model-based assessment of future RES progress. Remarkably, the year's 2020 energy demand drop as a consequence of the COVID-19 pandemic, and corresponding changes in RES supply play a decisive role in this respect.

RES policies under the given special circumstances of today (2020) – i.e. the significant drop in energy consumption driven by the COVID-19 pandemic during the first half of 2020. The UK was also included in the assessment and will most likely reach its RED 2020 RES target. For the remaining MS, namely Belgium, France, Ireland, Luxembourg, the Netherlands and Poland, currently implemented RES policy initiatives appear insufficient to trigger the required RES volumes to reach the binding 2020 RES targets purely domestically, despite the strong decline in energy consumption. The situation differs however from MS to MS: while results show that Belgium, Ireland and Poland may have only a comparatively small deficit in relative terms of less than 15% (i.e. as percentage deviation to required RES deployment) even under pessimistic circumstances (i.e. high demand trend for 2020), MS like France, Luxembourg and the Netherlands may face a comparatively larger gap (i.e. larger than 15%) by 2020. Thus, initiating RES cooperation with other MS and/or third countries represents a viable option for them to meet their binding RED 2020 RES targets.

Belgium, Ireland, Luxembourg, Malta and the Netherlands have already signed treaties with Denmark, Estonia and Lithuania to close their expected gaps in RES deployment by making use of cooperation mechanisms in the form of statistical transfers. The impact of RES cooperation on expected 2020 RES deployment is presented in section 3.2.1.1. Generally, the partially significant deficit in required RES deployment may however also reflect deficits in the financial support for RES and/or the required mitigation steps related to non-economic barriers that hinder an accelerated domestic RES diffusion. Complementary to targeted measures for an accelerated RES development, the success in improving energy efficiency and consequently reducing overall energy demand growth represents another important pillar for achieving the binding 2020 as well as future RES targets, since they are defined as RES shares, i.e. put in direct relation to demand (growth).

Deviation from 2020 NECP baselines

Next, a closer look is taken at the expected progress of MS in meeting the RES planned deployment as specified in NECPs for 2020. In this context, Figure 16 shows the deviation of expected 2020 RES deployment in relative terms from the NECP baselines. More precisely, this graph shows for 2020 the deviation in RES shares (in gross final energy demand) under default conditions for RES support, considering only currently implemented RES policy initiatives. Since energy demand developments (during 2020) play a decisive role, we show a lower and an upper boundary for the expected deviation in RES shares that refer to differences in underlying energy demand trends (i.e. a high and low energy demand trend for 2020).

Despite planned 2020 RES deployment as estimated in NECP baselines in the majority of MS being higher[32] than their binding RED 2020 RES targets, the number of MS that are expected to meet their planned NECP baseline in 2020 is the same as above – i.e. 22 of the analysed 27 MS are expected to meet their NECP baseline, and the same holds for the UK (being no longer a MS of the EU). Belgium and the Netherlands are expected to overachieve their NECP baseline. However, in both cases the NECP baseline is lower than the country's RED target on RES share. For Denmark and Romania, the opposite is the case. They might fall short in achieving their own 2020 NECP baseline planning concerning overall RES deployment, which both set significantly higher than their binding national RES obligation. As stated above, for the majority of MS, it can be expected that they succeed in meeting their 2020 NECP baselines. With deviations over 20%, most significant surpluses occur in Malta, Estonia, Slovakia, Finland, Greece, Croatia, and Cyprus. At the aggregated EU-27 (EU-28) level a surplus of 3.4% to 4.5% (3.1% to 4.3%) can be expected when comparing expected and planned RES shares for 2020 as of the aggregated MS NECP perspective.

[32] Adding up planned performance as expressed by MS's in their NECP baselines for 2020 leads to a RES share of 21.6% (20.9%) for the EU-27 (EU-28), similar to the binding RED 2020 RES target of 20% measured as RES share in gross final energy consumption.

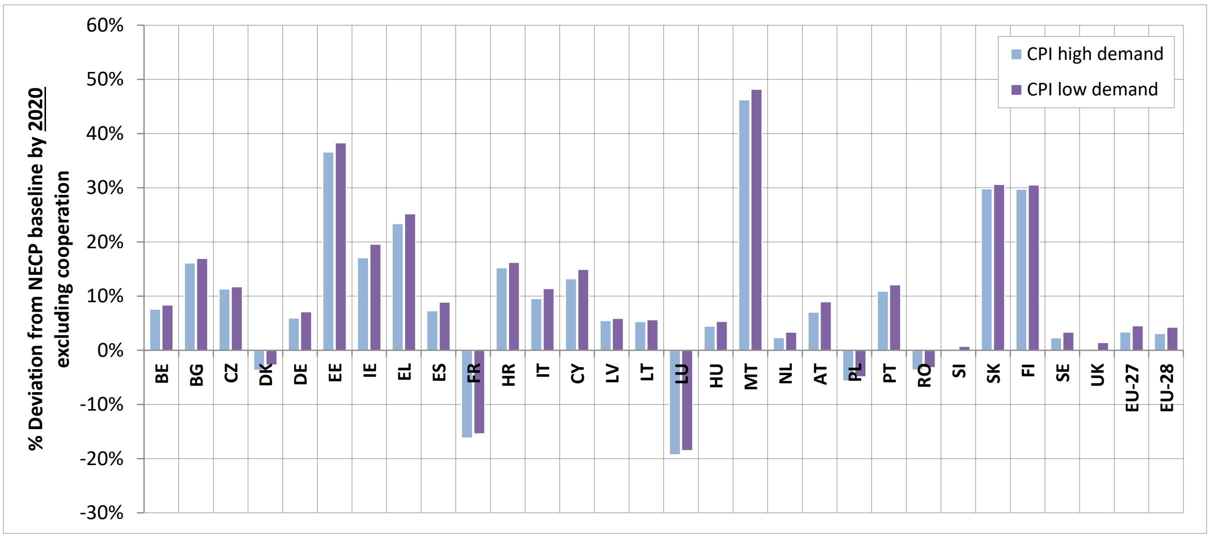

Figure 16. Deviation of expected RES shares (Green-X scenarios) from NECP baselines by 2020 excluding cooperation mechanisms

3.2.1.2. Projected future progress in RES overall including cooperation mechanisms

As of February 2021,, five MS act as buyers of statistical transfers while three MS act as sellers. In total, there were seven contracts on cooperation agreements on the statistical transfer of renewable energy amounts signed.

Two agreements support Luxembourg in achieving its binding national RES target for 2020 by receiving statistical transfers of a specified amount of renewable energy produced in Lithuania[33] and Estonia[34]. Both agreements refer to minimum values and stipulate the possibility of transferring additional amounts, which Luxembourg could potentially use. They therefore make it possible for Luxembourg to cover the amounts foreseen in its NECP baseline. It should also be noted that Luxembourg was the first MS which uses the cooperation mechanism to meet its binding RED 2020 RES target and send a clear signal in the interest of closer European cooperation in the area of renewable energies (4th Progress Report of Luxembourg, Paragraph 11.1). All agreements are described in further detail below.

The current RES cooperation agreements include:

- **Luxembourg (buyer) – Lithuania (seller):** Luxembourg signed a statistical transfer agreement with Lithuania for 0.7 TWh, or more if needed, between 2018 and 2020.[35, 36]

[33] Agreement on statistical transfers of renewable energy amounts between Lithuania and Luxembourg. Source: https://ec.europa.eu/info/news/agreement-statistical-transfers-renewable-energy-amounts-between-lithuania-and-Luxembourg-2017-oct-26_en

[34] Second agreement on statistical transfers of renewable energy amounts between Estonia and Luxembourg. Source: https://ec.europa.eu/info/news/second-agreement-statistical-transfers-renewable-energy-amounts-between-estonia-and-Luxembourg-2017-nov-13_en

[35] Estonia to help Luxembourg meet 2020 renewables goal – report. Source: https://renewablesnow.com/news/estonia-to-help-Luxembourg-meet-2020-renewables-goal-report-590343/

[36] Additionally, in September 2020 the two countries signed a Memorandum of Understanding on opportunities for cooperation beyond 2020. The additional memorandum is a positive sign for cooperation. However, it does not affect the 2020 projections. Source: https://enmin.lrv.lt/en/news/luxembourg-and-lithuania-to-continue-cooperating-in-the-field-of-renewable-energy

- **Luxembourg (buyer) – Estonia (seller):** Sales will be carried out between 2018 and 2020, with 0.3 TWh of transfers planned for the year 2018 and 0.4 TWh for 2020. Optional: 0.6 TWh for the renewable energy target in the year 2018, 2019 and 2020.[37]

- **Netherlands (buyer) – Denmark (seller):** On 19 June 2020 Denmark and the Netherlands signed an agreement on statistical transfers of 8 TWh RES volumes for 2020. Accordingly, the Netherlands can receive an additional volume of up to 8 TWh if required for RES target achievement. It needs to inform Denmark by August 1 2021 whether it would make use of that option in full or partially.[38]

  According to the results of our assessment, Denmark could transfer at least an additional volume of 5.6 TWh RES volumes to the Netherlands without falling short of their own RED 2020 RES target under both demand projections for 2020. That may suffice for the Netherlands, requiring an optional amount of 5.1 TWh (according to our analysis) in addition to the agreed volume of 8 TWh to achieve its RED 2020 RES target under both demand projections for 2020.

- **Malta (buyer) – Estonia (seller):** In January 2019, Malta and Estonia agreed on a statistical transfer of 0.1 TWh for a total amount of two million euros. The contract is flexible and Malta may either increase or reduce the amount to be purchased by 20 percent.[39]

  According to the results of our assessment, Malta does not need the agreed statistical transfers. Malta is expected to domestically achieve a RES share of 11.3% to 11.4% in 2020, surpassing its RED target RES share of 10%.

- **Belgium - Flanders (buyer) – Denmark (seller):** The Flemish government decided to purchase 1.8 TWh of renewable electricity for € 22.5 million from Denmark via a statistical transfer.[40]

- **Ireland (buyer) – Denmark, Estonia (sellers):** On 24 November 2020 the Irish cabinet signed of plans to pay Denmark and Estonia a total of € 50 million for a total of 3.5 TWh of renewable electricity credited for the year 2020. Ireland will pay:
  - € 37.5 million to Estonia for the purchase of 2.5 TWh of energy and
  - € 12.5 million to Denmark for a volume of 1 TWh of energy.

  The agreement also covers an option for further purchases of between 0.5 and 1.0 TWh of renewable energy in statistical terms.[41]

In the following, outcomes for 2020 are presented that include the stipulated use of statistical transfer agreements. We thereby applied, based on the agreements taken at bilateral basis, two distinct scenarios for the use of RES cooperation by means of statistical transfers: a "strong cooperation" and a "weak cooperation" scenario. More precisely, at MS level the following assumptions were taken:

- In the "strong cooperation" case we assumed a statistical transfer of in total 1.7 TWh from Estonia (1 TWh) and Lithuania (0.7 TWh) to Luxembourg, a statistical transfer of 16 TWh from Denmark to the Netherlands, a statistical transfer of 0.08 TWh from Estonia to Malta, a

[37] Agreement between the Republic of Estonia and the Grand Duchy of Luxembourg on the establishment of a framework for the statistical transfer of energy from renewable sources for target compliance purposes under the RES Directive. Source: https://www.riigiteataja.ee/aktilisa/2280/3201/8003/Lux_agreement.pdf

[38] Netherlands to pay EUR 100m to count Danish renewables towards 2020 goal. Source: https://renewablesnow.com/news/netherlands-to-pay-eur-100m-to-count-danish-renewables-towards-2020-goal-703888/.

[39] Estonia will sell renewable energy statistics to Malta. Source: https://www.mkm.ee/en/news/estonia-will-sell-renewable-energy-statistics-malta

[40] The Flemish government pays 22.5 million to Denmark to avoid a European fine for a shortage of renewable energy. Source: https://www.world-today-news.com/energy-ambition-that-is-too-low-costs-flanders-millions/

[41] Ireland to pay Denmark, Estonia €50m for 'statistical' renewable energy transfer. Source : https://www.irishtimes.com/news/ireland/irish-news/ireland-to-pay-denmark-estonia-50m-for-statistical-renewable-energy-transfer-1.4418420

statistical transfer of 1.8 TWh from Denmark to Belgium, and a statistical transfer of 3.5 TWh from Estonia (2.5 TWh) and Denmark (1 TWh) to Ireland.

- In the “weak cooperation” case we assumed statistical transfers of 1.1 TWh from Estonia (0.4 TWh) and Lithuania (0.7 TWh) to Luxembourg, of 8 TWh from Denmark to the Netherlands, of 0.08 TWh from Estonia to Malta, of 1.8 TWh from Denmark to Belgium, and of 3.5 TWh from Estonia (2.5 TWh) and Denmark (1.0 TWh) to Ireland.

Please note that in the case of Malta, acting as buyer, and Estonia as seller, we took the assumption that Malta would opt under both cases for the lower boundary of feasible transfer volumes (i.e. 80 GWh, implying a 20 percent reduction of the base volume of 100 GWh) since statistical transfers would not be required for Malta’s 2020 RES target achievement according to the expected RES generation volumes and the assumed reduction in energy consumption in 2020, driven by the COVID-19 pandemic. In both cases, an additional statistical transfer to Ireland was not assumed, as Ireland will reach its 2020 RED target RES share of 16.0% with great certainty assuming the agreed purchase of 3.5 TWh without opting for further purchases as agreed with Estonia and Denmark in prior.

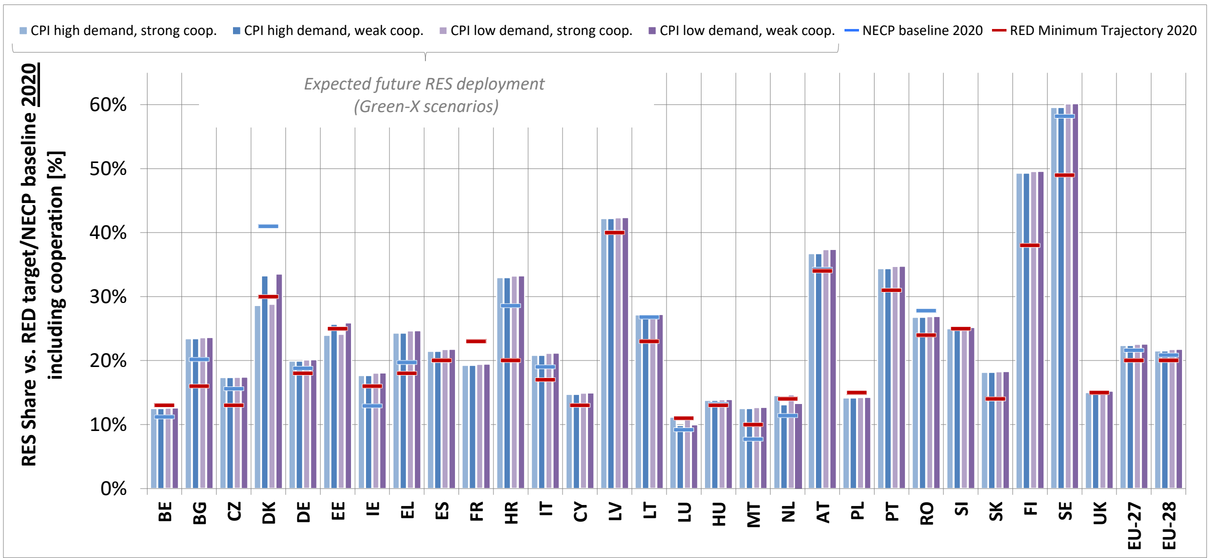

Figure 17. Expected RES share in 2020 vs. 2020 RED target RES share and 2020 NECP baseline (%) including cooperation mechanisms

Figure 17 indicates expected, required and planned RES deployment in relative terms (i.e. RES share in gross final energy consumption), including the use of cooperation mechanisms set-up under the RED. Figure 18 shows the resulting changes in deviations from binding RED targets for the overall RES shares by MS. Complementary to these graphs, table 10 lists all data on expected and required RES shares (i.e. 2020 RED targets), including the use of cooperation mechanisms. The table also provides an overview of deviations to binding RED 2020 RES targets in absolute terms, indicating lower and upper boundaries (min-max values) of surpluses or gaps by MS according to the scenarios assessed (i.e. low/high demand and weak/strong cooperation). MS like Italy, Sweden, Germany, Finland, Spain, Czechia, Greece, Bulgaria and Austria may possess significant surpluses in RES generation by 2020 that may facilitate RES target achievement for other MS like France or Poland. In this context, bilateral agreements on statistical transfers appear as an appropriate instrument to allow for that exchange.

A comparison with the corresponding figures and tables in section 3.2.1.1, where in contrast to where RES cooperation is excluded, highlights the changes for the affected MS: The gap in meeting their binding national 2020 RES target is significantly reduced or even closed for offtaker countries like Belgium, Ireland, Luxembourg, Malta and the Netherlands.

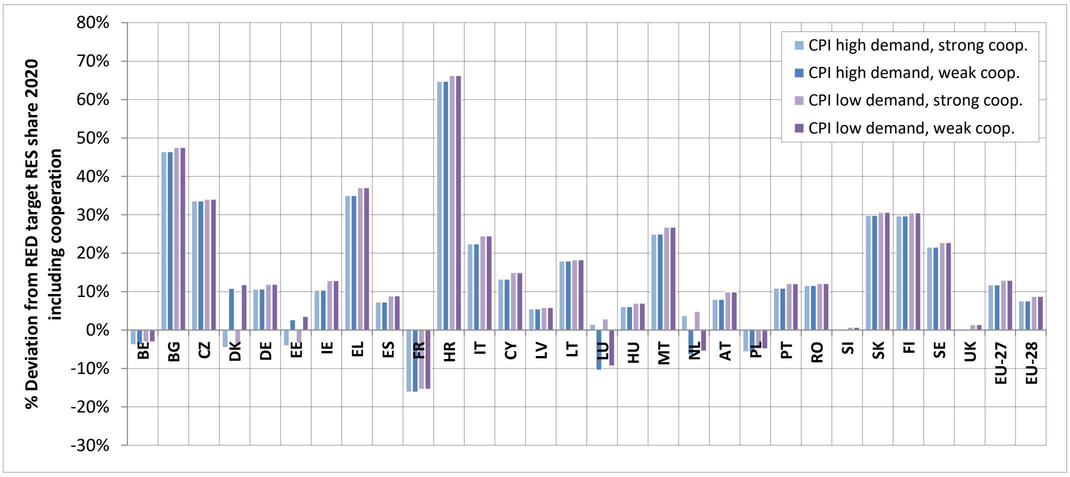

Figure 18. Deviation of expected RES shares (Green-X scenarios) from binding RED 2020 RES targets <u>including</u> cooperation mechanisms

RES share in gross final energy demand by 2020 - with impact of RES cooperation	Expected RES share 2020 (CPI scenario)		RED target RES share 2020	Deviation of expected from RED target RES share (CPI scenario)		Absolute deviation of expected from RED target RES share (CPI scenario)	
	Min.	Max.		Min.	Max.	Min.	Max.
Member State	[%]	[%]	[%]	[%]	[%]	[ktoe]	[ktoe]
Belgium	12.5%	12.6%	13.0%	-3.8%	-3.1%	-162	-127
Bulgaria	23.4%	23.6%	16.0%	46.5%	47.6%	747	749
Czechia	17.4%	17.4%	13.0%	33.6%	34.1%	1,059	1,066
Denmark	28.6%	33.5%	30.0%	-4.6%	11.8%	-208	528
Germany	19.9%	20.1%	18.0%	10.7%	11.9%	3,975	4,342
Estonia	24.0%	25.9%	25.0%	-4.1%	3.6%	-31	26
Ireland	17.7%	18.1%	16.0%	10.4%	12.9%	184	223
Greece	24.3%	24.7%	18.0%	35.1%	37.1%	962	994
Spain	21.5%	21.8%	20.0%	7.3%	8.9%	1,127	1,334
France	19.3%	19.5%	23.0%	-16.2%	-15.4%	-5,065	-4,697
Croatia	33.0%	33.2%	20.0%	64.8%	66.2%	814	818
Italy	20.8%	21.2%	17.0%	22.5%	24.5%	3,964	4,204
Cyprus	14.7%	14.9%	13.0%	13.2%	15.0%	26	29
Latvia	42.2%	42.4%	40.0%	5.5%	5.9%	88	92
Lithuania	27.1%	27.2%	23.0%	18.0%	18.3%	218	218
Luxembourg	9.8%	11.3%	11.0%	-10.5%	2.9%	-43	12
Hungary	13.8%	13.9%	13.0%	6.1%	7.0%	139	156
Malta	12.5%	12.7%	10.0%	25.0%	26.8%	13	14
Netherlands	13.1%	14.7%	14.0%	-6.4%	4.9%	-410	306
Austria	36.7%	37.4%	34.0%	8.0%	9.9%	725	881
Poland	14.2%	14.3%	15.0%	-5.7%	-4.9%	-598	-510
Portugal	34.4%	34.8%	31.0%	10.9%	12.1%	542	586
Romania	26.8%	26.9%	24.0%	11.6%	12.1%	647	665
Slovenia	25.0%	25.2%	25.0%	-0.1%	0.7%	-1	8
Slovakia	18.2%	18.3%	14.0%	29.8%	30.7%	397	399
Finland	49.3%	49.6%	38.0%	29.7%	30.5%	2,883	2,902
Sweden	59.6%	60.2%	49.0%	21.6%	22.8%	3,470	3,606
United Kingdom	15.0%	15.2%	15.0%	0.0%	1.4%	-3	245
EU-27	22.4%	22.6%	20.0%	11.8%	13.0%	16,173*	18,117*
EU-28	21.5%	21.8%	20.0%	7.6%	8.8%	16,170*	18,362*

Table 10 – Expected and required RES shares in 2020 including cooperation mechanisms

* The absolute deviations shown at EU-27 and EU-28 level represent the sum of the absolute deviations of the corresponding MS within a consistent scenario set of weak/strong cooperation and low/high energy demand. If absolute deviations at EU-27 and EU-28 are calculated in comparison to the EU RED target of 20% RES by 2020, higher surplus quantities would occur. This indicates that if all MS achieve their given RED 2020 RES target under assumed demand trends then at EU-28 level a higher RES share than 20.0% would occur, and a significantly higher one at EU-27 level. This is because the original projection of gross final energy demand for the year 2020, created for the effort sharing calculation before adoption of the RED in 2009, deviates from the actual demand projection. In addition, binding RED targets for MS have been rounded.

Further insights on expected 2020 RES target achievement and corresponding surpluses or gaps in RES volumes according to the scenarios assessed (i.e. low/high demand and weak/strong cooperation) are provided by **Table 11** for all MS affected by cooperation mechanisms. The following country-insights can be gained from this table:

- For Belgium the amount of statistical transfer agreed on with Denmark (1.8 TWh) will not suffice to close the gap to its RED target of 13%. It is expected that a gap of 1.5 to 1.9 TWh will remain to achieve its 2020 RED target, depending on actual gross final energy consumption and domestic renewable energy deployment in 2020.
- For Ireland it is expected that the statistical transfer with Denmark and Estonia of 3.5 TWh will suffice to reach and even over-succeed its RED target of 16% in 2020. According to our assessment a statistical transfer of 1.4 TWh would have safeguarded Ireland to reach its 2020 RED target.
- For Luxembourg it appears likely that the 2020 RES target can be met considering its optional statistical transfers from Estonia (strong cooperation) thanks to its proactive behaviour in setting these political agreements with Estonia and Lithuania well in time.
- For Malta it seems, that according to the results of our assessment, it does not require any of the agreed statistical transfers under the special circumstances of 2020 (i.e. the impact of the COVID-19 pandemic on energy consumption). Thus, Malta is expected to achieve a RES share of 11.3% to 11.4% in 2020 with domestic renewables, surpassing its RED target RES share of 10%.
- For the Netherlands the projections appear less optimistic but still the 2020 RES target can be met under the assumption of strong cooperation with Denmark (i.e. a statistical transfer of 16 TWh).
- The host countries Denmark, Estonia and Lithuania can consequently benefit from the financial compensations that have been agreed upon. For Denmark and Estonia, the (partly optional) volumes to be purchased might however endanger their own RES target achievement.

Table 11. Scenario-specific details for all MS affected by cooperation mechanisms – including cooperation mechanisms

	RES share in gross final energy demand by 2020 - with impact of RES cooperation	**Expected RES share 2020 (CPI scenario)**						**Absolute deviation of expected from RED target RES share (CPI scenario)**			
		High Demand, Strong Coop.	**High Demand, Weak Coop.**	**Low Demand, Strong Coop.**	**Low Demand, Weak Coop.**	**RED RES 2020**	**target share**	**High Demand, Strong Coop.**	**High Demand, Weak Coop.**	**Low Demand, Strong Coop.**	**Low Demand, Weak Coop.**
	Member State	**[%]**	**[%]**	**[%]**	**[%]**		**[%]**	**[ktoe]**	**[ktoe]**	**[ktoe]**	**[ktoe]**
Seller	**Denmark**	28.6%	33.3%	28.9%	33.5%		30.0%	-208	492	-171	528
Seller	**Estonia**	24.0%	25.7%	24.1%	25.9%		25.0%	-31	20	-25	26
Seller	**Lithuania**	27.1%	27.1%	27.2%	27.2%		23.0%	218	218	218	218
Buyer	**Belgium**	12.5%	12.5%	12.6%	12.6%		13.0%	-162	-162	-127	-127
Buyer	**Ireland**	17.7%	17.7%	18.1%	18.1%		16.0%	184	184	223	223
Buyer	**Luxembourg**	11.2%	9.8%	11.3%	10.0%		11.0%	6	-43	12	-38
Buyer	**Malta**	12.5%	12.5%	12.7%	12.7%		10.0%	13	13	14	14
Buyer	**Netherlands**	14.5%	13.1%	14.7%	13.2%		14.0%	239	-410	306	-342

3.2.1.3. Technology overview

Complementary to the above, in the following section the technology insights are presented. More precisely, Table 12 gives for each RES technology an overview of the status quo (2019) as well as the expected and planned (according to NREAP sectoral trajectories) deployment at EU-level by 2020. Additionally, aggregates (by sector and for RES in total) as well as deviations (i.e. comparing expected and planned deployment) are indicated. Complementary to this, Figure 19 and Figure

20provide a graphical illustration of the data, indicating the planned as well as the actual (2018, 2019) and expected future (2020) RES deployment by sector (Figure 19) and at technology level (Figure 20), using however aggregated technology clusters compared to the detailed technology breakdown shown in Table 12. Moreover, these graphs also allow for a comparison of this year's assessment of future progress with a previous one (eight years ago with slight deviations as Croatia was not included in the assessment, (Ecofys, 2013)).

For 2020, the picture regarding absolute and relative (considering the RES share in gross final energy demand) RES deployment levels appears ambiguous: energy volumes of RES origin are expected to be lower than planned but the RES share in energy demand is above planning (and well above the binding EU target for 2020). This indicates that overall energy demand estimates underlying the NREAP projections were higher than actual developments. Here, the impact of the currently ongoing COVID-19 pandemic appears decisive, causing a significant decline in energy consumption during the first three quarters of the year 2020. Additionally, concerning the supply side, energy produced from renewable fuels appear less affected by that crisis than the use of fossil fuels. Of interest, the situation differs by sector and by technology as discussed below.

Generally, the heat sector appears most advanced among all energy sectors if one compares actual, expected and planned RES volumes in absolute terms. With 101.5 Mtoe current (2019) deployment of RES-H&C, this is about 1% higher than the planned one (100.1 Mtoe as reported by MS in their NREAP sectoral trajectories). By 2020, a small gap between expected and planned RES volumes is expected to occur, causing a deficit in size of 0.7% to 2.4% compared to the planned volumes. Compared to an initial assessment as conducted throughout 2012, this represents the most significant change in perceptions: Previous scenarios have shown a 18% lower deployment for 2020. One key reason for changing expectations is that past progress in RES-H&C was far better than MS own expectations (as expressed in NREAPs or previous Progress Reports). In particular the developments in biomass heat and heat pumps have been remarkably strong in several MS. A higher than planned contribution from these technologies is also expected in 2020. In contrast to the above, one can identify a need for improvements in the sector of heating & cooling for technologies like biogas, solar thermal collectors and mid- to large-scale geothermal heating systems. These technology options may most urgently require additional initiatives for stipulating deployment as formerly planned. In relative terms, i.e. the RES share in corresponding sectoral demand, RES-H&C achieved a share of 22.1% in 2019, and this positive trend may hold well for 2020: here the expected RES share ranges from 24.1% to 24.2% (compared to 22.5% planned), depending on the 2020 demand developments and RES-H&C deployment.

In contrast to RES-H&C, RES-E shows a comparatively large gap in absolute terms, i.e. comparing actual (2019) or expected (2020) with planned electricity generation from renewables, over the whole assessment period. Apart from strong increases of solar PV and wind in several MS, a slowdown of past strong progress is applicable across the EU. This leads to a deficit of about 3.8 Mtoe when comparing actual (85.0 Mtoe) with planned (88.8 Mtoe) RES generation volumes in 2019, and it is expected that this gap increases to 4.7 Mtoe until 2020 (i.e. with 89.0 Mtoe expected vs 93.7 Mtoe planned generation). If one takes electricity demand developments also into account the picture changes: here actual and expected RES shares in gross electricity demand are significantly higher than planned. In 2019, RES-E achieved a share of 34.1% in demand which is significantly higher than planned (32.7%). This positive trend is expected to remain until 2020. The significant decline of electricity consumption in 2020 let us expect that the RES-E share will range from 37.2% to 37.5% by 2020. This is significantly higher than the planned deployment (34.2%). At technology level, as shown in Figure 20 the strong (historic) uptake of solar PV is getting apparent. Consequently, actual (2019) and expected (2020) electricity generation from solar technologies are larger than planned. In contrast to solar (PV), a deficit is applicable for wind energy as well as for hydro and ocean technologies like tidal stream and wave power where planned progress was significantly higher than the actual one. Table 12 indicates that for RES-E technologies like biomass and geothermal, planned deployment is higher than actual or expected, respectively, and in the case of biogas planning is lower than actual (3.7% surplus deployment in 2019) and higher than expected market trends (3.1% lower deployment than planned in 2020).

Regarding RES-T, recently implemented policy initiatives and changes in policy measures provide a positive outlook. Actual data for 2019 confirms that the achieved RES-T share is only slightly below the planned one – i.e. 8.9% (achieved) compared to 9.0% (planned), and modelled prospective deployment indicates that the planned RES-T shares can be over-succeeded (i.e. 12.9% to 13.0% expected compared to 10.1% planned or 10.0% required in 2020). E-mobility and lower than expected energy demand in the transport sector in 2020 is responsible for this turn to the better while actual and expected deployment of biofuels in transport is significantly lower than the planned one. This is mainly a consequence of past policy changes related to first generation biofuels where sustainability concerns are decisive in lowering their maximum contribution to overall RES-T target achievement (the 'ILUC Directive'). However, a closer look at 2020 also shows an increase in biofuel deployment in relative terms, i.e. compared to corresponding sectoral demand. Reason for that upward trend is that several MS have increased blending shares for biofuels specifically for the year 2020.

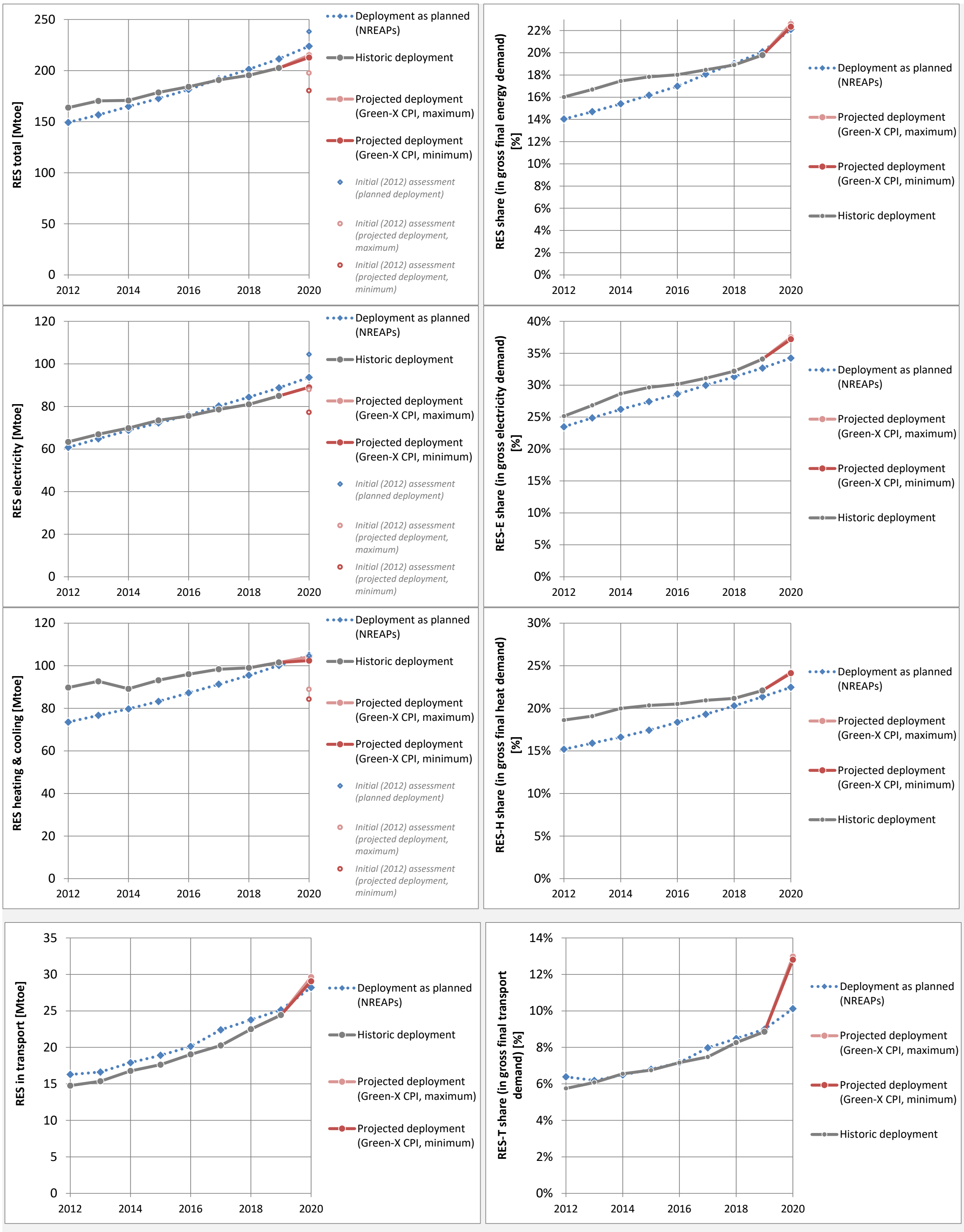

Figure 19. Historic (2012 to 2019), expected and planned sector-specific RES deployment at EU-level (EU-27) in absolute terms (Mtoe, left) and in relative terms (as RES share in corresponding demand, right)

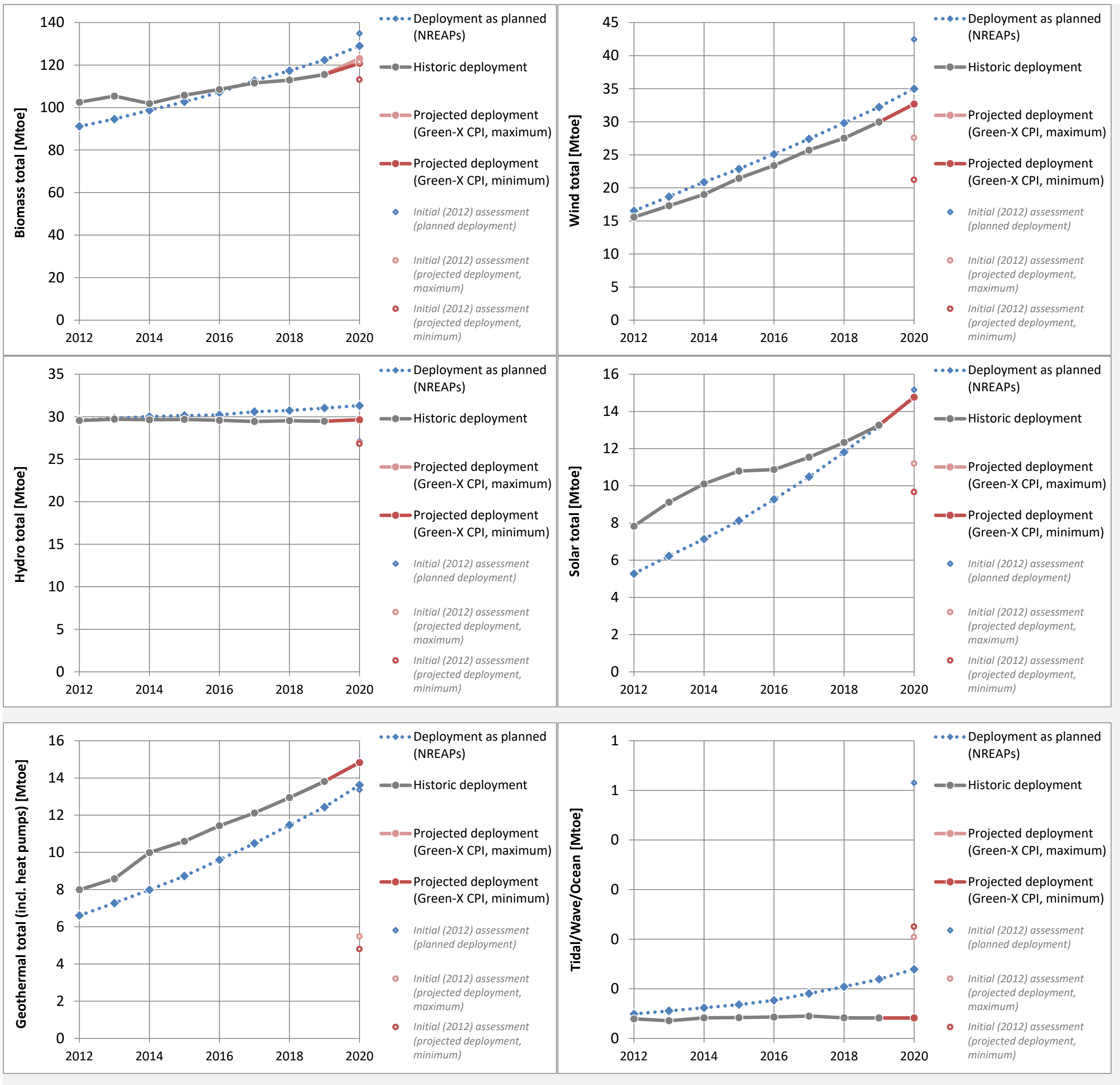

Figure 20. Historic (2012 to 2019), expected and planned technology-specific RES deployment at EU-level (EU-27)

Technology-specific RES deployment at EU level (EU-27) *Technology category*	Status Quo 2012 [Mtoe]	NREAP indicative target 2012 [Mtoe]	Status Quo 2019 [Mtoe]	NREAP indicative target 2019 [Mtoe]	Expected deployment 2020 (CPI scenario) High Demand [Mtoe]	Expected deployment 2020 (CPI scenario) Low Demand [Mtoe]	NREAP indicative target 2020 [Mtoe]	Deviation of expected from planned deployment (and of actual deployment vs planned (2018, 2019)) 2018 [%]	2019 [%]	2020 Min. [%]	2020 Max. [%]
RES electricity	63.3	60.8	85.0	88.8	89.0	89.0	93.7	-4.0%	-4.3%	-5.0%	-5.0%
Biomass (solid and liquid)	7.93	8.31	9.03	12.36	9.11	9.09	12.90	-26.5%	-26.9%	-29.5%	-29.4%
Biogas	3.49	2.39	4.73	4.56	4.82	4.82	4.97	12.7%	3.7%	-3.1%	-3.1%
Geothermal	0.50	0.55	0.58	0.85	0.59	0.59	0.96	-27.4%	-31.7%	-38.7%	-38.7%
Hydro	29.56	29.59	29.47	31.02	29.64	29.64	31.31	-3.9%	-5.0%	-5.3%	-5.3%
Photovoltaics	5.71	2.98	10.32	6.30	11.65	11.65	6.86	64.3%	63.9%	70.0%	70.0%
Concentrated solar power	0.32	0.41	0.49	1.35	0.50	0.50	1.56	-64.3%	-63.7%	-68.1%	-68.1%
Wind	15.58	16.52	29.96	32.22	32.68	32.68	34.99	-7.7%	-7.0%	-6.6%	-6.6%
Tidal/Wave/Ocean	0.04	0.05	0.04	0.12	0.04	0.04	0.14	-60.4%	-65.4%	-70.4%	-70.4%
RES heating & cooling	89.8	73.5	101.5	100.1	104.2	102.4	104.9	3.7%	1.4%	-2.4%	-0.7%
Biomass (solid and liquid)	78.50	63.71	82.49	79.11	83.96	82.14	81.66	6.1%	4.3%	0.6%	2.8%
Biogas	1.97	1.89	3.37	3.86	3.41	3.41	4.19	-10.2%	-12.7%	-18.7%	-18.7%
Geothermal	0.60	0.90	0.91	2.35	0.97	0.97	2.63	-60.1%	-61.1%	-63.0%	-63.0%
Heat pumps	6.89	5.15	12.32	9.24	13.27	13.27	10.03	34.4%	33.4%	32.3%	32.3%
Solar thermal	1.79	1.88	2.44	5.57	2.62	2.62	6.42	-50.3%	-56.1%	-59.2%	-59.2%
RES transport (biofuels only)	10.6	14.9	15.9	22.5	21.8	21.4	25.3	-28.4%	-29.1%	-15.4%	-13.7%
First generation biofuels*	10.6	14.2	15.9	20.4	21.8	21.4	22.9	-21.9%	-21.8%	-6.6%	-4.8%
Second generation biofuels	0.00	0.65	0.00	2.10	0.00	0.00	2.38	-99.9%	-100.0%	-99.9%	-99.9%
RES total	163.7	149.2	202.4	211.4	215.0	212.8	223.9	-3.0%	-4.2%	-5.0%	-3.9%

Note: *the technology category "first generation biofuels" includes also all biofuel import from non-EU countries

Table 11. Historic, expected and planned technology-specific RES deployment at EU-level by 2010, 2018, 2019 and 2020

3.2.2. Projected future in progress in RES-E

In this section, we provide more details on the projected future RES progress for the electricity sector.

3.2.2.1. RES-E Sector overview

Overview of expected deployment vs. NECP baselines for 2020

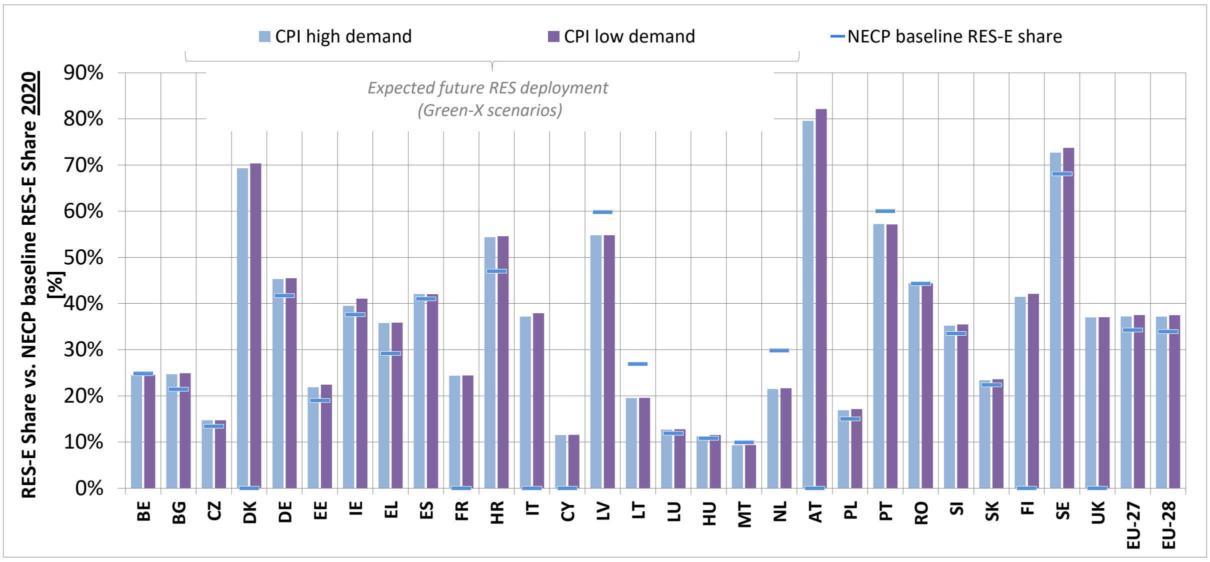

Figure 21. Expected RES-E share in 2020 vs. 2020 NECP baseline (%)

The expected (according to Green-X scenarios) and the planned (i.e. the baseline scenarios presented in the MS's NECPs) 2020 progress of RES in the electricity sector is compared in Figure 21, showing RES-E deployment in relative terms, that is the RES-E share in gross electricity demand. Please note that not all MS have reported in their NECPs transparently on their planned 2020 RES-E shares: for Denmark, France, Italy, Cyprus, Austria, Finland and the United Kingdom that information was not applicable (n.a. – as indicated in Figure 22 below).

Deviation from 2020 NECP baselines (sectoral planned contributions)

Complementary to above, Figure 22 illustrates the deviation of expected RES-E deployment from the planned contribution for this sector (i.e. the planned progress as prescribed in the MS NECPs). More precisely, Figure 22 indicates the deviation under business-as-usual conditions for 2020, taking into account only currently implemented policy initiatives. The uncertainty related to the development of 2020 energy demand is reflected, illustrating lower (i.e. CPI high demand) and upper levels (CPI low demand) of expected RES-E shares caused by reverse trends in corresponding demands.

By 2020, 15 MS (out of the 21 MS that have specified their planned contribution for RES-E shares in 2020 in their NECP) will be able to meet (and over-succeed) their RES-E deployment as planned in the NECPs under all assessed circumstances. Top of that list is Greece, followed by Estonia, Croatia, Bulgaria, Poland, Czechia, Germany, Ireland, Sweden, Luxembourg, Slovenia, Slovakia, Hungary, Spain and Romania. The remaining six MS that have also specified their planned baseline RES-E share in their NECP can be classified as not successful in planning their 2020 progress with respect to renewable electricity. Top of that list (of negative ranking) is the Netherlands, followed by Lithuania, with deficits larger than 20%. The remainder of MS, i.e. Latvia, Malta, Portugal, and Belgium, shows a smaller deficit in expected vs planned RES-E shares for 2020.

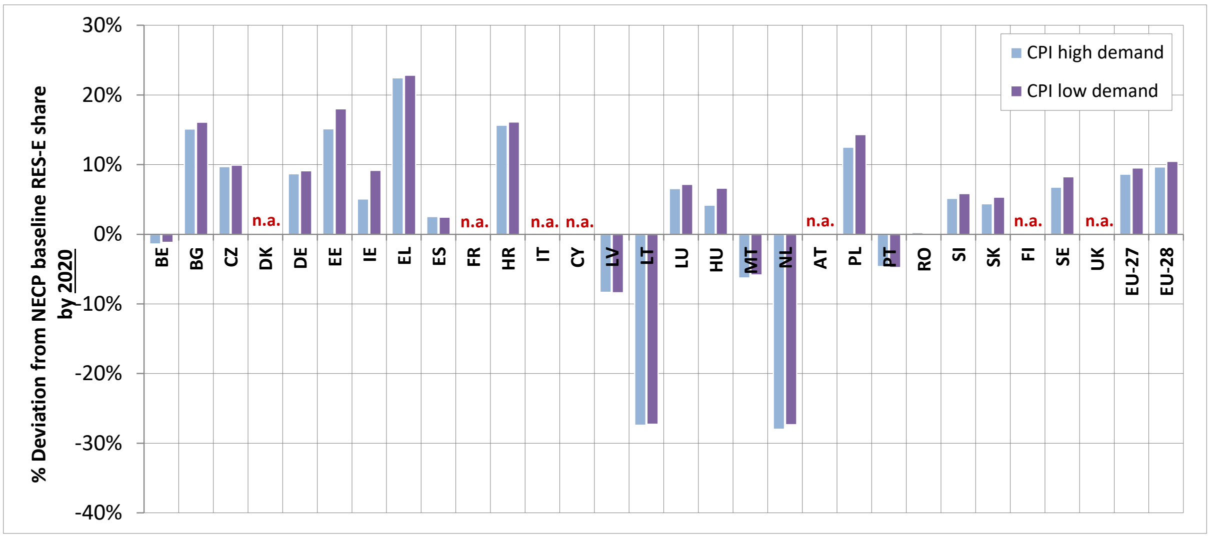

Figure 22. Deviation of expected RES-E Shares (Green-X scenarios) from NECP baseline by 2020

3.2.3. Projected future in progress in RES-H&C

In this section we provide more details on the projected future RES progress for the heating & cooling sector.

3.2.3.1. RES – H&C sector overview

Overview of expected deployment vs. NECP baselines for 2020

Figure 23 shows a comparison of the expected (according to Green-X scenarios) and the planned (i.e. the NECP baseline) 2020 contribution with respect to RES in the sector of heating and cooling. This depiction is done in relative terms, expressing the RES-H&C share in gross final heat demand. Please note that not all MS have specified transparently their planned 2020 RES-H&C shares in their NECPs: for Denmark, France, Italy, Cyprus, the Netherlands, Austria, Poland, Finland and the UK that information was not specified, indicating “not applicable (n.a.)” for those countries in Figure 24.

Overall this figure shows a positive picture of past success in stipulating RES-H&C deployment. The large majority of MS (i.e. 15 out of 19 MS that have specified their planned RES-H&C share for 2020) are on track or have even over-accomplished their planned 2020 RES-H&C share (as specified in their NECP baselines), while only Luxembourg, Ireland, Slovenia, and to a minor extent also Romania are lagging behind.

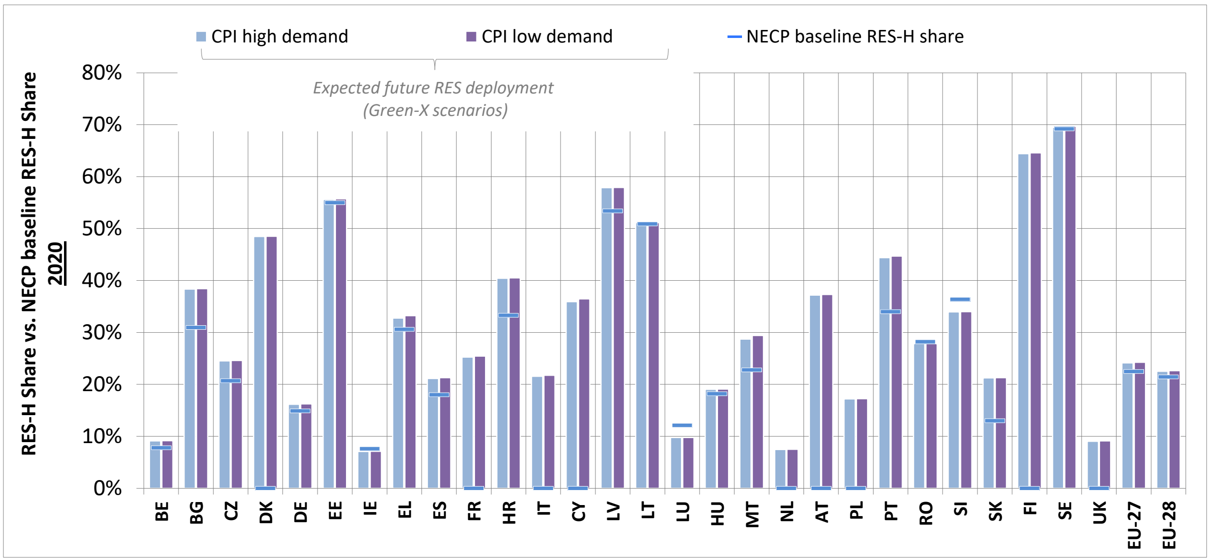

Figure 23. Expected RES-H share in 2020 vs. 2020 NECP baseline (%)
Deviation from 2020 NECP baselines (sectoral trajectories)

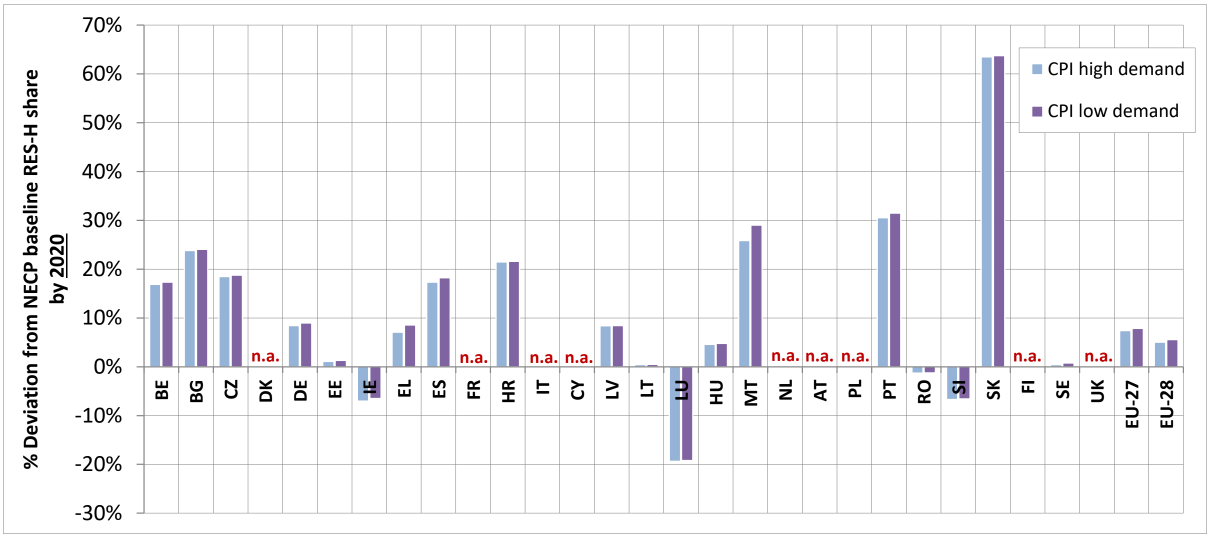

Figure 24. Deviation of expected RES-H shares (Green-X scenarios) from NECP baseline by 2020

Complementary to above, Figure 24 indicates the deviation of expected RES-H&C deployment from the planned contribution for this sector (i.e. the planned progress as prescribed in the MS NECPs) by 2020. More precisely, this graph shows the deviation under business-as-usual conditions, taking into account only currently implemented policy initiatives (CPI case). The uncertainty related to the development of 2020 energy demand is reflected, illustrating lower (i.e. CPI high demand) and upper levels (CPI low demand) of expected RES-H&C shares caused by reverse trends in corresponding demands.

In accordance with above, by 2020 the majority of MS will be able to meet (and significantly over-succeed) their planned contribution for RES-H&C. The strongest overachievement is expected for Slovakia, Portugal and Malta, all showing a deviation of more than 25% when comparing expected and planned RES-H&C shares. Other MS that clearly over-fulfil their plans (i.e. with a deviation higher than 10% but below 25%) are Belgium, Bulgaria, Czechia, Spain and Croatia. The other MS (Germany, Estonia, Greece, Latvia, Lithuania, Hungary and Sweden) have planned realistic 2020 RES-H&C shares in their NECPs – i.e. here deviations between expected and planned deployment are smaller than 10%, but not below the planned contribution. Contrarily, Ireland, Luxembourg and Slovenia fall more than 5% short of their planed RES-H&C share in 2020. An insignificant deviation between planned and excepted deployment is expected for Romania, here the gap amounts to approximately 1%.

3.2.4. *Projected future progress in RES-T*

In this section we provide more details on the projected future progress for the transport sector. Calculations of the RES-T share by 2020 consider caps for first generation biofuels as well as multipliers as defined for second generation biofuels and for the contribution of electricity used in transport as originally specified in the RED (e.g. Annex IX) and, later, partly revised in the Directive to reduce indirect land use change for biofuels and bioliquids (ILUC Directive).

3.2.4.1. RES-T sector overview

Overview of expected deployment vs. binding national RED RES-T sector target (10%) and NECP baselines for 2020

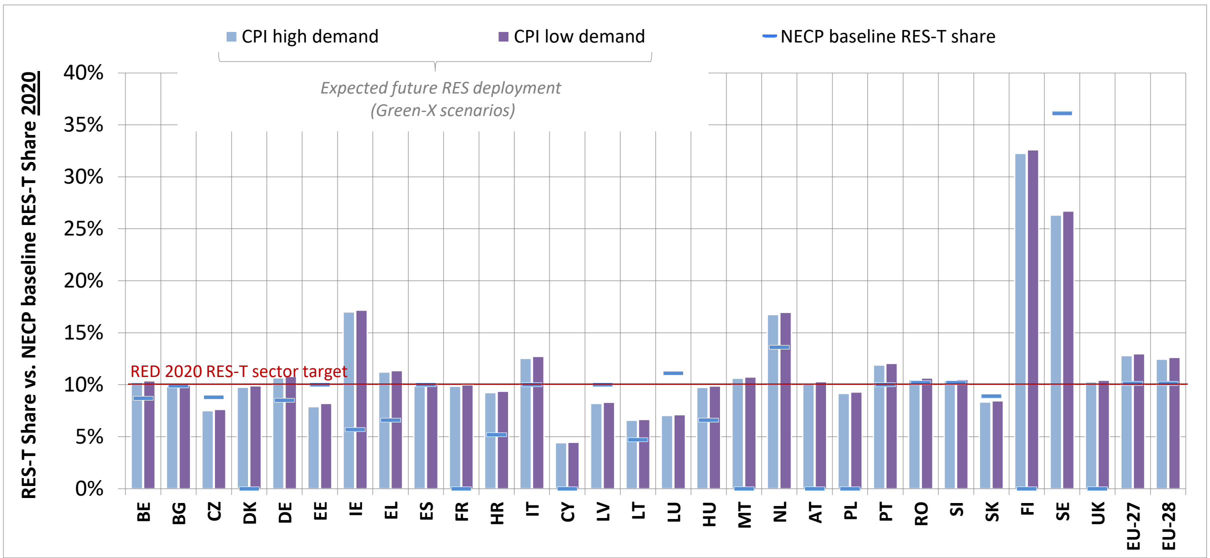

Figure 25. Expected RES-T share in 2020 vs. binding national RED RES-T sector target and NECP baseline (%)

The expected[42] and the planned (i.e. the planned contributions as specified in the NECP baselines) 2020 progress of RES in the transport sector is compared in Figure 25, showing RES-T deployment in relative terms. That is the RES-T share or, more precisely, the RES share in the final consumption of energy in transport. Please note that the calculation of RES-T share in the RED and the REDII differ, bringing an uncertainty in the comparisons presented in this section. Please see Article 3 (4) in the RES Directive for the detailed description of the calculation of the RES-T share (as applied for the modelling resulting in the values for the 'expected RES-T shares').

Deviation from 2020 RED RES-T sector target and NECP baselines (planned contributions)

Complementary to above, Figure 26 and Figure 27 illustrate the deviation of expected RES-T deployment from the required (i.e. the binding RED RES-T sector target of 10%, cf. Figure 26) or the

[42] Modelled RES-T deployment represents a combination of modelled biofuel deployment, done by use of the Green-X model, and an extrapolation of historic trends concerning electricity use in transport that builds on the historic record.

planned one (i.e. the planned contribution as specified in the MS NECP baselines, cf. Figure 27).[43] More precisely, for 2020 both graphs indicate the deviation under business-as-usual conditions, taking into account only currently implemented policy initiatives. Uncertainty related to the development of 2020 energy demand is reflected, illustrating lower (i.e. CPI high demand) and upper levels (CPI low demand) of expected RES-T shares caused by reverse trends in corresponding transport consumption.

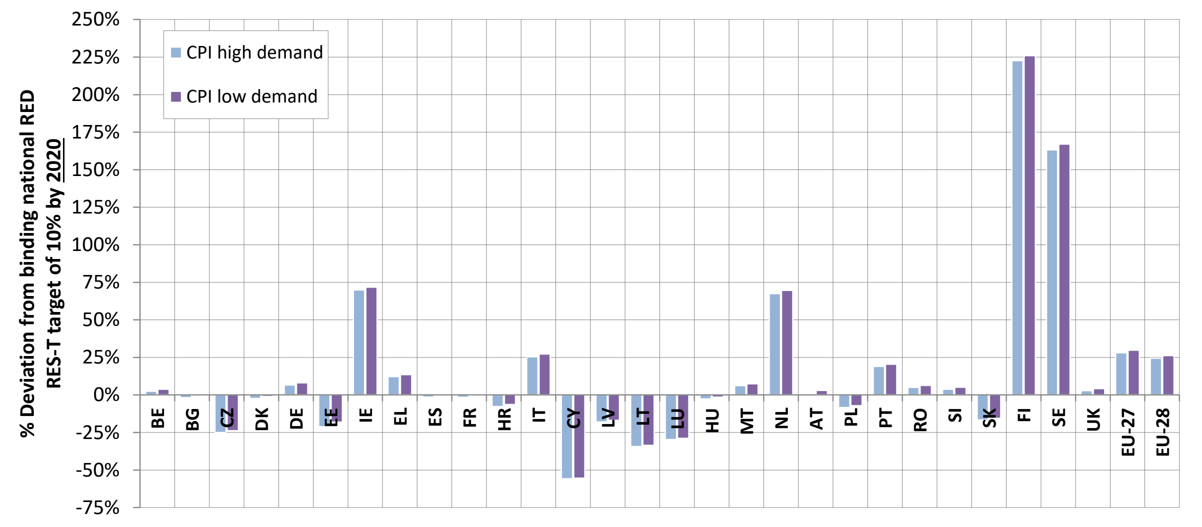

Figure 26. Deviation of expected RES-T shares (Green-X scenarios) from binding national RED RES-T sector target (10%) by 2020

As visible from Figure 26, by 2020 13 of 27 MS are expected to meet (and over-succeed) the binding RED RES-T sector target under all assessed circumstances. On the top of the list is Finland, followed by Sweden, Ireland, the Netherlands, Italy and Portugal. All of these MS show a relative surplus larger than 20% compared to the given sector target. Other MS where RES-T target achievement appears likely are Belgium, Germany, Greece, Malta, Austria, Portugal, Romania and Slovenia. At EU-27 (EU-28) level, a relative surplus of 28.6% to 30.4% (24.5% to 26.2%) can be expected. Of the remaining 14 MS, Bulgaria, Denmark, Spain, France and Hungary can be classified as maybe reaching their target in the low demand case or 'just' missing their 10% target. Their deviations from the binding national RED RES-T target of 10% reach from 0.0% to -2.7% depending on the final energy demand in the transport sector in 2020. All other 9 remaining MS are clearly not successful in meeting their binding RED RES-T sector target. Top of the list (of negative ranking) is Cyprus, followed by Lithuania and Luxembourg – all with deficits larger than 25%. Finally, a RES-T target achievement also appears unlikely for Czechia, Estonia, Latvia, Slovakia, Croatia and Poland – but here the gap to the given RES-T target is smaller in magnitude.

[43] Please note that the RES-T shares are calculated in a slightly different manner in the REDII compared to RED, which could influence the comparison with the NECP baselines.

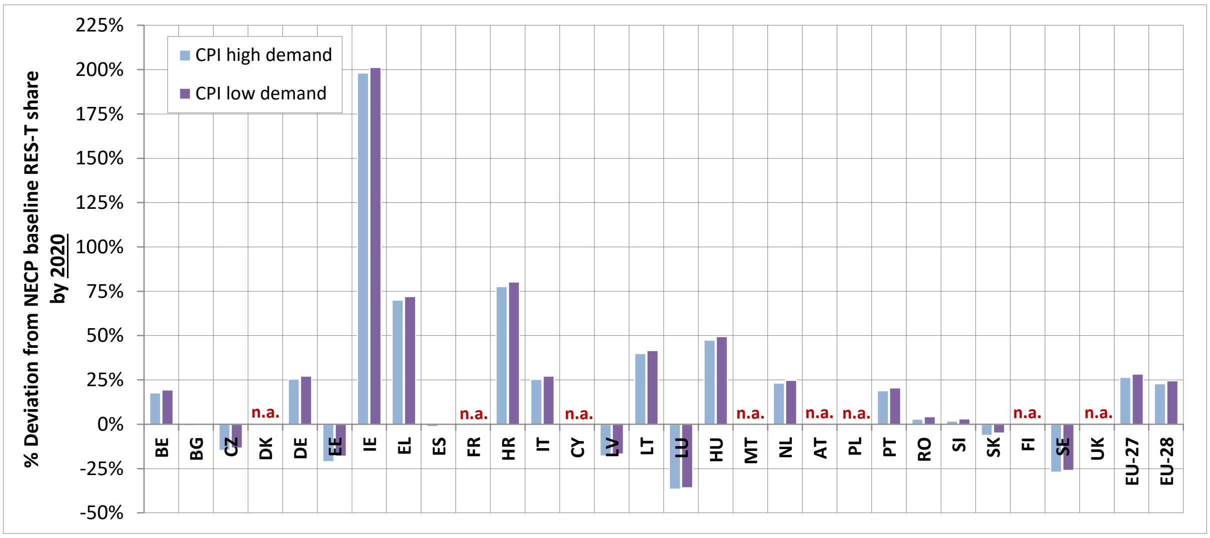

Figure 27. Deviation of expected RES-T shares (Green-X scenarios) from NECP baseline by 2020

The full references for the literature as referred to in this chapter can be found in Appendix B.

4. RECOMMENDATIONS

At the time of writing of this report, there were only a few months left in 2020.[44] Thus, the options for MS to close potential gaps to 2020 RES target achievement are limited. Two short-term solutions are still theoretically available:

- **Make use of cooperation mechanisms**: MS that are at risk of missing their 2020 target should consider the use of cooperation mechanisms and in particular statistical transfers (i.e. buying renewable energy from MS that exceed their targets).

- **Increase the share of biofuels, especially of advanced biofuels**: Another possibility for MS would be to increase the share of biofuels (although increasing a quota obligation might not be so quickly to transfer to fuel suppliers. Double-counting based on advanced biofuels could be an option to increase RES in transport.

Out of these options, statistical transfer seems to be most realistic.

In addition, it has been proposed that the **Renewable Energy Financing Mechanism** introduced in the Governance Regulation, which serves as a gapfiller for the national trajectories towards the EU 2030 RES target, may be used as gapfiller towards the 2020 baseline requirement. It is not clear whether this would include the 2020 target achievement. In the latter case, i.e. if the Financing Mechanisms could be used to close a 2020 target gap, this could be a third short-term solution for national 2020 RES target achievement. However, the related Implementing Act is still under consultation, so this option is still hypothetical.

Based on the 2020 projections displayed in Table 10 of section 3.2.1.2, Belgium, France and Poland are likely to miss their 2020 RES targets without the use of cooperation mechanisms (statistical transfers) while Luxembourg and the Netherlands are expected to reach their targets in the strong cooperation scenario. The reasons for the deficits vary. Judging from the 2018 trajectories, Belgium has only a small gap, but is lagging in RES-H&C as well as RES-T (although for the latter the projections suggest that they will catch up with their 2020 target). France has a substantial gap in RES-H&C, while Luxembourg is behind in RES-E. Netherlands are far behind in RES-E, but also lagging in RES-H&C. Poland is lagging behind in RES-E and has a substantial gap in RES-T.

The deviations to the overall RES targets set out in Directive 2009/28/EC range from 4.8% to 14.6% for the five MS, see Table 13 below. The combined gap of the five countries is estimated to be around 35,923 to 38,997 ktoe, while the total surplus in EU-27 is estimated to be around 71,068 to 80,522 ktoe (including the negative deviations). Thus, it is theoretically feasable for the five MS to reach their 2020 RES targets through cooperation mechanisms.

[44] Please note that there was an update to this report beginning 2021, at which moment statistical transfer is actually the only option possible.

Table 13. Excerpt of Table 10 - Expected and required RES shares in 2020 including cooperation mechanisms

RES share in gross final energy demand by 2020 - with impact of RES cooperation	**Expected share 2020**	**RES (CPI scenario)**	**RED target share 2020**	**Deviation of expected from RED target RES share (CPI scenario)**		**Absolute deviation of expected from RED target RES share (CPI scenario)**	
	Min.	**Max.**		**Min.**	**Max.**	**Min.**	**Max.**
Member State	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[ktoe]**	**[ktoe]**
Belgium	12.5%	12.6%	13.0%	-3.8%	-3.1%	-162	-127
France	19.3%	19.5%	23.0%	-16.2%	-15.4%	-5,065	-4,697
Luxembourg	9.8%	11.3%	11.0%	-10.5%	2.9%	-43	12
Netherlands	13.1%	14.7%	14.0%	-6.4%	4.9%	-410	306
Poland	14.2%	14.3%	15.0%	-5.7%	-4.9%	-598	-510
Sum of deviation for the five MS						-6,278	-5,016
EU-27	22.4%	22.6%	20.0%	11.8%	13.0%	16,173	18,117
EU-28	21.5%	21.8%	20.0%	7.6%	8.8%	16,170	18,362

To ensure target achievement in 2020, we thus recommend to make greater use of the statistical transfer as short-term solution. This is especially relevant for Belgium, France and Poland. It is important to note that this does not serve as alternative to RES development in the mid- to long-term.

5. Conclusions

Progress in deploying renewable energy sources in the EU and the Member States

At an EU-level, the shares of renewable energy sources (RES) in total, electricity (RES-E), heating and cooling (RES-H&C), and to a lesser extent also transport (RES-T) have been continuously increasing over the past years. In 2019, the EU reached a share of 18.9% of RES in gross final energy consumption, the target for 2020 being 20% as defined in the RES Directive 2009/28/EC (RED).

Regarding the indicative trajectory set in the RES Directive, defined as the average values of 2011/2012, 2013/2014, 2015/2016, 2017/2018 and 2019/2020, respectively, the EU-28 has been comfortably above up to 2018 and the overall RES share in 2019 stays between the indicative RES Directive trajectories set for 2017/2018 and 2019/2020.

However, the EU as a whole was slightly below the aggregated more ambitious trajectory defined by the MS themselves in their NREAPs in 2018 (by 0.1%). In 2019, the difference between the actual deployment and planned NREAP trajectory increased to 0.4%. With regard to individual sectors, the RES-E and the RES-H&C sectors are well on track, resulting from the especially high contributions on the "higher than planned" generation of RES-E from photovoltaics and use of heat pumps in the RES-H&C sector. Meanwhile, the RES-T sector stays below the planned share (8.9% actual versus 9.04% planned) resulting from the "lower than planned" RES consumption for all energy sources.

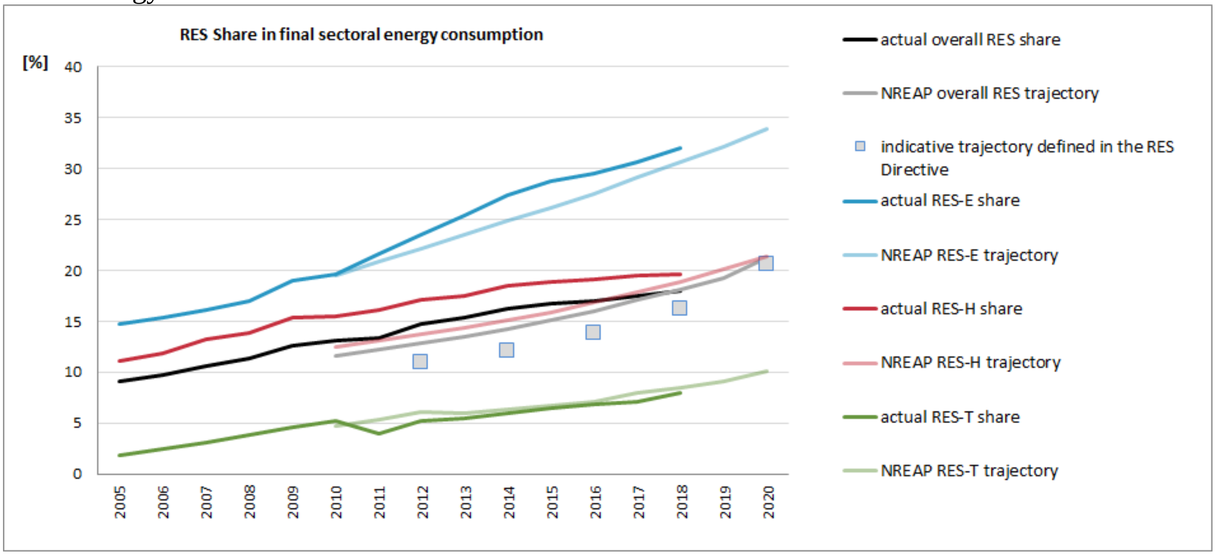

Figure 28. Actual and planned RES shares for the EU-28 (%). Source: Eurostat, NREAPs

When looking at RES deployment in 2018, 23 MS are above their indicative RED trajectory for 2017/2018. Only Ireland, France, the Netherlands, Poland and Slovenia are below their indicative RED trajectories. The largest positive deviations from their indicative RED trajectories can be observed in Croatia, Bulgaria, Czech Republic and Italy.

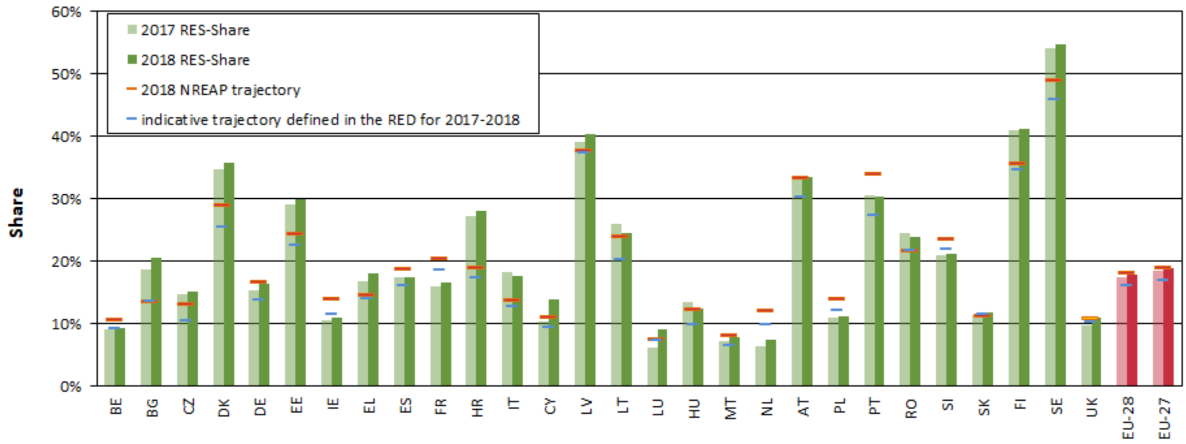

Figure 29. Actual renewable energy shares in 2017 and 2018 compared to indicative trajectories set in RES Directive and NREAP. Source: Eurostat[45]

For RES-E, the most common support schemes used by MS to stimulate RES deployment in 2017 and 2018 were premium and feed-in tariffs, the former often combined with tendering systems (auctions). However, also quota schemes, tax incentives, net-metering, investment grants and loans have been applied to support the development of renewable electricity generation. Almost all MS operate at least two support schemes to support different technologies, installation sizes and actors more specifically and needs-based. In the period 2017/2018, the shift from administratively set feed-in tariffs to feed-in premiums continued. While many MS had already changed their remuneration for new installations between 2014 and 2016, Bulgaria and Slovakia followed in 2018 and 2019 respectively[46]. The most prominent trend in support schemes in 2017 to 2020 was the continuous shift towards RES auctions. By July 2020, 18 MS determine the support levels for (larger) RES-E installations in a competitive bidding process. Most MS chose to implement technology-specific auctions rather than technology-neutral or multi-technology auctions.

The most commonly applied form of support for RES-H&C are investment grants. This form of subsidy was available in 24 MS during 2017 to 2018. Other forms of commonly provided support for RES-H&C are tax deductions and feed-in premiums. The support instruments that are in place usually apply to a broad range of technologies. The most popular technology are biomass plants. In addition, commonly supported technologies are geothermal, aerothermal and hydrothermal heat pumps as well as solar thermal plants.

The predominant support scheme for RES-T in the EU is a biofuel quota obligation. By 2020, some form of obligation scheme has been the main RES-T policy measure in all MS. 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.

[45] Quantitative assessments for Malta in this report are based on the National Renewable Energy Action Plan submitted in 2012. Malta submitted a new NREAP in June 2017.

[46] Please note that in the case of Slovakia, the planned tender scheme has been introduced by the new RES Act in 2019. However, the auctions have been postponed due to the COVID19 pandemic.

Most of the schemes applied by MS have an increasing quota, often targeting a 10% share by 2020. Germany and Sweden do 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[47] biofuels and a sub-target for advanced biofuels.

Feasibility of 2020 target achievement considering current progress

A comparison of expected with planned RES deployment by 2020 indicates that the EU would succeed in meeting its binding RED 2020 RES target: At EU-27 (EU-28) level a RES share of 22.4% to 22.6% (21.5% to 21.8%) can be expected with currently implemented RES policy initiatives[48]. The majority of MS is expected to perform well in meeting their binding RED 2020 RES targets. When not including the statistical transfers, 21 of the assessed 27 MS, including Bulgaria, Czechia, Denmark, Germany, Estonia, Greece, Spain, Croatia, Italy, Cyprus, Latvia, Lithuania, Hungary, Malta, Austria, Portugal, Romania, Slovenia, Slovakia, Finland and Sweden, may succeed in (over)fulfilling their binding RED 2020 RES targets with implemented RES policies under the given special circumstances of today (2020) – i.e. the significant drop in energy consumption driven by the COVID-19 pandemic during the first half of 2020. The UK was also included in the assessment and will most likely reach its RED 2020 RES target. For the remaining 6 MS, Belgium, Ireland, France, Luxembourg, the Netherlands and Poland, currently implemented RES policy initiatives appear insufficient to trigger the required RES volumes to reach their binding 2020 RES targets purely domestically, despite the strong decline in energy consumption projected for 2020.

Planned 2020 RES deployment as indicated in the NECP baselines is in the majority of MS higher[49] than their binding RED 2020 RES targets. 22 MS are expected to meet their planned NECP baseline of RES in gross final consumption of energy in 2020. Belgium and Ireland are expected to overachieve their NECP baseline which is, however, lower than the respective country's RED 2020 RES target. On the contrary, for Denmark an achievement of its own NECP baseline planning concerning overall RES deployment appears unlikely under the given circumstances, despite its ability to meet its significantly lower binding national RES obligation.

Until now, seven cooperation agreements on the statistical transfer of renewable energy were signed. Five MS act as buyers of statistical transfers while three MS act as sellers. Including the details from the agreed statistical transfers, the picture changes for all affected MS that are at risk of not reaching their 2020 RED target. The gap in meeting their binding national 2020 RES target is significantly reduced for the offtaker countries Belgium, Ireland, Luxembourg, Malta and the Netherlands. For Belgium, the amount of statistical transfer agreed upon with Denmark (1.8 TWh) will not suffice to close the gap to its RED target RES share of 13%. It is expected that a gap of 1.5 to 1.9 TWh to its 2020 RED target will remain, depending on the gross final consumption of energy and renewable energy deployment in 2020. For Ireland, it is expected that the statistical transfer with Denmark and Estonia of 3.5 TWh will be sufficient to reach its RED target RES share of 16% in 2020. According to our assessment a statistical transfer of 0.9 to 1.4 TWh would suffice for Ireland to reach its 2020 RED target RES share. For Luxembourg it appears likely that the 2020 RES target can be met thanks to its proactive behaviour in setting these political agreements with Estonia (400 GWh plus 600 GWh optional) and Lithuania (700 GWh) under the assumption of strong cooperation (of at least 1.63 TWh). For Malta it appears that, according to the results of our assessment, the country does not need any of the

[47] Biofuels produced from 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.
[48] Note that the range indicates the uncertainty related to key input parameter for the model-based assessment of future RES progress. Remarkably, this year's (2020) energy demand drop as a consequence of the COVID-19 pandemic, and corresponding (comparatively small) changes in RES supply play a decisive role in this respect.
[49] Adding up planned performance as specified by MS's in their NECP baselines for 2020 leads to a RES share of 21.0% (21.7%) for the EU-28 (EU-27), similar to the binding RED 2020 RES target of 20% measured as RES share in gross final energy consumption.

agreed statistical transfers to reach its RED 2020 RES target (due to the decline in energy consumption in 2020). For the Netherlands the projection appears less optimistic but still the 2020 RES target can be met under the assumption of strong cooperation with Denmark (i.e. a statistical transfer of at least 13.6 TWh should suffice for that purpose, compared to 16 TWh possible according the contractual agreements taken in prior) in combination with both assumed energy demand projection for 2020.

A closer look at sectorial RES deployment is taken below, comparing expected RES deployment with NECP planning for 2020.

Within the electricity sector, by 2020 15 MS (out of the 21 MS that have transparently specified their NECP baseline RES-E shares in 2020) will be able to meet (and over-succeed) their RES-E deployment as planned in the NECPs under all assessed circumstances. Top of that list is Greece, followed by Estonia, Croatia, Bulgaria, Poland, Czechia, Germany, Ireland, Sweden, Luxembourg, Slovenia, Slovakia, Hungary, Spain, and Romania. The remaining six MS that have also specified their planned baseline RES-E share in their NECP can be classified as not successful in planning their 2020 progress with respect to renewable electricity. Top of that list (of negative ranking) is the Netherlands, followed by Lithuania, with deficits larger than 20%. The remainder of MS, i.e. Latvia, Malta, Portugal, and Belgium, shows a smaller deficit in expected vs (NECP) planned RES-E shares for 2020.

For the H&C sector a comparatively similar picture occurs: The large majority of MS (i.e. 15 out of 19 MS that have specified their planned RES-H&C share for 2020) are on track or have even over-accomplished their planned 2020 RES-H&C share (as specified in their NECP baselines). The strongest progress ahead of the trajectory is expected for Slovakia, Portugal and Malta, all showing a deviation of more than 25% when comparing expected and planned RES-H&C shares. Other MS that clearly overfulfil their plans (i.e. with a deviation higher than 10% but below 25%) are Belgium, Bulgaria, Czechia, Spain and Croatia. The other MS (Germany, Estonia, Greece, Latvia, Lithuania, Hungary and Sweden) have planned realistic 2020 RES-H&C shares in their NECPs – i.e. here deviations between expected and planned deployment are smaller than 10%, but not below the planned contribution. Contrarily, Ireland, Luxembourg and Slovenia fall more than 5% short of their planed RES-H&C share in 2020. An insignificant deviation between planned and excepted deployment is expected for Romania, here the gap amounts to approximately 1%.

In transport, by 2020 13 of 27 MS are expected to meet (and exceed) the binding RED RES-T sector target under all assessed circumstances. On top of that list is Finland, followed by Sweden, Ireland, the Netherlands, Italy and Portugal, all showing a surplus larger than 20% compared to the given sector target of 10% by 2020. Other MS where RES-T target achievement appears likely are Belgium, Germany, Greece, Malta, Austria, Portugal, Romania and Slovenia. At EU-27 (EU-28) level a surplus of 28.6% to 30.4% (24.5% to 26.2%) can be expected. Of the remaining 14 MS, Bulgaria, Denmark, Spain, France and Hungary can be classified as maybe reaching their target in the low demand case or ‘just’ missing their 10% target. Their deviations from the binding national RED RES-T target of 10% reach from 0.0% to -2.7% depending on the final energy demand in the transport sector in 2020. All other 9 remaining MS are clearly not successful in meeting their binding RED RES-T sector target. Top of that list (of negative ranking) is Cyprus, followed Lithuania, Luxembourg – all with deficits larger than 25%. Finally, a RES-T target achievement appears also unlikely for Czechia, Estonia, Latvia, Slovakia, Croatia and Poland – but here the gap to the given RES-T target is smaller in magnitude.

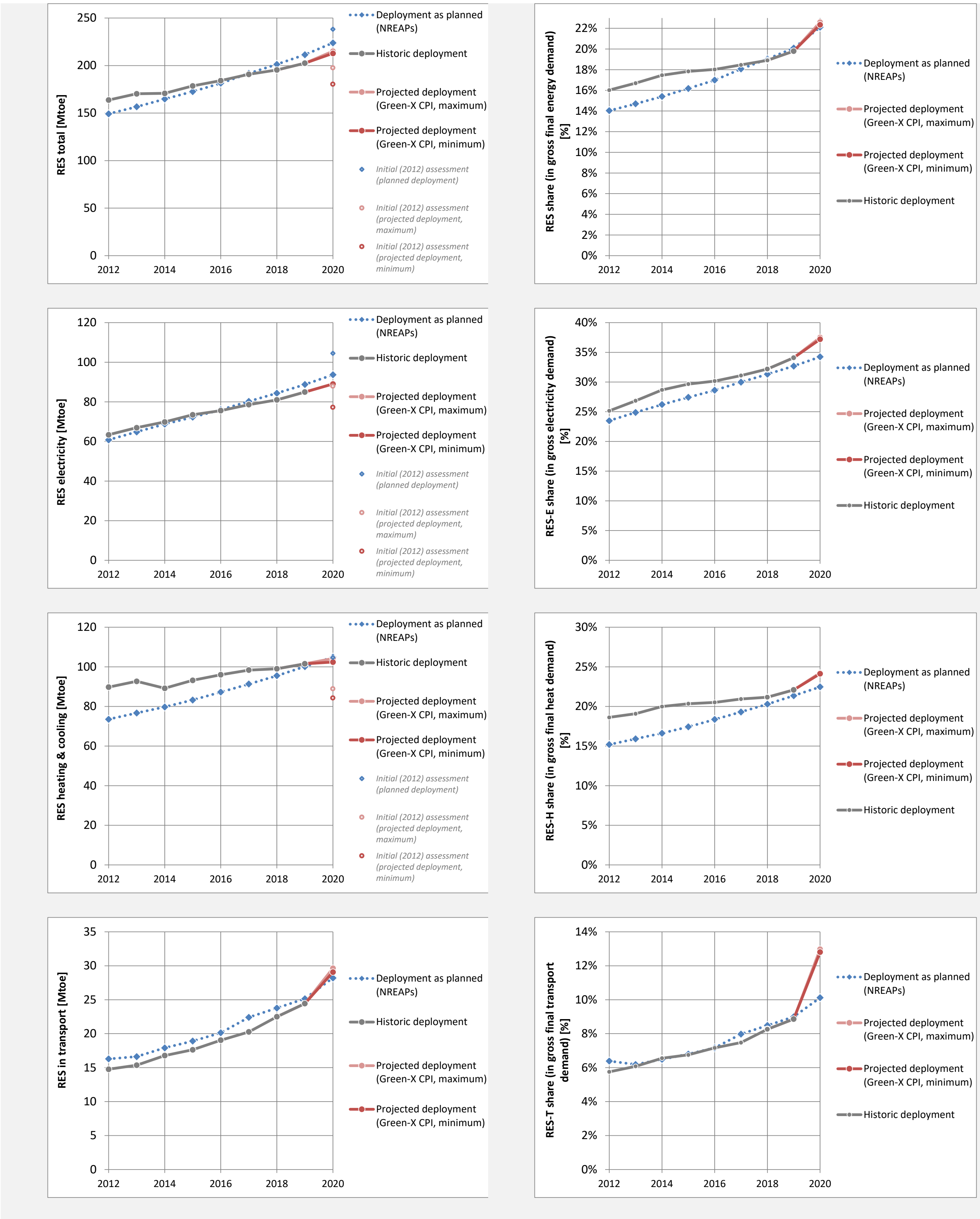

Figure 30. Historic, expected and planned sector-specific RES deployment at EU-level (EU-27) by 2018, 2019 and 2020 in absolute terms (Mtoe, left) and in relative terms (as RES share in corresponding demand, right)

APPENDIX A QUANTITATIVE PROGRESS OF MEMBER STATES

This section displays the progress of the MS in RES deployment in quantitative terms. It is split into three sectors, RES-E, RES-H&C and RES-T, and provides for each sector an overall view as well as a detailed table on progress by technologies. The graphs depicting the progress by technologies, NREAP tables 10, 11, and 12, are compared to corresponding deployment data of Eurostat Energy Balances and Eurostat SHARES by technologies. In previous years, NREAP progress reports have been used, while this year the analysis relies solely on Eurostat data as they provide a consistent and complete overview and is more suitable to draw conclusions of the progress. Differences between these two data sources, which point out a different trend on the progress, are marked in the text or in footnotes.[50] Each graph also includes an EU-28 figure as well as an EU-27 figure. The EU-28 and EU-27 figures are obtained from summing the individual MS' commitments. Note that there is no formal separate commitment to 2019 NREAP RES targets or to 2017/2018 indicative interim trajectory on EU level.

A.1 RES-E sector overview

Figure 31 shows that the trend of the last years is continuing, and the deployment of RES-E technologies mainly relying on wind and PV as well as on solid biomass has further increased. In 2019, they contributed together significantly more than the established hydropower, accounting for roughly 694 TWh of electricity produced, compared to a total of 333 TWh for hydro (not normalised). Apart from hydro, onshore wind held the largest share in RES-E technologies with 359 TWh produced in 2019 (not normalised), followed by PV with 133 TWh, solid biomass with 130 TWh, offshore wind with 72 TWh, and biogas with 63 TWh. Geothermal electricity (7 TWh), solar CSP (6 TWh) and bioliquids (5 TWh) played minor roles in the RES-E mix.

[50] Note: In the figures showing the deviation of actual generation from NREAP indicative trajectory, those MS with 100% deviation have not yet reported any production/consumption for the respective technology, although it had been planned in the NREAP.

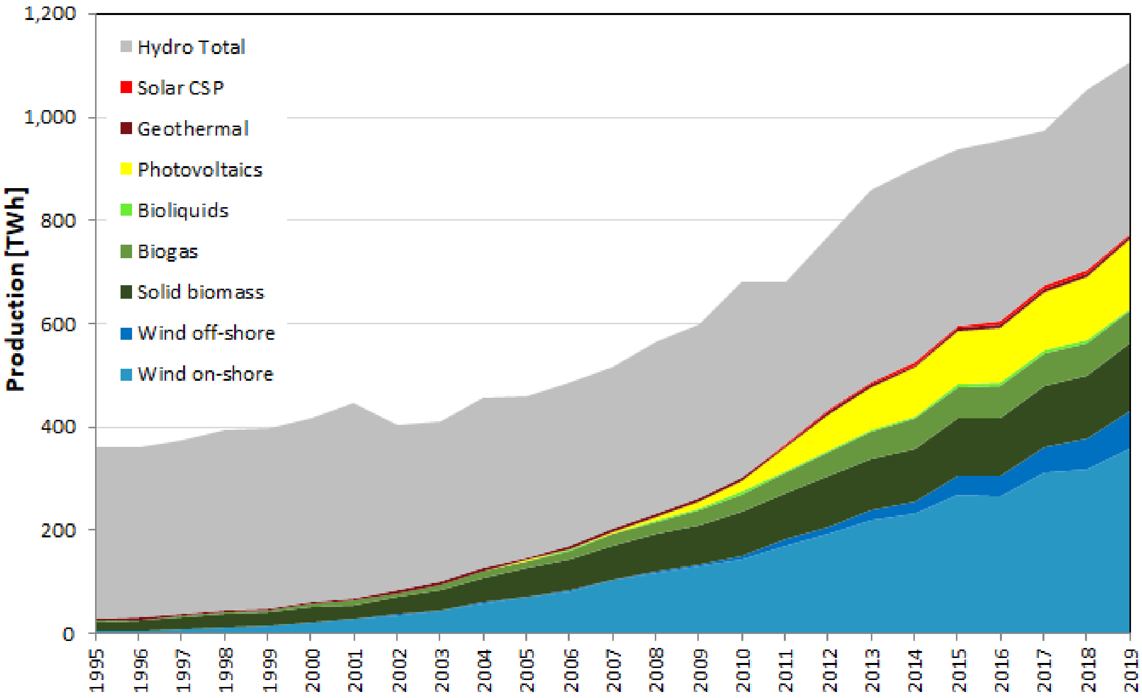

Figure 31. Production of electricity from RES-E technologies in the EU-28 for 1995-2019.[51] Source: Results are based on Eurostat Energy Balances

The following graphs display the progress in RES-E deployment of the individual MS. Sixteen MS had a RES-E share lower than envisaged in their NREAP indicative trajectories for 2018. In 2016 and 2012, a similar number of MS (15 MS), while in 2014 only 10 MS were below their NREAP indicative trajectories. Most of the MS who display lower shares than their NREAP indicative trajectories, only lag behind their NREAP RES targets slightly. Therefore, both EU-28 and EU-27 as a whole exceed the share as planned in the NREAPs of the MS.

In 2019 as well as in previous years, Austria had the highest RES-E share of 75% among all MS, followed by Sweden (71%) and Denmark (65%). All of them stayed above their NREAP indicative trajectories (see Figure 32). On the contrary, Malta (8%), Cyprus (9.8%), Hungary (10%) and Luxemburg (10.9%) displayed low RES-E shares below their NREAP indicative trajectories. Malta had the lowest RES-E share of all MS.

As shown in Figure 33, the largest positive deviation from its planned RES-E share as set in its NREAP can be observed in Estonia (+40%) and Italy (+37%), followed by Croatia (+28%), Denmark (+26%) and the UK (+24%). The largest negative deviations was reported in the Netherlands (-46%), followed by Cyprus (-31%) and Malta (-26%). Although the Netherlands have deviated the most from its NREAP trajectory among all MS in 2019, less deviation from its NREAP trajectory than in 2018 and an increase in RES-E share of +3% from 2018 to 2019 can be observed. This is a result of strong growth of electricity generation with PV and solid biomass from 2018 to 2019. Both at EU-28 level and at EU-27 level, there are more positive deviations in 2019 than in 2018. Without the contribution of the UK, the EU-27 has a lower positive deviation (+4.3%) than the EU-28 (+6.1%).

[51] Data for wind and hydro are not normalised according to procedures in the RES Directive and may thus differ from the values shown in the table below. Hydro shown here is hydro non-pumped. Solid biomass includes primary solid biofuels and renewable municipal waste.

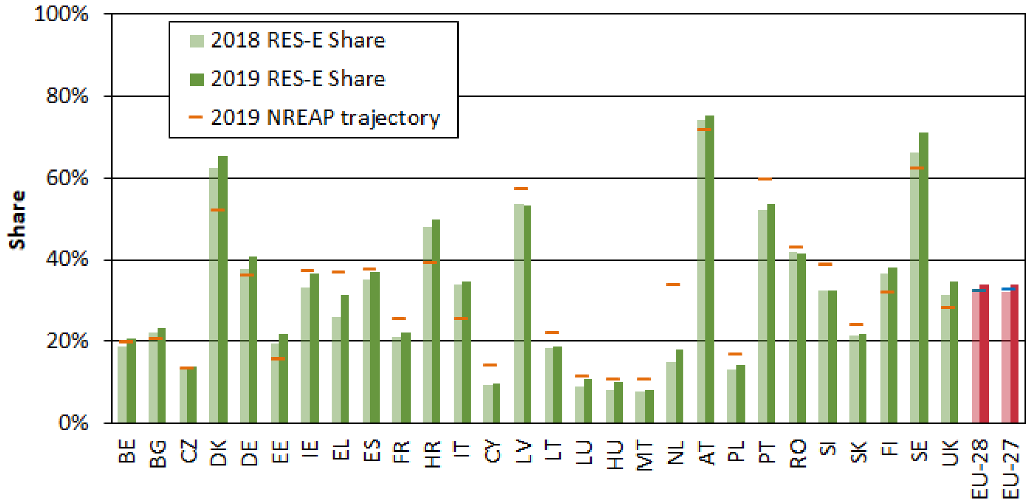

Figure 32. RES-E actual share vs. NREAP indicative sectoral trajectory in 2019 (%). Source: Eurostat SHARES and NREAPs

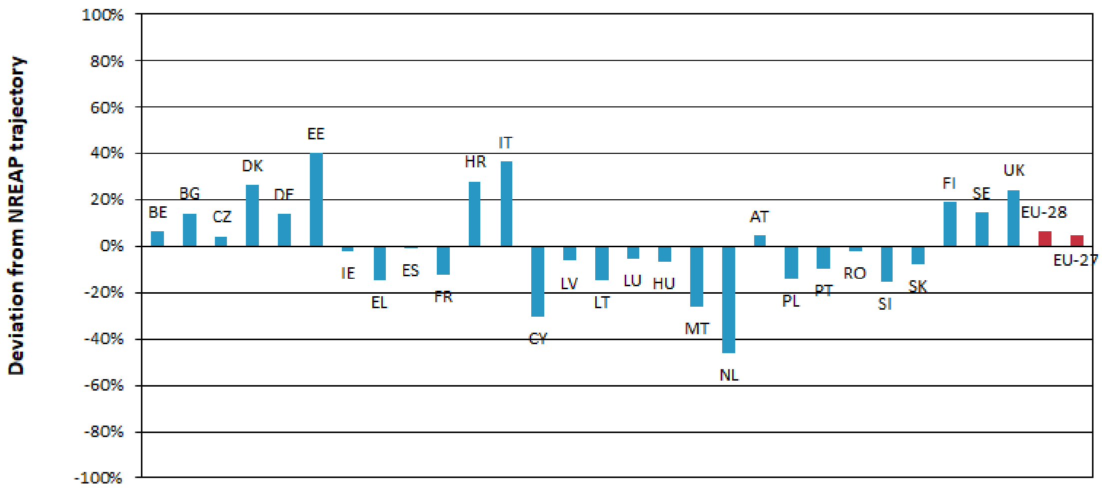

Figure 33. Deviation of actual 2019 share from 2019 NREAP indicative sectoral trajectory for RES-E. Source: NREAPs and Eurostat SHARES

The following two tables show the growth rate of major RES-E technologies from 2018 to 2019 as well as their absolute values in 2019. Wind onshore showed the highest growth in absolute numbers between 2018 and 2019 both for the EU-28 and the EU-27, followed by wind offshore for the EU-28 and PV for the EU-27, Wind onshore is the largest RES source apart from hydropower on EU level. Offshore wind, however, was the fastest-growing technology in 2019, followed by solar CSP and PV. Solid biomass ranked third regarding its generation as part of total RES-E generation. For PV, very high growth rates can be observed in some individual MS since 2015, such as Estonia, Ireland, Latvia, Poland or Finland, which have still low levels of PV deployment. Hydropower remains the largest source of renewable energy, mainly due to investments made before 2000, while growth over the last decade has been only minimal.

Table 13. Growth of RES-E technologies from 2018-2019. Source: Eurostat SHARES & Eurostat Energy Balances. – Normalised data for wind and hydro

Member State	RES-E [%]	Offshore wind [%]	Onshore wind [%]	Solid biomass[%]	Biogas [%]	Bioliquids [%]	Photovoltaics [%]	Hydro [%]	Geothermal [%]	Concentrated solar power [%]	Tide, wave, ocean [%]
Belgium	10.76	35.53	12.35	-5.15	0.23	-3.77	8.82	-3.01	-	-	-
Bulgaria	3.22	-	-0.14	16.86	8.68	-	7.42	-1.53	-	-	-
Czech Republic	2.02	-	9.15	12.72	-3.03	-	-2.01	-0.39	-	-	-
Denmark	4.45	12.23	2.43	0.75	3.72	-100.00	1.08	1.28	-	-	-
Germany	4.46	20.94	6.47	-2.40	-0.63	-12.17	1.33	0.69	10.67	-	-
Estonia	4.36	-	-0.27	4.32	2.22	-	138.62	-20.66	-	-	-
Ireland	11.62	-	13.45	0.38	0.66	-	28.18	2.44	-	-	-
Greece	12.11	-	20.06	105.13	24.96	-	16.83	-1.45	-	-	-
Spain	4.20	-	5.39	-6.45	-2.06	8.33	19.59	-1.91	-	16.77	-
France	4.86	-	13.15	0.80	9.19	-8.59	12.25	-0.17	1.19	-	-0.20
Croatia	2.60	-	6.24	52.36	13.05	-	10.95	-2.18	4495.00	-	-
Italy	2.56	-	6.80	0.71	-0.28	9.00	4.57	0.54	-0.50	-	-
Cyprus	5.94	-	3.83	-	1.80	-	9.41	-	-	-	-
Latvia	-1.15	-	-0.36	0.96	-5.79	-100.00	146.43	-1.08	-	-	-
Lithuania	2.87	-	6.35	-6.03	10.36	-	5.20	-1.51	-	-	-
Luxembourg	16.13	-	16.19	45.46	-5.63	-	8.90	0.10	-	-	-
Hungary	21.10	-	1.39	-2.80	-5.36	-	138.00	1.09	50.00	-	-
Malta	10.22	-	0.00	-	-28.53	-	12.07	-	-	-	-
Netherlands	18.11	0.83	7.36	33.52	0.90	-	43.84	-1.47	-	-	-
Austria	1.28	-	8.96	-3.91	-2.62	112.50	16.97	0.18	-16.32	-	-
Poland	9.31	-	4.28	20.81	0.66	-2.60	136.51	-0.17	-	-	-
Portugal	1.90	-	1.64	7.43	-2.55	-	33.44	-1.50	-6.52	-	-
Romania	-0.04	-	1.66	22.72	-23.32	-	0.37	-1.16	-	-	-
Slovenia	0.61	-	5.18	6.42	-20.60	-17.03	18.86	-0.02	-	-	-
Slovakia	1.30	-	3.03	6.72	-0.93	-	0.68	0.30	-	-	-
Finland	1.78	8.34	8.92	3.55	-13.47	-63.92	63.20	-2.23	-	-	-
Sweden	4.67	-1.01	15.32	9.59	70.00	-38.46	66.83	0.69	-	-	-
UK	9.17	21.46	5.97	9.12	-1.61	-	1.43	1.42	-	-	50.47
EU-28	**4.93**	**19.75**	**7.43**	**5.32**	**-0.32**	**6.18**	**7.90**	**-0.21**	**1.06**	**16.77**	**0.76**
EU-27	**4.45**	**18.42**	**7.58**	**4.24**	**-0.14**	**6.18**	**8.65**	**-0.23**	**1.06**	**16.77**	**-0.20**

Table 15. RES-E generation in the EU-28 and in EU-27 in 2019 per technology. Source: Eurostat SHARES & Eurostat Energy Balances. Normalised data for wind and hydro

Member State	RES-E [GWh]	Offshore wind [GWh]	Onshore wind [GWh]	Solid biomass [GWh]	Biogas [GWh]	Bioliquids [GWh]	Photovoltaics [GWh]	Hydro [GWh]	Geothermal [GWh]	Concen-trated solar power [GWh]	Tide, wave, ocean [GWh]
Belgium	19,165	4,772	4,603	4,223	947	71	4,247	302	0	0	0
Bulgaria	8,942	0	1,407	1,590	231	0	1,442	4,272	0	0	0
Czech Republic	10,221	0	651	2,504	2,528	0	2,312	2,227	0	0	0
Denmark	23,113	6,200	9,981	5,317	636	0	963	16	0	0	0
Germany	235,464	24,424	94,421	16,914	32,910	397	46,392	19,809	197	0	0
Estonia	2,150	0	687	1,324	39	0	74	26	0	0	0
Ireland	11,458	0	9,844	667	185	0	21	741	0	0	0
Greece	17,344	0	7,324	24	378	0	4,429	5,190	0	0	0
Spain	103,424	0	53,283	4,655	904	13	9,420	29,466	0	5,683	0
France	113,726	0	32,463	6,056	2,587	0	12,225	59,787	128	0	479
Croatia	9,353	0	1,403	477	401	0	83	6,897	92	0	0
Italy	115,520	0	19,142	6,609	8,277	4,677	23,689	47,052	6,075	0	0
Cyprus	502	0	225	0	58	0	218	0	0	0	0
Latvia	4,037	0	149	575	352	0	3	2,957	0	0	0
Lithuania	2,389	0	1,319	379	154	0	91	445	0	0	0
Luxembourg	753	0	241	206	71	0	130	104	0	0	0
Hungary	4,665	0	689	1,906	318	0	1,497	237	18	0	0
Malta	218	0	0	0	6	0	212	0	0	0	0
Netherlands	22,188	3,582	7,363	4,919	895	0	5,335	93	0	0	0
Austria	55,592	0	6,893	4,133	612	0	1,702	42,252	0	0	0
Poland	24,965	0	14,240	6,546	1,135	2	711	2,331	0	0	0
Portugal	29,646	0	12,814	3,099	264	0	1,342	11,910	215	0	0
Romania	25,501	0	6,749	450	54	0	1,778	16,470	0	0	0
Slovenia	5,089	0	6	151	94	5	303	4,528	0	0	0
Slovakia	6,613	0	6	1,159	534	0	589	4,324	0	0	0
Finland	33,762	241	5,652	12,926	363	2	147	14,429	0	0	0
Sweden	101,294	620	20,121	12,987	17	32	679	66,837	0	0	0
UK	119,128	31,463	32,405	29,734	7,569	0	12,918	5,026	0	0	14
EU-28	**1,106,221**	**71,303**	**344,082**	**129,531**	**62,521**	**5,200**	**132,953**	**347,730**	**6,726**	**5,683**	**493**
EU-27	**987,093**	**39,840**	**311,678**	**99,797**	**54,951**	**5,200**	**120,035**	**342,704**	**6,726**	**5,683**	**479**

Offshore Wind

Offshore wind was a costly RES technology in 2010, which is why many MS did not foresee any deployment in their NREAPs. Fourteen MS had planned some offshore wind electricity production by 2019, namely Sweden, Greece, Estonia, Latvia, the UK, Denmark, Belgium, Germany, the Netherlands, Ireland, Spain, Italy, Portugal and France. Of these, six have reported actual production. Additionally, Finland, which originally had not planned any offshore wind capacity, reported production as well. In absolute values, the UK had the highest electricity production from offshore wind in 2019 (31,463 GWh), followed by Germany (24,424 GWh) and Denmark (6,200 GWh). In absolute terms, significant amounts were additionally produced by Belgium and the Netherlands, while Sweden's contribution was small but clearly larger than Finland's generation of offshore wind power. Sweden and Denmark were on track while other MS seem to face challenges in deploying this technology (see Figure 34). Although offshore wind generation in Belgium, Germany and in the UK has increased, the growth of actual generation lagged slightly behind the planned NREAP trajectories. The needed lead time from policy planning to tendering, and from the tender to the installation of offshore wind power might have been underestimated, and thus explains partly the delay in some MS. Other challenges, which may explain the restrained deployment of offshore wind, are the competing uses of the sea as well as high uncertainties in planning and construction. In Greece there is currently neither any installed wind-offshore capacity nor a regulatory framework promoting the deployment of offshore. Reasons are very deep waters such that floating solutions are needed, which reveal quite some progress in recent years.[52] Collaborations have been taken off for studying the potential of floating offshore wind in Greece's sea area.[53] Moreover, the Greek government is currently considering a new legislative framework for offshore wind. The Greek wind energy association ELETAEN is running a consultation for this new framework.[54] Portugal and Italy face similar problems with respect to the depth of water. So far Portugal has no regulatory framework for wind-offshore but has financially supported the installation of a first floating offshore wind park (25 MW in 2020), which is a first step towards the use of wind resources on sea.[55] Similar, due to high costs and technological uncertainties, Italy has started the development of a floating wind power park (250 MW in 2020)[56], and Spain is also testing offshore and floating turbines (2019)[57]. In France, although it shows a delay, many wind offshore projects have been initiated, e.g. a floating wind turbine has been launched (2 MW in 2018)[58], the installation of a 480 MW (2020) wind offshore park has started[59] and a floating turbine contract (28 MW 2020) was signed[60]. Overall, it has a total of six approved offshore projects (2020, 2.6 GW)[61] pointing to a strong deployment in the future.

Because of these delays, both the EU-28 and the EU-27 as a whole still lag behind the NREAP trajectories. However, due to technological progress and the decrease in technology costs of offshore wind turbines - they have halved within the last 6 years globally[62] - the offshore wind deployment is expected to take-up speed after 2020. The decrease in technology costs is mirrored in recent auction results, e.g. bids in the UK ranging around 40€/MWh in 2019.[63] Auction results in Germany, Denmark and the Netherlands underpin this development as well. The Netherlands had tendered offshore wind projects without subsidies, but the costs of the grid connection are covered by the government. Main

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[52] https://www.windpowermonthly.com/article/1678282/steady-outlook-wind-sector-record-year-greece
[53] https://www.offshorewind.biz/2020/03/04/greeks-studying-floating-offshore-wind-potential/
[54] https://windeurope.org/newsroom/news/offshore-wind-is-coming-to-greece

[55] https://www.windbranche.de/news/nachrichten/artikel-36876-schwimmender-offshore-windpark-vor-portugal-in-betrieb
[56] https://www.evwind.es/2020/06/19/italy-begins-the-first-floating-wind-power-plant-in-the-mediterranean/75240
[57] https://www.windpowermonthly.com/article/1691595/first-floating-turbine-online-off-mainland-spain and https://www.offshorewind.biz/2019/03/18/spains-first-offshore-wind-turbine-goes-operation/
[58] https://www.offshore-windindustrie.de/news/nachrichten/artikel-36258-offshore-windpark-in-frankreich-geht-in-die-nchste-runde
[59] https://www.offshore-windindustrie.de/news/nachrichten/artikel-36258-offshore-windpark-in-frankreich-geht-in-die-nchste-runde and https://www.offshore-windindustrie.de/news/nachrichten/artikel-36779-startschuss-fr-franzsisches-offshore-wind-grossprojekt-fcamp
[60] https://www.offshore-windindustrie.de/news/ticker/frankreich-mhi-vestas-erhaelt-zuschlag-fuer-schwimmendes-offshore-projekt-artikel1911
[61] https://www.offshore-windindustrie.de/news/nachrichten/artikel-36525-frankreich-schliesst-14-atomkraftwerke-und-setzt-auf-erneuerbare-energien
[62] BNEF 2018, Beyond the Tipping Point. Flexibility gaps in future high-renewable energy systems in the UK, Germany and Nordics.
[63] BEIS 2019, Contracts for Difference Allocation Round 3 Results, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/915678/cfd-ar3-results-corrected-111019.pdf

drivers of this cost decline have been new developments of e.g. turbines, advances in offshore supply chain, new designs and business models and low capital costs. Furthermore, there is an increasing number of offshore developers in the (EU) market, giving evidence of a growing industry and market competition in this area. Therefore prices are expected to reduce under further pressure. Nevertheless, offshore wind technology risks are still considered high compared to onshore wind. In many MS, these risks were recently subject of debates as support systems were adapted, e.g. in Germany (new EEG 2021 and WindSeeG in December 2020).[64]

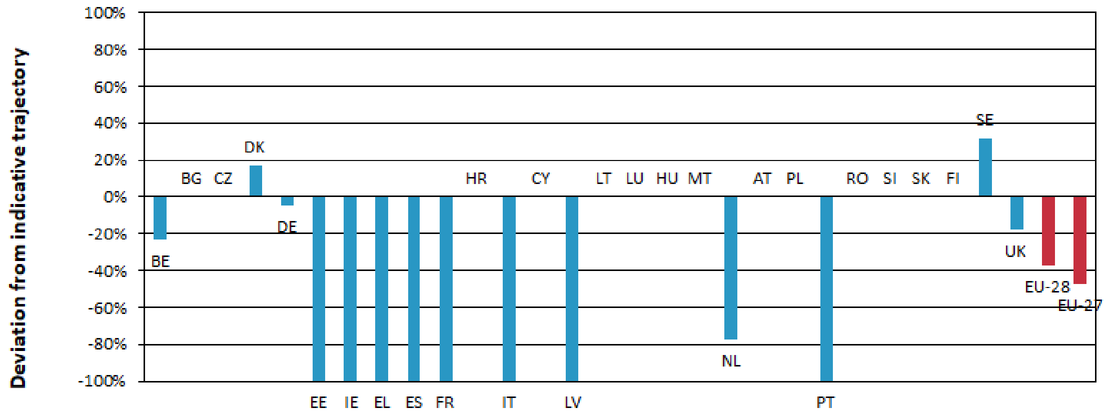

Figure 34. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for offshore wind.[65] Note: Those MS with 100% deviation have not yet generated any electricity from wind offshore – even though in some MS, e.g. France, projects are commissioned but not yet implemented[66]

Onshore Wind

Many MS planned significant deployment of onshore wind in their NREAPs. The EU-28 as well as the EU-27 are above the total planned production for 2019. The largest producers in absolute numbers in 2019 were Germany with 94,421 GWh, Spain with 53,283 GWh, France with 32,463 TWh and the UK with 32,405 GWh. Despite the high absolute value of generation in Spain, the onshore wind generation has not increased as planned since 2016, which leads to increasing negative deviations from the NREAP trajectory. While onshore wind is seeing positive growth rates in 24 MS (see Table 14), actual development is lagging behind the NREAP trajectory in 13 MS. Lithuania and Luxembourg lagged behind in 2018, but are above their NREAP trajectories in 2019, resulting from higher actual increases in generation than planned. Lithuania re-designed its auction-scheme in September 2019. It moved from a technology-specific feed-in tariff to technology-neutral RES-E auctions with feed-in premiums. It was expected that onshore wind would dominate the auctions in 2019 and 2020, and grow faster than in the first half of 2019[67]. The largest negative deviations can be observed in Slovakia (6 GWh actual vs. 560 GWh planned) and in Slovenia (6 GWh actual vs 191 GWh planned). While delays in Greece are mainly due to the economic crisis, in Hungary[68], a combination well-established utilities and weak political support has slowed down the deployment of wind energy in the past. The highest positive deviations can be observed in Sweden and in Croatia, which have been increasing their generation steadily since 2011. An increasing positive deviation is also shown for Croatia, since the actual deployment increased continuously, although no expansion of onshore wind was planned after 2015.

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[64] Wind Europe 2019, https://windeurope.org/newsroom/press-releases/german-offshore-wind-can-deliver-more-legal-framework-for-at-least-20-gw-by-2030-required/

[65] Finland did not distinguish on- and offshore wind power in its NREAP. It is therefore assumed to be on track.

[66] EurObserv'ER Wind Energy Barometer 2020, https://www.eurobserv-er.org/wind-energy-barometer-2020/

[67] https://www.icis.com/explore/resources/news/2019/09/12/10416921/power-perspective-lithuania-announces-redesigned-renewable-energy-auctions

[68] Antal 2019, How the regime hampered a transition to renewable electricity in Hungary in Environmental Innovation and Societal Transitions, https://doi.org/10.1016/j.eist.2019.04.004

There are many different reasons for slower uptake at national levels. Among others are past changes in policies and partly low or no support or uncertain revenues from sales (e.g. in Bulgaria, Cyprus, Hungary, Slovenia, Slovakia, Malta, Spain). In addition, non-cost barriers such as long lead times for administrative and grid access procedures, aviation safety and spatial planning and environmental issues still slow down the deployment of onshore wind. These challenges are also reflected in the latest auction results, e.g. in Germany, where the onshore wind auctions were undersigned and competition was less intense, which is probably due to the difficult and long permission processes.

Costs are still declining for onshore wind turbines, and investments in onshore wind projects dropped in the last year.[69] At the same time, the average size of turbines installed in 2019 reached a range of 2.3 to 4.3 MW (1.0 to 3.1 MW in 2017).[70] Thus, cost reductions and increased competition have made it possible to finance more capacity for less money.

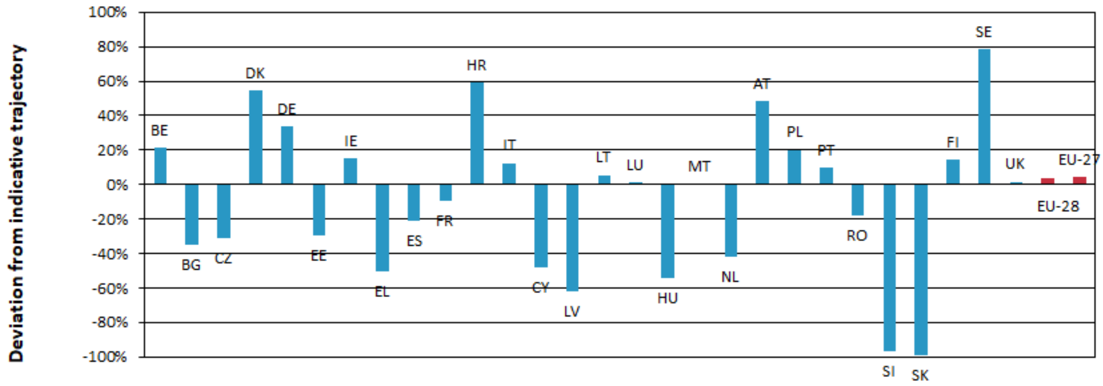

Figure 35. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for onshore wind

Photovoltaics

In many MS actual installations of PV plants and the resulting electricity generation have far surpassed national target figures, as system costs for PV have dropped much faster than was estimated by MS at the time of drafting the NREAPs. This trend had already become apparent in previous progress reports. Malta was above the planned PV trajectory for 2019. Another 20 MS have even surpassed the production envisioned for 2020. Only Latvia, Cyprus, Spain and the Czech Republic remain below their planned production. Czech Republic has had phases of rapid PV deployment earlier in the decade, leading to an strongly increasing support costs at the time. After this, policy makers limited the support given to PV installations, which caused a break in growth. In Spain most of the new RES capacity is provided by projects selected inthe second auction, held in 2017, in which PV was the only winner. The deadline, at which the projects had to be connected to the grid, was end of December 2019, [71] Latvia had only planned a small amount (4 GWh) for 2019 and reported 3 GWh PV production. As a result, Latvia shows the largest negative deviation from NREAP trajectory. Denmark has only planned 4 GWh till 2020, while the actual generation in 2019 had reached 963 GWh. This leads to Denmark having the highest positive deviation among all MS. Estonia, Ireland and Finland had not planned any deployment until 2020, but they all produced small amounts. Germany continues to be the largest producer by far with 46,392 GWh, in 2019, followed by Italy with 23,689 GWh and the UK with 12,918 GWh. Given most MS were on track with their planned targets, both the EU-28 and the EU-27 as a whole are above the planned NREAP trajectories for PV deployment.

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[69] Wind Europe, Financing and investment trends 2019

[70] Wind Europe, Annual Statistics 2019

[71] https://www.pv-magazine.com/2020/01/27/spain-reaches-8-7-gw-of-cumulative-solar

Due to increasing manufacturing capacities and concomitant competition and price decreases, PV has become one of the cheapest technologies for electricity generation worldwide.[72] Between 2009 and 2018, production costs fell by 75% while the EU market grew by 8 GW.[73] Prices for modules will most likely continue to decrease over the next few years. Due to the cost reductions, together with new business models and progress in system and battery technologies, PV will continue to grow in Europe. This is also expected in countries with lower solar radiation potential such as Latvia where also due to low-cost grid usage power parity is not yet given for PV.[74] Many MS have just started to install PV on a larger scale, making the PV market a great opportunity for the manufacturing industry.[75] Europe was leading the manufacturing of PV at the beginning of the 21st century and is still strong in the field of research and development.[76] The main support schemes for PV are, as for wind onshore, feed-in premiums or tariffs, often in combination with an auction. PV faced high competition which resulted in low bids in many auctions as well as small margins for developers and manufacturers (e.g. in Germany).[77] Overall, competition and price pressures will encourage more efficient manufacturing and ongoing innovation.

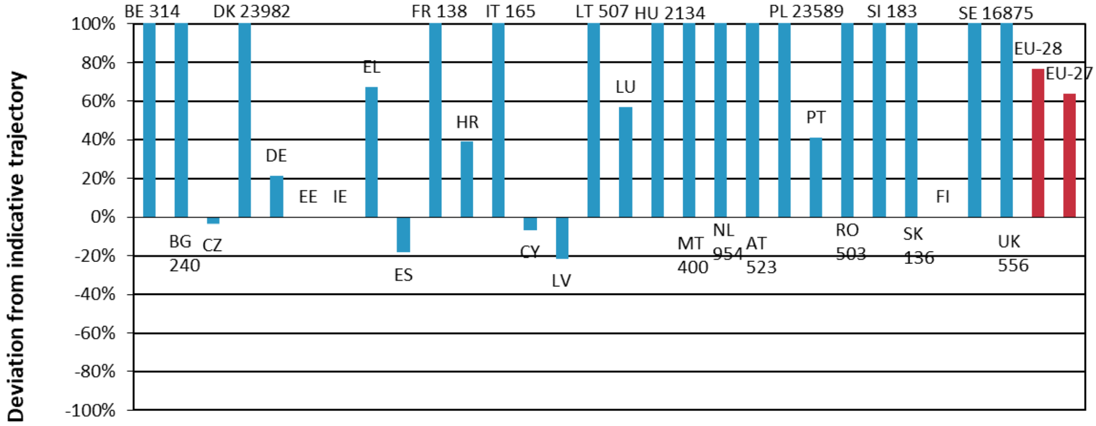

Figure 36. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for solar PV

Solid Biomass

Most MS planed significant amounts of electricity from solid biomass in their NREAPs, and the technology has made significant contributions to the RES-E sector throughout the last decade. The growth has been stronger between 2018 and 2019 (+5.32%) in comparison to the growth between 2017 and 2018 (+5.06%) and between 2016 and 2017 (3.51%) in the EU-28. The number of MS who stayed below their NREAP-planned amounts has increased from 2014 (17 MS) to 2016 (20 MS) and decreased again from 2018 (19 MS) to 2019 (17 MS). Croatia and Luxembourg lagged behind in 2018 and are above their NREAP trajectories in 2019, resulting from the growth higher as planned from 2018 to 2019 (+164 GWh and +65 GWh respectively). The highest positive deviation can be observed in Estonia. Bulgaria had the second highest positive deviation, which was due to the strong increase of electricity generation from 2017 (180 GWh) to 2018 (1361 GWh) through the conversion of existing plants from conventional fuels to biomass, and further increase in 2019 (1590 GWh). The largest negative derivation is shown in Malta, followed by Greece. Malta has an abundance of solar intensity,

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[72] European Commission, Solar power, https://ec.europa.eu/energy/topics/renewable-energy/solar-power_en
[73] European Commission, Solar power, https://ec.europa.eu/energy/topics/renewable-energy/solar-power_en
[74] Antal 2019, How the regime hampered a transition to renewable electricity in Hungary in Environmental Innovation and Societal Transitions, https://doi.org/10.1016/j.eist.2019.04.004
[75] Fraunhofer ISE 2020, Sustainable PV Manufacturing in Europe, https://www.ise.fraunhofer.de/content/dam/ise/de/documents/publications/studies/ISE-Sustainable-PV-Manufacturing-in-Europe.pdf
[76] Fraunhofer ISE 2020, Sustainable PV Manufacturing in Europe, https://www.ise.fraunhofer.de/content/dam/ise/de/documents/publications/studies/ISE-Sustainable-PV-Manufacturing-in-Europe.pdf
[77] REN21, Renewables 2020, Global Status Report, https://www.ren21.net/gsr-2020/

but limited landmass, a difficult sea floor, small wave sources and only low-energy wind resources.[78] Consequently, Malta considers solar as their main renewable energy source and therefore puts less policy efforts into biomass deployment. Even though Greece displays a highly negative deviation from its interim trajectory, substantial growth in biomass electricity generation (+13 GWh) as well as in installed capacity (+1.2 MW) was observed.

Ten MS were on track with their planned NREAP trajectories, while 17 MS lag behind (Cyprus did not plan any electricity generation from solid biomass in its NREAP). As a consequence, both the EU-28 and the EU-27 had lower shares in solid biomass use than envisaged. The UK was the largest producer in absolute terms in 2019 with 29,734 GWh, followed by Germany with 16,914 GWh as well as Sweden and Finland (12,987 GWh and 12,926 GWh, respectively). With these amounts, these four MS contribute more than half of the EU-28's production of solid biomass electricity. Although absolute values in Germany and Sweden are high, these two MS did not show a substantial increase in actual production as planned and therefore were behind their planned targets.

Bioenergy continues to be the main source of renewable energy in the EU in terms of gross final consumption, despite the rapid growth of wind and solar power over the past decade.[79] In terms of end use, the largest sector where biomass is used, is heating and cooling, while electricity from biomass accounts for only 13%.[80] Biomass currently used in the EU includes wood from forests, agricultural crops and residues, byproducts from the wood and agricultural industry, herbaceous and woody energy crops, municipal organic wastes and manure, and could potentially integrate algae and marine biomass in the future.[81] The residential sector retains the largest share of solid wood energy consumption (27%), followed by the industrial use of wood chips (22%) and the small-scale use of woodchips (14%).[82] Pellet consumption in modern appliances is also growing fast, representing 6% of the EU's total wood energy consumption.[83]

The cost of electricity from biomass, in contrast to wind and PV, is mainly driven by the operating costs of the fuel. It is not expected that the technology costs will decrease significantly. With regard to support schemes, feed-in tariffs and feed-in-premiums are the dominant support schemes for the deployment of electricity from biomass.[84] Thereby, the focus in many MS is on large power stations, in particular combined heat and power (CHP) plants. A stable support showed the highest effectiveness in the past and remains the key factor for biomass deployment beyond 2020.[85]

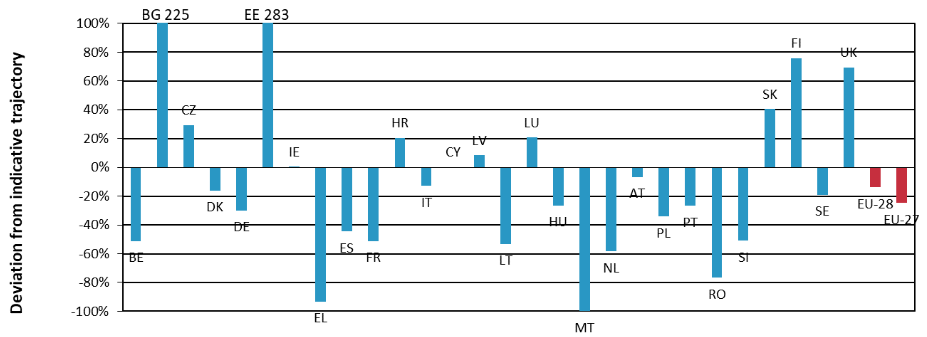

Figure 37. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for solid biomass

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[78] Energy Transition 2017, Malta's energy transition, https://energytransition.org/2017/04/maltas-energy-transition-a-slow-but-promising-start/

[79] EU Commission, Brief on biomass for energy in the European Union, https://publications.jrc.ec.europa.eu/repository/bitstream/JRC109354/biomass_4_energy_brief_online_1.pdf

[80] EU Commission, Brief on biomass for energy in the European Union, https://publications.jrc.ec.europa.eu/repository/bitstream/JRC109354/biomass_4_energy_brief_online_1.pdf

[81] Bioenergy Europe, https://bioenergyeurope.org/

[82] Bioenergy Europe, https://bioenergyeurope.org/

[83] Bioenergy Europe, https://bioenergyeurope.org/

[84] Banja et al. 2019, Biomass for energy in the EU – The support framework in Energy Policy, https://doi.org/10.1016/j.enpol.2019.04.038

[85] Banja et al. 2019, Biomass for energy in the EU – The support framework in Energy Policy, https://doi.org/10.1016/j.enpol.2019.04.038

Biogas

The EU in total was on track regarding its electricity production from biogas in 2019. However, there is a large variation between MS. Finland has continuously been above its planned trajectory since 2010 and showed the largest positive deviation among all MS with 363 GWh actual production versus 70 GWh planned in 2019. In contrast, 20 MS stayed below their planned deployment. Among these MS, the largest negative deviation can be observed in Romania, with 54 GWh actual deployment and 920 GWh planned target for 2019. Romania has a high potential for biomass and biogas, and several ongoing projects focus on its utilisation. However, the use of biomass or biogas for electricity generation is affected by several aspects. There are competing uses of biomass between the heating and electricity sector, and it is well suited for sector coupling (via combined heat and power (CHP) plants). Further, it is partly considered as a transitory energy source due to its polluting emissions.[86] This mix of reasons may explain the negative deviation. In absolute terms, Germany was by far the largest producer in 2019 with 32,910 GWh, more than all other MS combined. However, growth in Germany has slowed after a support scheme change in 2014 aimed at limiting the development of biogas electricity. In contrast, despite relatively small absolute production in Lithuania (154 GWh), very high growth could be observed in recent years. This may be due to the Lithuanian Rural Development Programme 2014-2020, which is expected to support up to 30 new biogas plants with total capacity of 20 MW by the end of 2020.[87] The highest growth rates between 2018 and 2019 can be observed in Sweden, followed by Greece.

Overall, the deployment of biogas varies across MS and times, and costs depend less on the technology, but on operating costs, as in the case of solid biomass. The use of biogas electricity is currently mainly influenced by the shift in the regulative framework, the stage of the auctions and the feasibility of long-term objectives.[88] National targets were very supportive of the rapid introduction of biogas electricity in recent years. However, at the present time, in several MS, a clear picture of biogas after 2020 is still missing.[89]

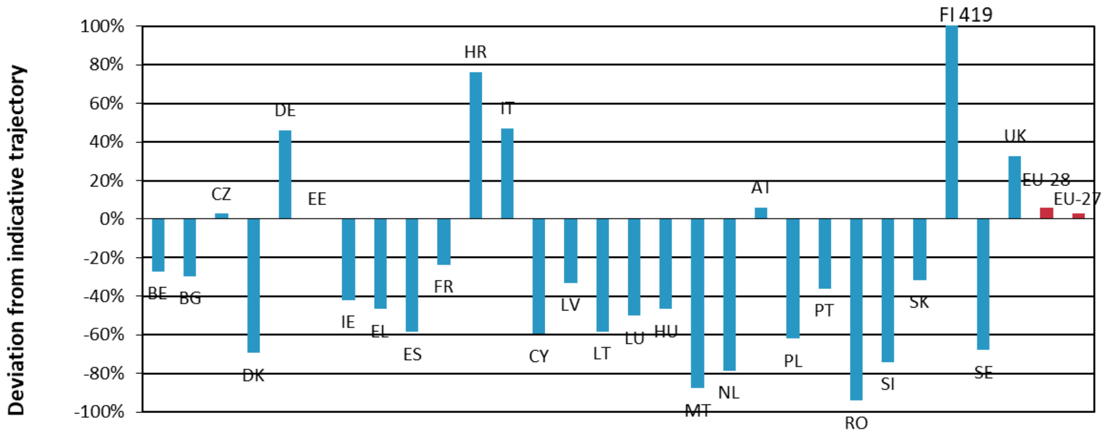

Figure 38. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for biogas[90]

[86] Cîrstea, Ş.D.; Martiş, C.S.; Cîrstea, A.; Constantinescu-Dobra, A.; Fülöp, M.T. Current Situation and Future Perspectives of the Romanian Renewable Energy. Energies 2018, 11, 3289., DOI: 10.3390/en11123289
[87] Lithuanian Energy Institute 2018, Biogas upgrading, https://www.beic.nu/resources/02_Andrius_Tamosiunas.pdf
[88] Banja et al. 2019, Support for biogas in the EU electricity sector – A comparative analysis in Biomass and Bioenergy, https://doi.org/10.1016/j.biombioe.2019.105313
[89] Banja et al. 2019, Support for biogas in the EU electricity sector – A comparative analysis in Biomass and Bioenergy, https://doi.org/10.1016/j.biombioe.2019.105313
[90] The change of the UK is due to incomplete/invalid data during last update. Based on the updated data, the UK is also on track in 2018.

Hydro

This chapter on hydro combines the subcategories small hydro and large hydro from previous progress reports and includes installations of "<1 MW", "1-10 MW" and ">10 MW". On EU-28 level, the total hydro production is 347,730 GWh in 2019, of which Sweden had the largest contribution (66,837 GWh), followed by France (59,787 GWh), Italy (47,052 GWh) and Austria (42,252 GWh). Despite the high absolute values in these four MS, only Italy and Austria were on track with their planned NREAP trajectories. In 2019, only six MS had higher actual deployment than planned. Hungary, Estonia and Germany were on track with their NREAP trajectories in 2018 and lagged behind in 2019. A decrease in generation can be observed from 2018 to 2019 in Estonia. The highest positive deviation can be observed in Italy, followed by Bulgaria. The largest negative deviation is shown in the Netherlands, which had set a constant NREAP target value of 184 GWh from 2013 to 2020, while the actual generation has been decreasing since 2014 from 102 GWh to 93 GWh in 2019. Similarly, the MS with the second largest deviation, Denmark, had set a constant target of 31 GWh for hydropower from 2010 to 2020, while the actual deployment is stagnating since 2016. Denmark is geographically small and relatively flat with only a few rivers suitable for hydropower, which might be one reason for a low deployment. By contrast, hydropower is far more common in the other Nordic countries, in particular in Norway and Sweden, where great amounts of water and height differences are available.[91] Denmark benefits from this hydropower potential as a source of storage[92] but in times of droughts a dependency on this potential becomes costly.

Large hydro is the most mature RES-E technology, with the majority of potentials already being exploited in most MS. Thus, most MS have planned only low growth rates in this technology. Although electricity production from wind onshore, offshore and PV combined has overtaken the production from large hydro installations, large hydro nevertheless remains, for the time being, the single most important RES-E technology, contributing the largest share to RES-E generation. Significant potentials for capacity expansion in large hydropower remain in France, Italy, Portugal, Greece, Romania, Austria, and Poland.

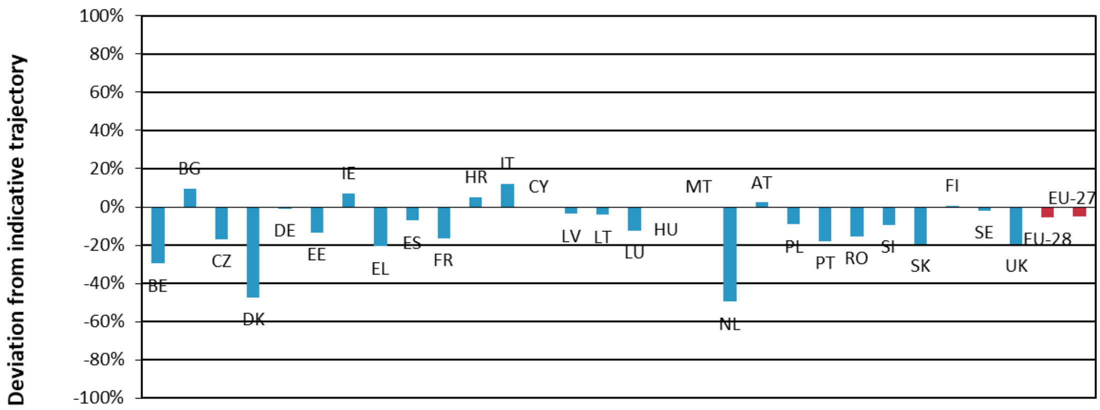

Figure 39. Deviation of actual 2019 deployment (Eurostat SHARES) from 2019 indicative trajectory (NREAP) for non-pumped hydropower[93]

Mixed Hydro

While Table 10 of the NREAP had only differentiated between the hydro subcategories "<1 MW", "1-10 MW", ">10 MW" and "of which pumped", the MS Progress Report template introduced a new category called "mixed", which - in accordance with the new Eurostat methodology - refers to the

[91] Danish Energy Agency, https://ens.dk/en/our-responsibilities/wave-hydropower/facts-about-wave-power-and-hydropower

[92] Danish Energy Agency, https://ens.dk/en/our-responsibilities/wave-hydropower/facts-about-wave-power-and-hydropower

[93] Note: We consolidated the categories small (< 1 MW), medium (1-10 MW) and large hydro (>10 MW) in one category.

renewable portion of electricity produced in mixed (pumped and non-pumped) hydropower plants. Due to the absence of NREAP-planned figures, no comparison for this subcategory is provided here.

Bioliquids

The contribution of bioliquids to renewable electricity generation in 2019 is about 1% of wind energy or about 4% of biomass-based electricity and the targeted share of bioliquids in the RES-E mix is about 0.96% of all RES-E sources in the EU. Thus, the significance of bioliquids with respect to its magnitude is minor in RES-E. Only three MS had planned any significant amount of bioliquid electricity for 2019: Finland with 4,730 GWh, Italy with 4,550 GWh, and Germany with 1,450 GWh. Of these, Italy and Germany had noticeable deployment, with Italy even slightly above its NREAP trajectory, while Finland had only 2.5 GWh of electricity from bioliquids despite having the highest planned target of the three. Italy had planned an increasing trajectory till 2020, while the actual deployment has decreased from 2015 (4,894 GWh) to 2018 (4,291 GWh) and increased again in 2019 (4,677 GWh). Sweden, Austria, Belgium and Denmark (in descending order) had planned very small amounts ranging between 8 and 65 GWh. Belgium, even though having planned only minor contributions, was the only MS considerably above track, with 71 GWh actual versus 26 GWh planned for 2019. On the contrary, Austria reported a deployment below 1 GWh, although 36 GWh was planned from 2010 to 2020.

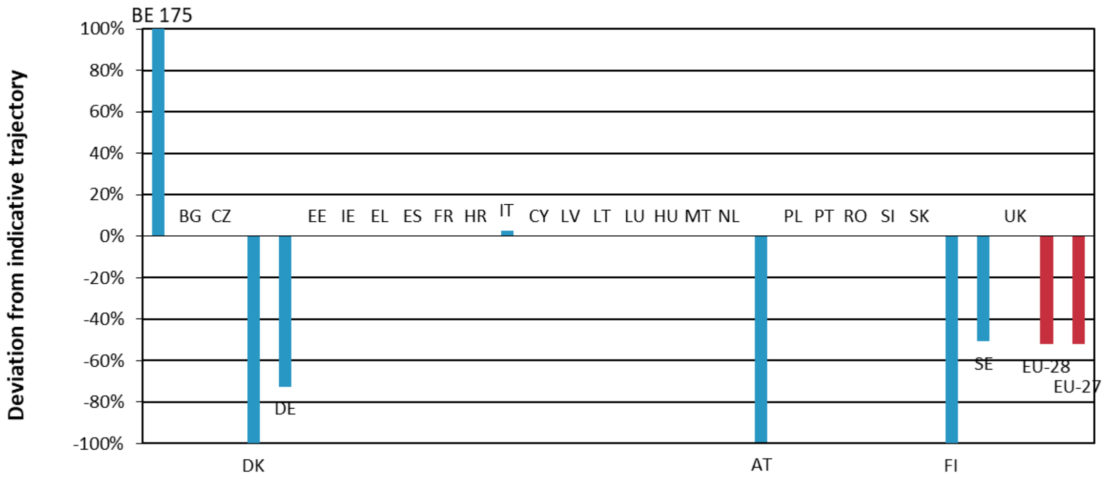

Figure 40. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for bioliquids

Geothermal

The planned contribution of geothermal based electricity to renewable power generation is with 0.87% of total RES-E sources, minor at the EU-level. Fifteen MS did not foresee any geothermal electricity production by 2019. Belgium and Spain planned to start geothermal electricity with 22 GWh and 60 GWh respectively in 2018 and to increase to 26 GWh and 180 GWh respectively in 2019. However, no actual deployment is observed in Belgium or Spain. Geothermal electricity production on the EU-28 level has decreased from 2016 with 6,733 GWh to 6,658 GWh in 2018 and increases in 2019 to 6,726 GWh. The highest contribution of 6,075 GWh came from Italy. Nevertheless, the production on Italy has been decreasing since 2016 and Italy is therefore below their NREAP trajectory. Croatia, Hungary, France, Germany, Austria and Portugal, all with planned contributions between 2 and 1,281 GWh, reported small amounts of actual deployment between 0.2 GWh and 215 GWh, but all (except for Croatia) stayed well below plan. Croatia shows an increase (+90 GWh) from 2018 to 2019 and therefore became on track with the NREAP trajectory in 2019. Greece and the Netherlands planned a generation of 123 GWh and 411 GWh respectively, but had no actual production. In the Netherlands the main support instrument for geothermal power is the SDE++ (feed-in premium), which has been improved in terms of remuneration and scope of the regulation. In addition, the government has increased the budget for guarantees on drilling risks while financing difficulties and slow permitting hampered a significant increases in geothermal power.[94] The Czech Republic and Slovakia reported zero production even though having foreseen some small contributions of 18 and 29 GWh respectively in their NREAPs.

Overall, limitations of geothermal resources in certain locations, the costly evaluation and associated risks as well as long lead times from initial project ideas to final installations, missing support policies and financing might explain some of the delays. In addition, geothermal based electricity faces acceptance problems in some MS, as the environmental impact of the technology is in some regions highly disputed.

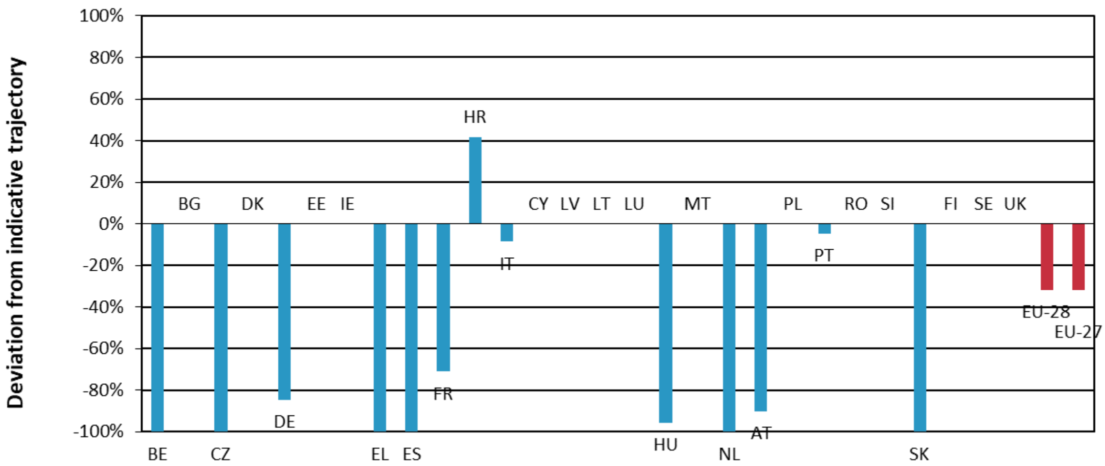

Figure 41. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for geothermal installations

Concentrated Solar Power

Concentrated Solar Power (CSP) deployment in the EU is significantly below planned amounts. Six MS had planned a total of 15,661 GWh of CSP electricity production for 2019 and have actually achieved around 36% of this. Most of this planned amount and all of the actually realised production of 5,683 GWh comes from Spain. The other five MS had planned only small amounts ranging between 68 and 851 GWh, but all reported a production of zero. In Spain, the total installed capacity has remained 2,304 MW from 2013 to 2019. However, the actual CSP electricity production in Spain has increased to the peak of 5,883 GWh in 2017, decreased to 4,867 GWh in 2018 and increased again in 2019. The decrease in 2018 is due to atmospheric pollution from wildfires.[95] The deviation from the NREAP trajectory has thus d in 2019 in comparison to in 2018. One reason for this delay is that the costs of installations remain comparatively high in Europe. It seems that only in Spain commercial investment in CSP are possible.

[94] http://europeangeothermalcongress.eu/wp-content/uploads/2019/07/CUR-19-Netherlands.pdf

[95] SolarPACES, https://www.solarpaces.org/generation-from-spains-existing-2-3-gw-of-csp-showing-steady-annual-increases/

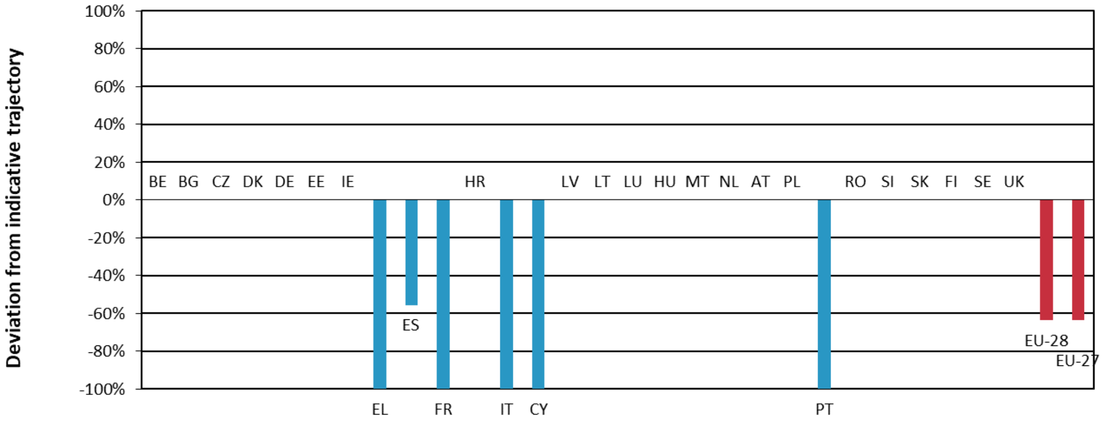

Figure 42. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for concentrated solar power

Tide, Wave and Ocean Energy

Tidal, wave and marine technologies are developing much slower than planned in the EU. It is also the technology with the lowest planned contribution to the RES-E mix. Of the six MS who had foreseen any production, only France (479 GWh) and the UK (14 GWh) reported electricity generation in 2019. Portugal has reported 0.01 GWh generation in 2017, which decreased to 0 GWh in 2018 and 2019. The UK is the most ambitious MS with the highest planned NREAP trajectory of 2,980 GWh for 2019, but production is marginal although it has been increasing since 2016. However, currently 33 tidal energy projects are in the planning (2,860 MW), development (1,089 MW), construction phase (3 MW) or consented and awaiting construction (729 MW) in the UK.[96] The same, albeit on a smaller scale, applies to wave energy, with 16 projects in planning, development or construction, totalling approximately 463 MW.[97] It can therefore be assumed that UK's contribution to tidal and wave energy generation will be closer to planned levels in the coming years. Ireland had planned no electricity production from tide, wave and ocean energy till 2016. On the contrary, a small amount was planned for 2017 (42 GWh), almost doubled for 2018 (81 GWh) and nearly tripled for 2019 (124 GWh). However, no actual deployment was reported. Besides these, other MS (namely Italy, Portugal, and Spain) have planned NREAP trajectories ranging between 3 and 165 GWh. Denmark had not planned any deployment, but currently three wave power plants have permissions to test in Danish seas and one developer has permission to do pre-investigations to prepare an area for future wave energy plants.[98]

[96] RenewableUK Marine Energy, https://maps.esp.tl/maps/pages/map.jsp?geoMapId=19671&TENANT_ID=115744
[97] RenewableUK Marine Energy, https://maps.esp.tl/maps/pages/map.jsp?geoMapId=19671&TENANT_ID=115744
[98] Danish Energy Agency, https://ens.dk/en/our-responsibilities/wave-hydropower/facts-about-wave-power-and-hydropower

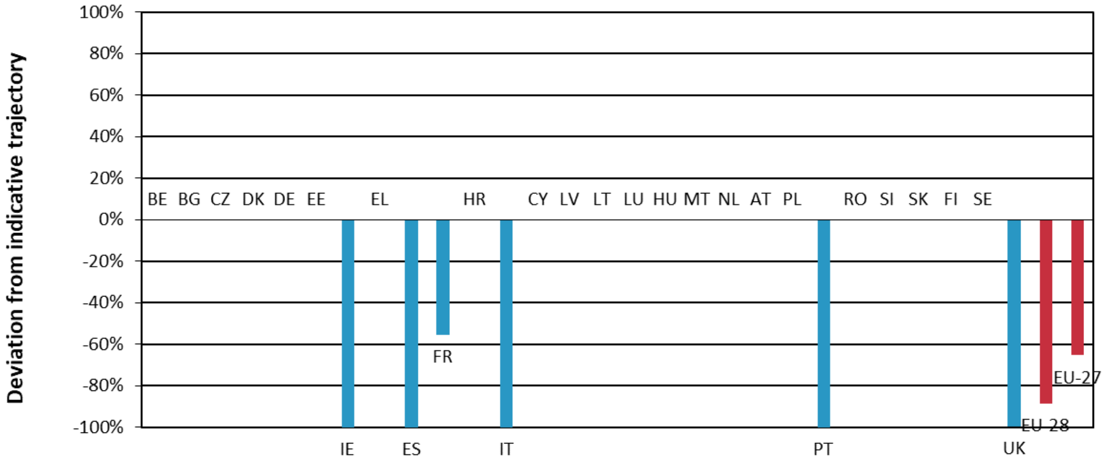

Figure 43. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for tide, wave and ocean energy

A.2 RES-H&C sector overview

Consumption of RES-H&C has increased gradually over the last decades. In 2019, RES-H&C consumption at EU-28 level reached 105,701 ktoe (see Figure 44) and at EU-27 level reached 101,539 ktoe. Thereby, solid biomass contributed with 84,718 ktoe most to the sector. Heat consumption from heat pumps stood at 12,934 ktoe, biogas at 3,515 ktoe, solar thermal heating at 2,497 ktoe, bioliquids at 1,124 ktoe and geothermal heating at 914 ktoe. Most MS use financial and/or fiscal incentives to support RES in the heating and cooling sector.[99] In several MS, there is not yet a comprehensive approach to support RES-H&C, which might explain the relatively moderate growth in this sector compared to RES-E. However, the heating and cooling sector has become more prominent in several MS and has been addressed in the NECPs with new measures and policies to be implemented in the coming years (e.g. CO_2-prices for heating and transport, new support programs for the development of district heating and cooling or new information services and campaigns on building renovations). An increasing focus on heating and cooling is of great relevance, especially in light of the fact that in 2019 only 21% of heating and cooling in the EU was generated from RES.[100] More renewable energy sources still need to be integrated in the heating and cooling sector in order to achieve the EU climate and energy targets.

[99] JRC 2017, Renewables in the EU, https://e3p.jrc.ec.europa.eu/sites/default/files/documents/publications/kjna29100enn.pdf
[100] Eurostat, Share of energy from renewable sources in heating and cooling [nrg_ind_ren]

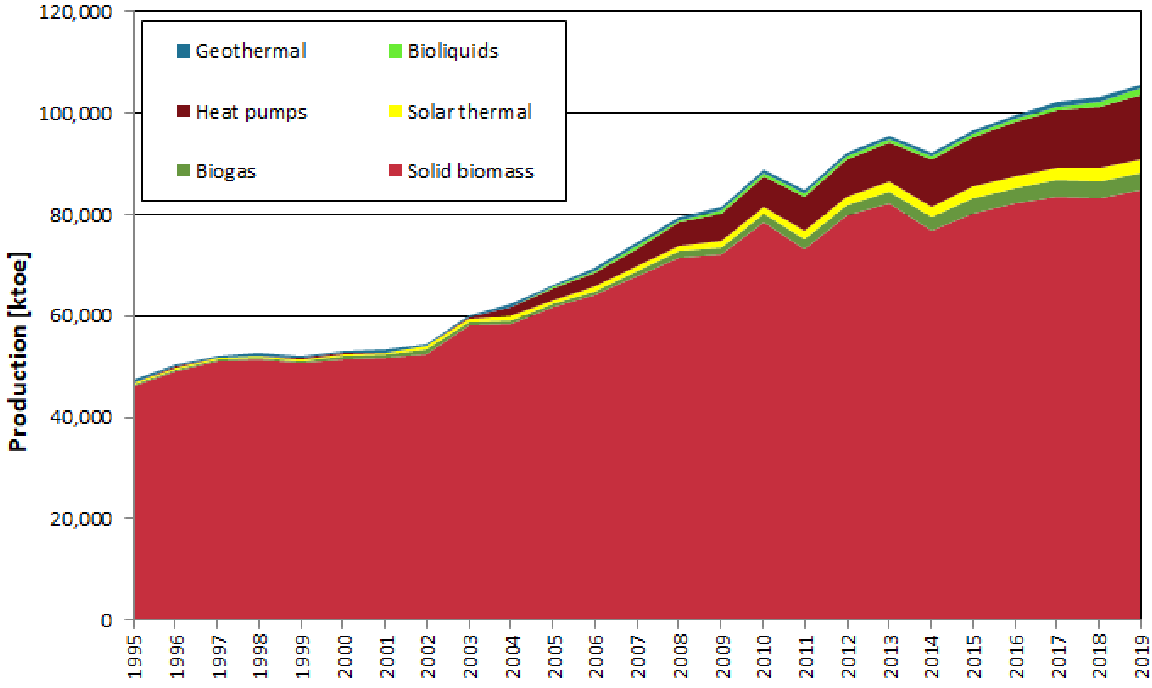

Figure 44. Production of heating and cooling from RES-H&C technologies in the EU-28 for 1995-2019.[101] Source: Results for heat pumps from 2004 to 2019 are based on Eurostat SHARES, other results are based on Eurostat Energy Balances

The following graphs and tables outline the developments in the RES-H&C sector for individual MS.

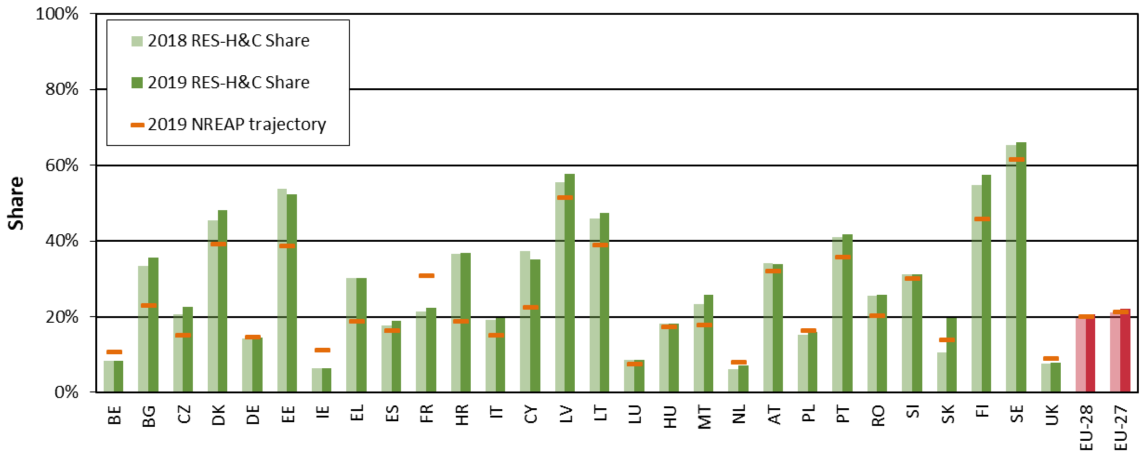

Figure 45. RES-H&C actual share vs. NREAP indicative sectoral trajectory in 2019 (%). Source: Eurostat SHARES and NREAPs

Seven MS, namely Belgium, Germany, Ireland, France, the Netherlands, Poland as well as the UK, stayed below their NREAP indicative sectoral trajectories envisioned for RES-H&C consumption in 2019. The remaining 21 MS were above. Both EU-28 level and EU-27 continued to be above the (aggregated) indicative trajectory. The largest positive deviation can be observed in Croatia, Greece and Cyprus, while the largest negative deviation can be observed in Ireland and France.

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[101] Solid biomass includes primary solid biofuels and renewable municipal waste.

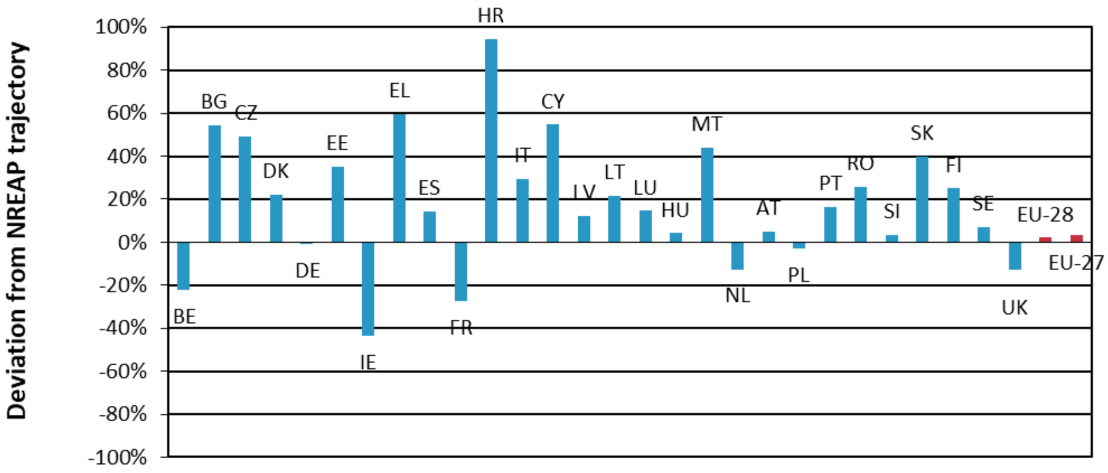

Figure 46. Deviation of actual 2019 share from 2019 NREAP indicative sectoral trajectory for RES-H&C. Source: Eurostat SHARES and NREAPs

The following tables show the growth rate of RES-H&C technologies from 2018 to 2019, as well as their absolute values in 2019. Growth rates for RES-H&C technologies are in general lower than in the RES-E and RES-T sectors due to the already large contribution of the well-established technology of solid biomass (which has slightly decreased in 2018, but again increased in 2019). All RES-H&C technologies showed positive growth rates between 2018 and 2019. Geothermal heating was the fastest-growing technology although it contributed the least in absolute terms. Similarly, bioliquid heating contributed very little in absolute terms but it has been growing steadily since 201. Biogas and heat pumps also showed a strong growth but only heat pumps were also significant in absolute figures.

Table 16. Growth of RES-H&C technologies from 2018-2019. Source: Eurostat Energy Balances and Eurostat SHARES

Member State	RES-H [%]	Solar thermal [%]	Solid biomass [%]	Biogas [%]	Heat pumps [%]	Geothermal [%]	Bioliquids [%]
Belgium	-2.25	-0.52	-4.43	2.76	22.55	7.05	13.68
Bulgaria	4.13	4.60	3.48	-2.86	14.22	1.38	-
Czech Republic	8.08	1.96	8.16	-1.95	17.34	-	-
Denmark	1.11	4.37	-0.21	21.83	12.96	-37.79	-33.90
Germany	1.75	-4.42	1.50	1.14	8.69	4.72	3.04
Estonia	-5.61	-	-6.75	-49.88	12.97	-	-
Ireland	-3.49	1.07	-7.35	4.16	14.83	-	-
Greece	1.11	3.11	-4.57	63.80	9.73	16.44	-14.15
Spain	4.93	4.91	3.02	0.09	16.15	0.00	0.68
France	3.62	3.43	1.06	8.91	12.06	6.46	6.97
Croatia	-1.14	10.85	-1.30	6.98	-4.04	-6.06	-
Italy	-0.26	4.36	-0.02	21.52	-3.76	1.68	8.06
Cyprus	0.24	1.56	-3.90	10.94	1.15	0.00	-
Latvia	0.13	-	0.30	-7.78	0.00	-	4.61
Lithuania	-1.03	-	-1.16	1.51	6.03	-	-
Luxembourg	5.62	2.77	8.40	-23.36	14.91	-	-
Hungary	-2.91	6.26	-3.97	-9.80	60.86	7.45	-
Malta	15.05	0.89	25.14	44.65	18.76	-	3.88
Netherlands	13.10	4.41	10.93	3.91	20.05	49.14	2.58
Austria	0.56	-1.08	-0.02	4.51	9.43	-9.60	-8.71
Poland	2.14	26.24	1.00	10.69	19.23	5.99	20.19
Portugal	3.11	2.04	2.72	-11.99	4.58	-1.28	-0.52
Romania	0.76	-0.97	0.77	4.16	-	-1.81	-
Slovenia	-3.18	0.09	-3.27	-14.63	-	3.70	-17.12
Slovakia	91.76	6.35	94.93	-16.14	-	7.37	-
Finland	1.98	9.64	1.61	13.08	5.84	-	-21.13
Sweden	1.59	-2.41	1.39	65.71	0.00	-	6.28
UK	2.43	1.09	2.43	4.73	1.98	0.00	-
EU-28	**2.53**	**1.29**	**1.77**	**5.08**	**6.65**	**8.74**	**4.36**
EU-27	**2.53**	**1.29**	**1.74**	**5.10**	**6.89**	**8.75**	**4.36**

Table 17. RES-H&C consumption in the EU-28 in 2019 per technology. Source: Eurostat Energy Balances and Eurostat SHARES

Member State	RES-H [ktoe]	Solar thermal [ktoe]	Solid biomass [ktoe]	Biogas [ktoe]	Heat pumps [ktoe]	Geothermal [ktoe]	Bioliquids [ktoe]
Belgium	1,513	27	1,260	109	108	1	6
Bulgaria	1,401	26	1,222	13	106	35	0
Czech Republic	3,145	18	2,757	167	203	0	0
Denmark	3,332	69	2,936	77	246	1	3
Germany	15,664	730	11,664	1,689	1,253	122	207
Estonia	790	0	707	5	78	0	0
Ireland	300	14	225	10	50	0	0
Greece	1,483	286	789	35	355	10	7
Spain	5,546	341	4,228	55	863	19	41
France	13,670	187	9,794	288	2,915	195	291
Croatia	1,166	15	1,116	12	14	7	0
Italy	10,583	228	7,338	311	2,498	152	56
Cyprus	174	73	47	7	46	2	0
Latvia	1,365	0	1,335	27	1	0	2
Lithuania	1,190	0	1,160	11	19	0	0
Luxembourg	93	2	83	6	2	0	0
Hungary	1,812	13	1,635	15	13	136	0
Malta	21	5	2	1	13	0	0
Netherlands	1,800	29	1,141	135	260	133	103
Austria	4,604	179	3,972	41	365	23	25
Poland	5,816	72	5,346	116	255	25	1
Portugal	2,607	96	1,812	7	679	2	11
Romania	3,496	1	3,453	12	0	31	0
Slovenia	547	11	516	6	0	14	0
Slovakia	1,227	8	1,138	37	39	6	0
Finland	8,068	2	7,451	116	490	0	8
Sweden	10,125	11	8,241	61	1,451	0	361
UK	4,163	53	3,350	148	611	1	0
EU-28	**105,701**	**2,497**	**84,718**	**3,515**	**12,934**	**914**	**1,124**
EU-27	**101,539**	**2,443**	**81,368**	**3,367**	**12,323**	**913**	**1,124**

Solar Thermal

The consumption of heat from solar thermal energy only accounted for about 2% of the total RES-H&C consumption in the EU-28 and the EU-27 in 2019. In absolute terms, the consumption of solar thermal energy reached 2,497 ktoe in the EU-28. Except for Estonia and Finland, all other MS had planned small amounts of solar thermal heating. Although the deployment has been increasing steadily and continuously, the technology showed a slower deployment in the last years than was expected at the time the NREAPs were drafted. Thus, the EU as a whole lags behind planned deployment. Only six MS reported a consumption of more than 100 ktoe for 2019, namely Austria with 179 ktoe, Spain with 341 ktoe, Germany with 730 ktoe, Greece with 286 ktoe, Italy with 228 ktoe and France with 187 ktoe. Nevertheless, all six of these MS remained below their planned amounts, as shown in the figures below. In total, 20 MS were below their envisaged trajectories. Lithuania and Latvia had planned 8 ktoe and 2 ktoe respectively but Lithuania reported no production and Latvia only reported 0.11 ktoe. Finland had planned no production, but reported 2 ktoe in 2019. Belgium, Denmark, Malta, the Netherlands, Sweden and the UK continued to be on track with their planned NREAP trajectories. Despite the relatively small absolute consumption (69 ktoe), the highest positive deviation can be observed in Denmark as only 16 ktoe was planned. Ireland was on track with its trajectory in 2014 but has been lagging behind since 2015.

The market development of solar thermal energy is highly dependent on prices of electricity and gas as well as on funding opportunities. In the majority of MS, neither the funding opportunities nor the avoided costs from using gas or electricity for heating seem to be sufficient to incentivise the planned deployment of solar thermal heat. Growth in Belgium is still slow, although an income tax reduction of the investment costs of a solar thermal system and low-interest loan are in place.[102] Uncertainties continue to have an impact on the deployment level. In North-East Europe, especially in Latvia and Lithuania, there are only a few hours of sunshine, resulting in low incentives for solar thermal energy deployment. In Southern Europe the potential is higher and so are the trajectories.

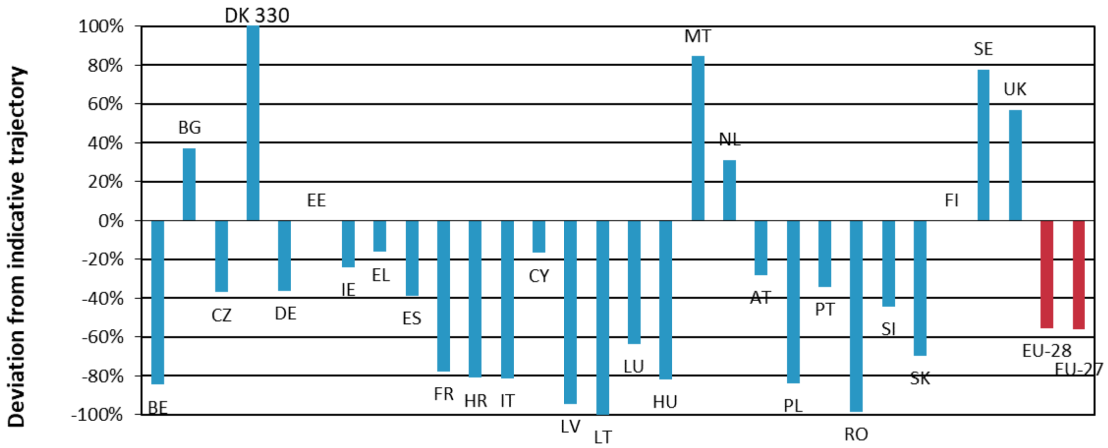

Figure 47. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for solar thermal installations[103]

Solid Biomass

The largest contribution to RES-H&C consumption was provided by biomass with 84,718 ktoe in 2019 at EU-28 level (80%). In absolute terms, the largest consumers of heating and cooling produced from solid biomass were Germany with 11,664 ktoe, France with 9,794 ktoe, Sweden with 8,241 ktoe, Finland with 7,451 ktoe and Italy with 7,338 ktoe. The use of solid biomass had already been well established in some MS before 2010, who did, thus, not foresee any large net increases of solid biomass use in their NREAPs. The focus is rather on replacing traditional biomass installations with newer, more efficient ones. Finland had planned increasing trajectories from 2,710 ktoe in 2010 to 3,940 ktoe in 2020, which was lower than the NREAP baseline of 5,450 ktoe in 2005. However, the actual deployment has generally been increasing with higher consumption than the baseline and reached 7,451 ktoe in 2019. Nineteen MS have surpassed their 2019 planned consumption, 17 of which are even already above their indicative sectoral trajectory for 2020. These are Bulgaria, Croatia, Cyprus, Finland, the Netherlands, Italy, Hungary, Estonia, Lithuania, the Czech Republic, Poland, Austria, Luxemburg, Denmark, Germany Slovenia and Slovakia. Moreover, Malta had planned no deployment at all until 2020 but actually reports 1.6 ktoe. Romania was on track in 2018 and lagged behind in 2019, due to a lower than planned increase on actual biomass deployment. On the contrary, Slovakia shows the highest growth rate (95%) in comparison to 2018 among all MS and became on

[102] Solarthermalworld, Belgium: Ambitious Targets for Solar Thermal, https://www.solarthermalworld.org/news/belgium-ambitious-targets-solar-thermal

[103] MT changed its NREAP in 2017 stating new solar thermal energy targets for the year 2020. However, as the updated NREAP does not contain a trajectory for solar thermal, data from its previous NREAP is used.

track with its NREAP trajectory in 2019.[104] Beside Romania and Slovakia, all other MS performed similarly to the previous years and the EU-28 and the EU-27 continued to be above the aggregated NREAP indicative trajectory in 2019. The highest positive deviation can be observed in Croatia with 1,1116 ktoe actual consumption from solid biomass, while only 389 ktoe was planned for 2019. Ireland continued to be the MS with the largest negative deviation from its NREAP trajectory and even larger than in 2018 although it has introduced a new support scheme for biomass in 2017, called the "Support Scheme for Renewable Heat". This scheme incentivises the installation and use of biomass and anaerobic digestion heating systems. In 2018, the support scheme provided €7 million for the initial stage of the programme.[105] Currently the scheme is open for applications.[106]

Solid biomass consumption has been a traditional form of heating especially in rural areas of e.g. Romania, Bulgaria and Poland. Its use depends on policies but also on weather conditions.[107] In 2018, the demand for heat from solid biomass in the EU fell slightly (-0.3%), probably due to a milder winter.[108]

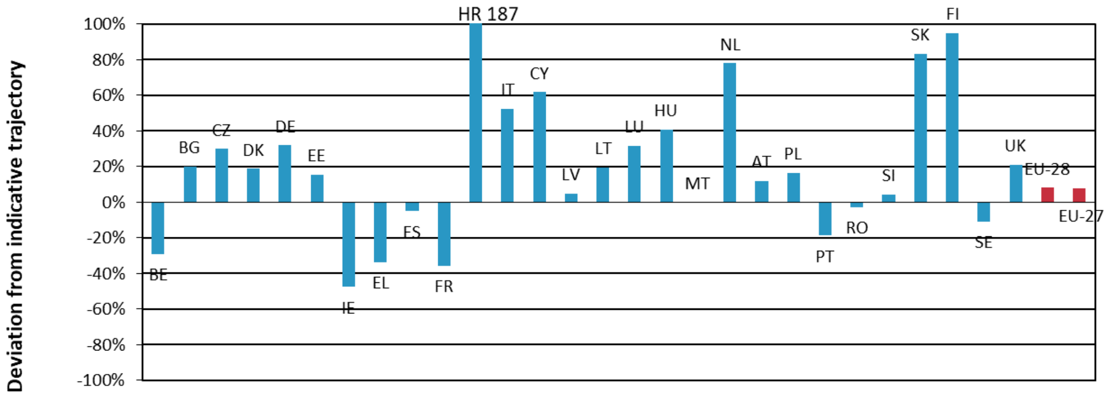

Figure 48. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for solid biomass

Biogas

Biogas was the third largest technology in RES-H&C, after solid biomass and heat pumps, with a consumption of 3,515 ktoe in 2019 on EU-28 level. Germany was the largest consumer of biogas for heating with 1,689 ktoe, almost half of the EU-28 total. It was followed by Italy with 311 ktoe, France with 288 ktoe, the Czech Republic with 167 ktoe and the UK with 148 ktoe. Seventeen MS consumed less biogas for heating in 2019 than they had been planned for in their NREAPs. The largest negative deviation was observed in Lithuania, with 11 ktoe actual deployment versus 46 ktoe planned for 2019, followed by Poland, with 116 ktoe actual and 408 ktoe planned deployment. Other MS such as Finland, Sweden, Austria, Croatia and Belgium showed significant overachievement. Estonia, Greece, Cyprus and Slovenia had not foreseen any production for 2019, but all report small amounts of biogas heating (ranging between 4.8 ktoe and 6.9 ktoe). However, in total, the EU-28 and the EU-27 are below the aggregated NREAP indicative sectoral trajectories for biogas heating.

Denmark, Germany and Italy have supported biogas technologies and developed support schemes to facilitate their large-scale deployment for more than a decade. Denmark has a clear interest in making

[104] This unexpected increase seems to be caused by applying new survey results of households on heating, but so far no official communication on the structure of the data or the contribution to the RE target has been launched (https://www.euractiv.com/section/politics/short_news/slovakia-suddenly-a-frontrunner-in-renewable-energies/)

[105] Sustainable Energy Authority of Ireland, Support Scheme for Renewable Heat, https://www.seai.ie/business-and-public-sector/business-grants-and-supports/support-scheme-renewable-heat/

[106] Sustainable Energy Authority of Ireland, Support Scheme for Renewable Heat, https://www.seai.ie/business-and-public-sector/business-grants-and-supports/support-scheme-renewable-heat/

[107] EurObserv'ER, Solid biomass barometer 2019, https://www.eurobserv-er.org/solid-biomass-barometer-2019/

[108] EurObserv'ER, Solid biomass barometer 2019, https://www.eurobserv-er.org/solid-biomass-barometer-2019/

biogas and biomethane central parts of its future energy system, given the depletion of its gas fields in the North Sea.[109] Germany has pursued a robust development of combined heat and power (CHP) plants using biogas. In Italy, the high availability of agricultural raw materials in particular was a strong argument in favour of biogas production.

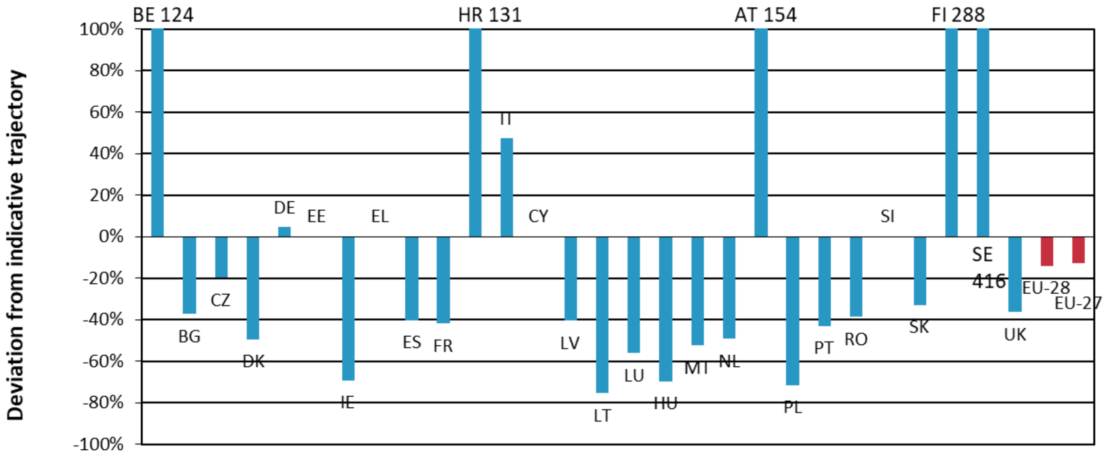

Figure 49. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for biogas[110]

Heat Pumps

The EU-28 consumed in total 12,934 ktoe of heat from heat pumps in 2019, making this technology the second-largest contributor to RES-H&C after solid biomass. Ten MS contributed with a positive deviations from their NREAP trajectories to the achievement of the indicative sectoral trajectory at the EU level. The highest positive deviation can be observed in Spain with 863 ktoe actual deployment versus 46 ktoe planned target. Cyprus had the second highest positive deviation with a planned target of 2.7 ktoe in its NREAP versus an actual consumption of 46 ktoe in 2019. France shows the biggest consumption of heat from heat pumps with 2,915 ktoe, followed by Italy with 2,498 ktoe. They were followed by Sweden and Germany with 1,451 ktoe and 1,253 ktoe respectively. Although high absolute consumption was reported in Italy, the consumption in 2019 decreases in comparison to 2018. Since increasing consumption was expected in the planned NREAP trajectory, Italy lagged behind in 2019. In addition, heat pumps are being deployed in MS, which previously saw little to no development in this field. Latvia reported small amounts of actual deployment of 0.7 ktoe from 2017 to 2019. Lithuania reported 19 ktoe consumption for 2019. Some MS were still below their indicative trajectories, for example Finland where a clear trend towards large geothermal heat pumps can be observed while the domestic systems are still growing the fastest.[111] Romania and Slovenia continued to report no deployment of heat pumps, although small amounts were planned in their NREAPs. Except for these two MS, the largest negative deviations can be observed in Hungary, Luxembourg, Croatia, Latvia and Belgium.

In Hungary, aerothermal heat pumps have higher market share than ground source heat pumps and a rising sales of aerothermal heat pumps can be observed between 2017 and 2019.[112] This is also reflected in the Eurostat statistics[113] on installed thermal capacity of heat pumps. It reveals an increase

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[109] Energypost 2019, Biogas and Biomethane in Europe: Denmark, Germany, Italy lead, https://energypost.eu/biogas-and-biomethane-in-europe-denmark-germany-italy-lead/

[110] For UK: The UK was on track in 2017 but lag behind in 2018 and 2019. The change is due to the data variation in 2018.

[111] http://europeangeothermalcongress.eu/wp-content/uploads/2019/07/CUR-10-Finland.pdf

[112] EurObserv'ER, 19th annual overview barometer, https://www.eurobserv-er.org/19th-annual-overview-barometer/ and Heat pumps barometer 2020, https://www.eurobserv-er.org/heat-pumps-barometer-2020/

[113] https://ec.europa.eu/eurostat/databrowser/view/NRG_INF_HPTC__custom_10724/default/table?lang=en and http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

of aerothermal heat pumps from 91 MW in 2018 to 138 MW in 2019 as well as an increase of 25 MW for ground source heat pumps and an increase of 1MW for hydrothermal heat pumps. However, it also reveals a decrease in time usage of aerothermal heat pumps (89 hours less in 2019) and ground source heat pumps (225 hours less in 2019) in comparison to 2018. Although 311 hours more of hydrothermal heat pumps were used in 2019 than 2018, the deployment of heat pumps in general in Hungary has been slowed down. In Belgium, installations of heat pumps are still low but have sped up in 2019 due to several reasons, including mandatory efficiency standards of buildings (making the use of heat pumps more efficient) and mandatory RES shares in heating. However, the ratio of gas to electricity was – as in many other countries - unfavourable for the use of heat pumps.[114] Overall, the deployment of heat pumps in Hungary and Belgium has increased, but more moderately than planned. For Romania, great difficulties are reported with respect to legislative and regulatory acts for shallow geothermal sources.[115]

The installation of heat pumps has specific requirements regarding the heating system (e.g. radiators) as well as the insulation of the building. Badly isolated buildings with conventional heating systems often require high temperature heat that makes running heat pumps at a rather inefficient level. Installations of heat pumps in such building stocks might entail significant replacement costs. Moreover, the regional climate influences the application of the heat pump technology. In regions with moderate winters, air-heating pumps are more economic while in colder regions geothermal heat pumps become more competitive but also entail higher investment expenditures. These factors combined with a missing policy support and an unfavourable gas-electricity price ratio, could contribute to a slower adoption rate of heat pumps in some countries.

In total, the EU heat pump market has achieved double-digit growth for the fourth year in a row and reached 17.7% in 2019.[116] The significance of heat pumps has grown in line with the energy transition. With their thermal and demand-side flexibility potential, heat pumps are a crucial cross-sectional technology, which is required for the transition of the energy system and the achievement of the 2050 climate targets.[117] At present, heat pumps provide heat for around 10% of all buildings, but there is still a huge potential that remains to be exploited.[118] Several EU policies affect the deployment of heat pumps and thus contribute to enhance the installed capacity of heat pumps. Beyond that, national support schemes of institutional or financial nature can accelerate the deployment of heat pumps, which has been proven by successful schemes in Sweden, Germany and France.[119] Sweden is supporting all building renovation efforts. In Germany the level of support varies between new and renovated buildings and includes several activities from energy-efficient measures in builings to the installation of heat pumps. In France support schemes include a direct income tax reduction or direct payment based on the investment cost of the heat pump.[120]

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[114] http://europeangeothermalcongress.eu/wp-content/uploads/2019/07/CUR-03-Belgium.pdf
[115] http://europeangeothermalcongress.eu/wp-content/uploads/2019/07/CUR-23-Romania.pdf
[116] EHPA 2019, Market data, https://www.ehpa.org/market-data/and https://www.ehpa.org/market-data/market-report/report-2020/
[117] EHPA 2019, Market data, https://www.ehpa.org/market-data/
[118] EHPA 2019, Market data, https://www.ehpa.org/market-data/
[119] European Copper Institute 2018, Heat Pumps, https://www.ehpa.org/fileadmin/user_upload/White_Paper_Heat_pumps.pdf
[120] European Copper Institute 2018, Heat Pumps, https://www.ehpa.org/fileadmin/user_upload/White_Paper_Heat_pumps.pdf

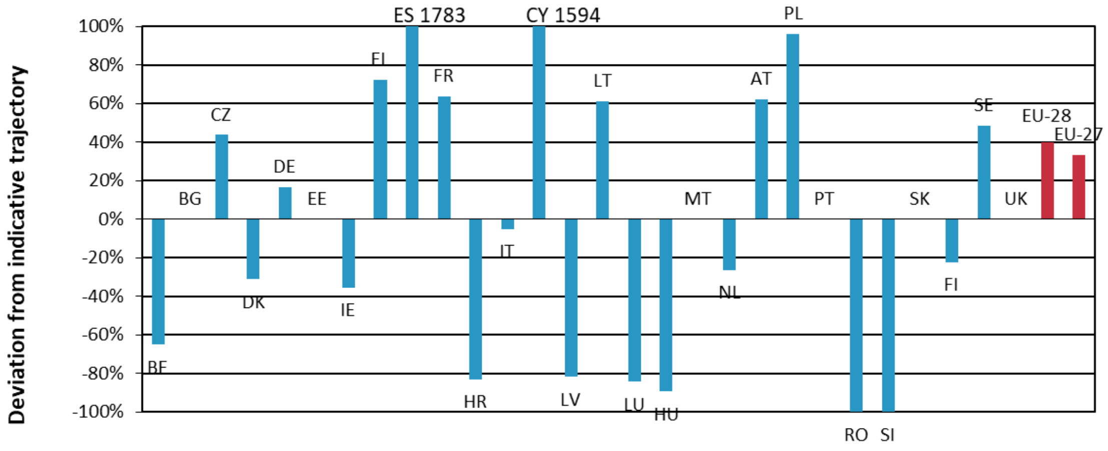

Figure 50. Deviation of actual 2019 deployment (Eurostat SHARES) from 2019 indicative trajectory (NREAP) for heat pumps[121] [122]

Geothermal Heating

Geothermal heat has been growing steadily since 2010, but still plays a marginal role in RES-H&C sector. Ten MS had not planned any consumption of geothermal heating in 2019. Nevertheless, of these MS, Denmark, the UK and Cyprus reported some small amounts of actual consumption (less than 2 ktoe). Sixteen MS underachieved their planned deployment, putting the EU-28 and the EU-27 in total below the aggregated indicative trajectory. In absolute numbers, the largest consumers are France (195 ktoe), Italy (152 ktoe), Hungary (136 ktoe), the Netherlands (133 ktoe) and Germany (122 ktoe) in 2019, while all other MS reported a consumption of less than 100 ktoe. Besides the relatively high absolute consumption, the Netherlands shows the highest growth rate (+49%) in 2019. With the Geothermal Heat Action Plan from 2018, the Netherlands has introduced better risk insurance, software support for exploration and a collaborative venture in which government and industry work together, providing a suitable framework for the deployment of geothermal heat.[123] Bulgaria and Spain remained MS with positive deviations, although no consumption increase in Spain and only minor increase in Bulgaria were observed. The Czech Republic reported no deployment, although 15 ktoe were planned in its NREAP. Lithuania also planned small amounts of consumption of geothermal heating in its NREAP, however, heating from geothermal technology has decreased from 2012 with 1.6 ktoe to zero in 2018 as well as in 2019. There is only one geothermal plant installed in Klaipėda City in the west of Lithuania, but due to problems with injection of the used geothermal water the plant is currently not operating.[124] Besides the Czech Republic and Lithuania, the largest negative deviation can be observed in Slovakia, whose deployment remained to be 5 ktoe from 2016 to 2018 and increased slightly to 5.6 ktoe in 2019, although a consumption of 50 ktoe to 80 ktoe was planned in its NREAP.

The use of geothermal energy can scale up very rapidly with the right policies and market conditions such as a stable policy framework, appropriate insurance schemes, a comprehensive research and innovation policy, a carbon price and ending support for fossil fuels.[125] The Netherlands is an example of how the geothermal sector can grow strongly given the right policies. Despite the fact that the Netherlands had not achieved its NREAP trajectory in 2019, it is still the driving European market for deep geothermal heating and cooling with six new plants commissioned in 2019.[126] In Belgium, the

[121] MT changed its NREAP in 2017 stating heat pump targets for the year 2020. However, as its updated NREAP does not contain a trajectory for heat pumps, data from its previous NREAP is used.
[122] PL: change of trend is due to the data change after update. Based on the updated Eurostat data, Poland was also on track in 2018.

[123] https://www.government.nl/topics/renewable-energy/government-stimulates-geothermal-heat

[124] European Geothermal Congress 2019, Geothermal Energy Use, Country Update for Lithuania, http://europeangeothermalcongress.eu/wp-content/uploads/2019/07/CUR-17-Lithuania.pdf
[125] EGEC Geothermal market report 2019, https://www.egec.org/media-publications/egec-geothermal-market-report-2019/
[126] EGEC Geothermal market report 2019, https://www.egec.org/media-publications/egec-geothermal-market-report-2019/

contribution of geothermal energy is still low, but there are promising initiatives such as new decree on geothermal projects and implementation of an insurance system covering geological risks, as well as two ongoing geothermal projects.[127] In the Czech Republic, no geothermal power is produced and two projects - in the pipeline - have been stagnating for a long time as government support is missing and feed-in tariffs for geothermal sources are low.[128]

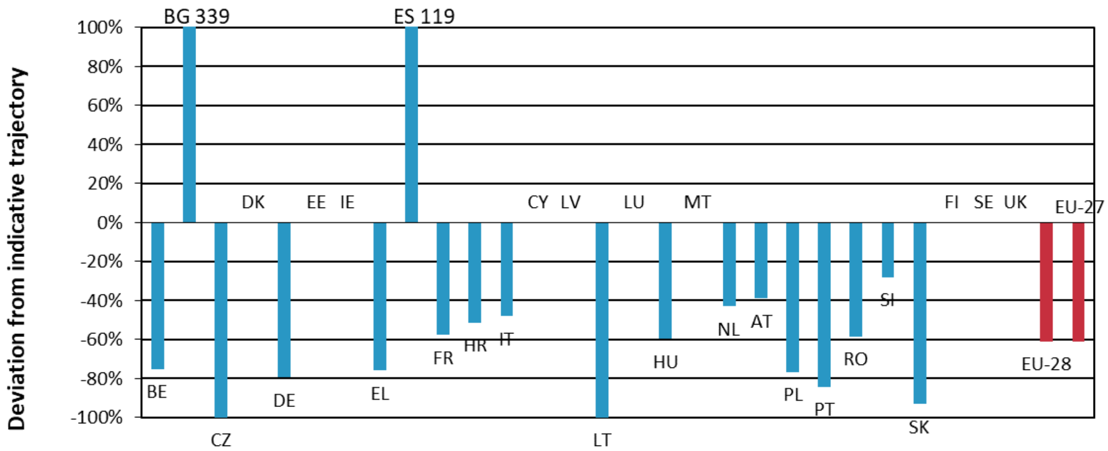

Figure 51. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for geothermal heating installations[129]

Bioliquids

Bioliquids contributes only 1% of the RES-H&C consumption, but the category's growth rate was +4% in the EU-28 as well as in the EU-27. Only eight MS planned heating and cooling from bioliquids in 2019. Sweden was the largest consumer in 2019 with 361 ktoe, followed by France with 291 ktoe, Germany with 207 ktoe, the Netherlands with 103 ktoe, Italy with 56 ktoe, Spain with 41 ktoe, Austria with 25 ktoe and Portugal with 11 ktoe. Belgium, Denmark, Greece, Latvia, Poland, Slovenia and Finland have reported small amounts of consumption (lower than 10 ktoe). Seven MS display a negative deviation from their indicative trajectory, of which only Romania reported no deployment at all. In total, the EU-28 and the EU-27 were below the envisioned indicative sectoral trajectory for bioliquids.

[127] http://europeangeothermalcongress.eu/wp-content/uploads/2019/07/CUR-03-Belgium.pdf

[128] http://europeangeothermalcongress.eu/wp-content/uploads/2019/07/CUR-08-Czech-Republic.pdf

[129] SI: The change of trend is due to the update of Eurostat data, according to the updated Eurostat data, SI underachieved as well in 2018.

Figure 52. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative trajectory (NREAP) for bioliquids[130] [131]

A.3 RES-T sector overview

While both sectors, RES-E and RES-H&C, featured shares above the (aggregated) NREAP trajectories on EU level, the RES share in the transport sector was slightly below the trajectory in the year 2019 (8.9% actual, whereas a share of 9% was planned). Overall, the consumption of RES-T on EU-28 level has reached 19,521 ktoe in 2019.[132] Biodiesel continued to be the dominating renewable energy source in the transport sector in 2019. It had the highest growth rate (+6%) between 2018 and 2019 on the EU-28 level, followed by renewable electricity. Although the usage and development of renewable electricity in the transport sector is still limited, its deployment is growing (e-mobility).

The development of biofuels and renewable electricity consumption in transport since 1995 is shown in Figure 53. Use of renewable electricity for transport have been growing since 2010, while the consumption of biodiesel and bioethanol had stagnated between 2014 and 2016 and has been increasing since then. 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 in 2019 was biodiesel, with 14,218 ktoe. "Other biofuels", a category, which includes primary solid biofuels, biogas and other liquid biofuels, has been on a growth track again since 2010 and stood at 161 ktoe in 2019. The use of renewable electricity grew slowly but steadily since 2006, standing at 2,049 ktoe in 2019.

[130] For SE, it was stated in the Progress Report that “there are some sustainable bioliquids, in the form of bio-oils that are used in Sweden in the year 2018. There are no statistics available, however, with regard to where they are used and whether they are used in industry or for electricity and heat production.” However, 340 ktoe was recorded according to Eurostat Energy Balances. Furthermore, the historical values for SE differ a lot between the ones provided in the Progress Reports (0 ktoe from 2011-2016) and by Eurostat.

[131] FR: Change due to Eurostat data update, Eurostat data from last year shows FR with less than 10 ktoe in 2018, but updated Eurostat data reveals 272 ktoe in 2018.

[132] Due to an update of the MS Progress Report template since 2017 as well as adaptations regarding the Eurostat Energy Balances terminology, discontinuities were observed in some MS and between data sources (Eurostat Energy Balances and Progress Reports). These observations are noted as footnotes below the affected figures.

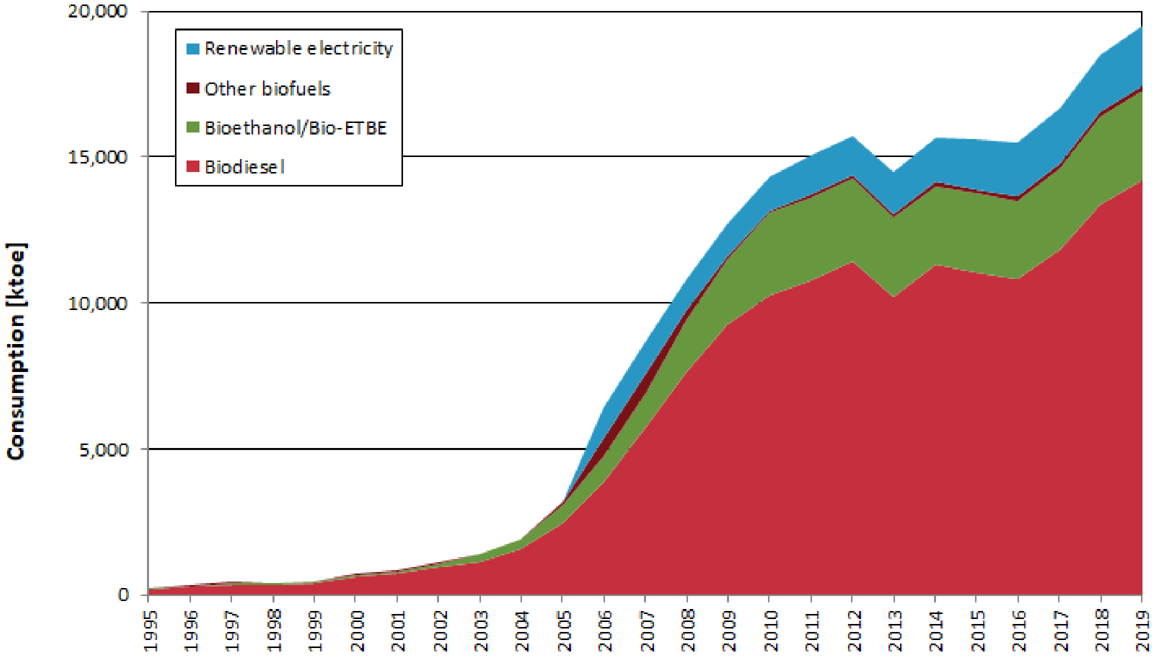

Figure 53. Consumption of energy in transport (RES-T) in the EU-28 for 1995-2019.[133] Source: Results of renewable electricity are based on Eurostat SHARES, other results are based on Eurostat Energy Balances

The following graphs and tables display the developments in the RES-T sector for individual MS.

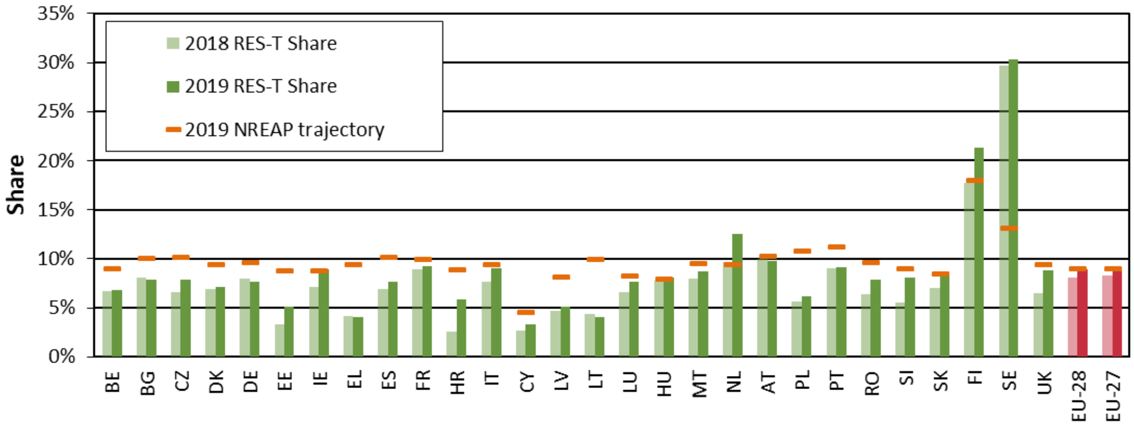

Figure 54. RES-T actual share vs. NREAP indicative sectoral trajectory 2019 (%). Source: Eurostat SHARES & NREAPs

In comparison to previous years, the RES-T sector has grown faster especially in 2018 and 2019. The RES-T growth rate between 2018 and 2019 was even higher than the growth rates in the RES-E and the RES-H&C sectors at EU-28 level. Nevertheless, a total of 23 MS are below their NREAP trajectories for RES-T for 2019. Thereby, Greece and Lithuania achieved less than half the share they were planning for in their NREAP indicative sectoral trajectories. This leads to a lower RES-T share than the NREAP indicative trajectory at EU-28 level. The highest share as well as the highest positive deviation can be observed for Sweden, where the RES-T share stands at around 30%, which surpasses by far the 14% foreseen for 2020 in their NREAP sectoral trajectory. The Netherlands as well, has

[133] The category other biofuels includes primary solid biofuels, biogas and other liquid biofuels.

already achieved the binding national RES-T 2020 target (10%) with a RES-T share of 12.5% in 2019. Besides Sweden and the Netherlands, Ireland, Hungary and Finland have surpassed their 2019 indicative sectoral trajectories. Among all MS lagging behind their 2019 NREAP RES targets, Estonia, Croatia and Romania display the highest increase in their share of RES-T, while Lithuania shows the largest decline from 2018 to 2019 of RES in the transport sector.

In 2019, Finland shows +3.6% increase on RES-T between 2018 and 2019 and continued to be on track with its NREAP trajectory. This results from the high growth rates of other liquid biofuels and renewable electricity consumption in transport sector. In general, the RES-T share in Finland is expected to grow further, since the support scheme to improve the electric transport infrastructure and the use of biogas in the transport sector has been updated for 2018-2021.[134] Moreover, Finland plans (as specified in its NECP) to increase the share of renewable energy to 30% of the final energy use in road transport and increase the number of electric and gas vehicles to 250,000 and 50,000 respectively by 2030.[135]

Besides Finland, the Netherlands shows a high increase in the RES-T share as well, from 9.6% in 2018 to 12.5% in 2019. This was due to the high growth rates of all biofuels as well as renewable electricity in transport, especially of biodiesel consumption in the transport sector. This is the result of an increased annual obligation since 2018 on fuel delivered to road- and rail transport as well as non-road mobile machinery.[136]

Regarding reasons for the slow uptake in e-mobility, there are on the one side economic, market, geopolitical challenges in battery supply for e-mobility as well as slow structural changes on the manufacturers' side and uncertainty about the most promising future energy source/mobility technology. Nevertheless, being far more efficient (in terms of tank-to-wheels efficiency) than combustion engine vehicles[137], electric vehicles are increasingly subsidised by national support schemes and thus experienced positive growth rates in 22 MS.

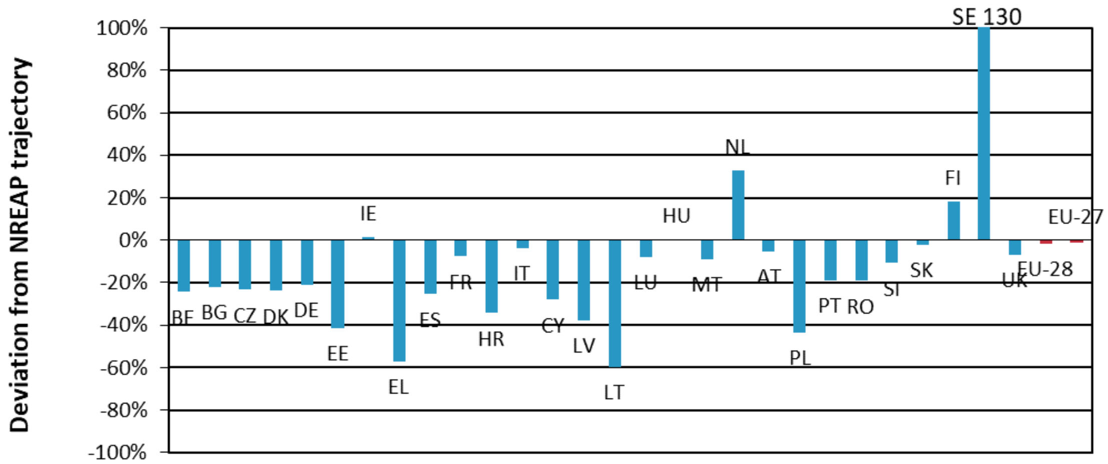

Figure 55. Deviation of actual 2019 share from 2019 NREAP indicative sectoral trajectory for RES-T. Source: Eurostat SHARES and NREAPs

[134] Intelligent Transport 2020, Finland updates infrastructure support for EV network and biogas transport, https://www.intelligenttransport.com/transport-news/103051/finland-updates-infrastructure-support-for-ev-network-and-biogas-transport/

[135] Finnland Ministry of Economic Aairs and Employment, NECP, https://ec.europa.eu/energy/sites/ener/files/documents/fi_final_necp_main_en.pdf

[136] Dutch Emissions Authority, https://www.emissionsauthority.nl/topics/reports---energy-for-transport/summary-yearly-report-energy-for-transport-2018

[137] EU Commission, Electric vehicles, https://ec.europa.eu/transport/themes/urban/vehicles/road/electric_en

Table 18. Growth rates in RES-T consumption in the EU-28 from 2018-2019 per technology. Source: Eurostat Energy Balances and Eurostat SHARES

Member State	RES-T [%]	Bioethanol/ Bio-ETBE [%]	Biodiesel [%]	Renewable electricity [%]	Other biofuels [%]	Hydrogen [%]
Belgium	1.69	14.14	-2.59	5.17	-	-
Bulgaria	9.89	11.27	9.32	14.49	-	-
Czech Republic	9.35	20.00	7.86	3.13	-	-
Denmark	6.89	1.78	6.83	18.17	-	-
Germany	0.34	-3.73	-0.66	8.21	68.54	-
Estonia	86.48	51.69	63.00	34.25	-	-
Ireland	22.03	-3.97	27.51	29.75	-	-
Greece	15.91	-	1.28	3.38	-	-
Spain	-3.03	-15.33	-1.78	-3.24	-	-
France	1.91	11.48	-0.41	3.00	-	-
Croatia	91.76	137.47	131.66	-3.70	-	-
Italy	1.72	-6.67	2.35	0.28	0.00	-
Cyprus	19.99	-	19.99	-	-	-
Latvia	0.14	-13.63	1.19	18.88	-	-
Lithuania	-3.35	21.77	-6.33	0.11	-	-
Luxembourg	5.47	70.69	-0.27	4.54	0.00	-
Hungary	4.33	-10.00	10.06	1.55	-	-
Malta	6.72	-	6.55	73.52	-	-
Netherlands	22.13	16.44	26.28	14.89	-	-
Austria	-2.27	-1.90	-2.79	-1.28	13.91	-
Poland	11.37	8.38	13.28	1.41	-	-
Portugal	3.49	46.17	2.77	1.13	-	-
Romania	34.16	8.16	52.22	-1.39	-16.60	-
Slovenia	26.57	-45.64	37.67	0.21	-	-
Slovakia	3.61	13.02	3.60	-7.09	-	-
Finland	16.44	5.64	20.24	8.98	36.59	-
Sweden	-5.09	-21.47	-3.80	8.12	-18.33	-
UK	28.55	-0.66	43.75	12.85	-	-
EU-28	**5.43**	**3.38**	**6.10**	**4.00**	**4.68**	**-**
EU-27	**3.54**	**3.99**	**3.45**	**3.38**	**4.68**	**-**

Table 19 RES-T consumption in the EU-28 in 2019 per technology. Source: Eurostat Energy Balances and Eurostat SHARES

Member State	RES-T [ktoe]	Bioethanol/ Bio-ETBE [ktoe]	Biodiesel [ktoe]	Renewable electricity [ktoe]	Other biofuels [ktoe]	Hydrogen [ktoe]
Belgium	531	129	356	46	0	0
Bulgaria	189	32	148	10	0	0
Czech Republic	387	74	267	47	0	0
Denmark	250	44	183	24	0	0
Germany	3043	720	1902	363	57	0
Estonia	34	7	20	1	5	0
Ireland	190	26	162	2	0	0
Greece	190	24	161	5	0	0
Spain	1754	130	1501	123	0	0
France	3460	653	2537	270	0	0
Croatia	73	1	62	11	0	0
Italy	1615	30	1246	338	0	0
Cyprus	11	0	11	0	0	0
Latvia	42	7	30	5	0	0
Lithuania	77	10	65	2	0	0
Luxembourg	134	17	113	4	0	0
Hungary	234	46	157	32	0	0
Malta	11	0	11	0	0	0
Netherlands	679	199	418	63	0	0
Austria	682	57	423	202	0	0
Poland	1117	187	838	91	0	0
Portugal	295	8	264	23	0	0
Romania	451	98	315	38	0	0
Slovenia	102	4	91	6	0	0
Slovakia	171	20	137	14	0	0
Finland	455	89	339	26	1	0
Sweden	1543	93	1198	155	97	0
UK	1799	386	1267	146	-	0
EU-28	**19521**	**3093**	**14218**	**2049**	**161**	**0**
EU-27	**17721**	**2706**	**12951**	**1903**	**161**	**0**

In the following sections, bioethanol/bio-ETBE, biodiesel, renewable electricity in transport and other biofuels are described more in detail.

Bioethanol/Bio-ETBE

The EU-28 consumed a total of 3,093 ktoe bioethanol and bio-ETBE in 2019. The consumption fluctuated from 2010 to 2015 between 2,700 ktoe and 2,870 ktoe, dropped to 2,679 ktoe in 2016 and has been increasing since then. In absolute numbers, the biggest consumers in 2019 were Germany with 720 ktoe, France with 653 ktoe and the UK with 386 ktoe. Cyprus and Malta reported no consumption. Besides the MS reporting no consumption, Italy and Croatia show the largest negative deviation. The EU as a whole is below the aggregated NREAP trajectory, while two MS were on track with their NREAP indicative trajectories: France shows +11% growth rate and became with 653 ktoe actual consumption on track, while only 625 ktoe were planned k in 2019; Belgium, the MS with the highest positive deviation, was on track with its 2019 NREAP RES target with 130 ktoe actual deployment versus 84 ktoe planned consumption, which results mainly from consuming more than double the amount in 2017 in comparison to in 2016. The steep increase of biodiesel consumption in 2017 occurred after the blending mandate was adjusted from 4 to 8.5% on January 1st of 2017.[138] On the contrary, Bulgaria was on track with its NREAP trajectory in 2018 but lagged behind in 2019, as the increase on consumption was slower than anticipated.

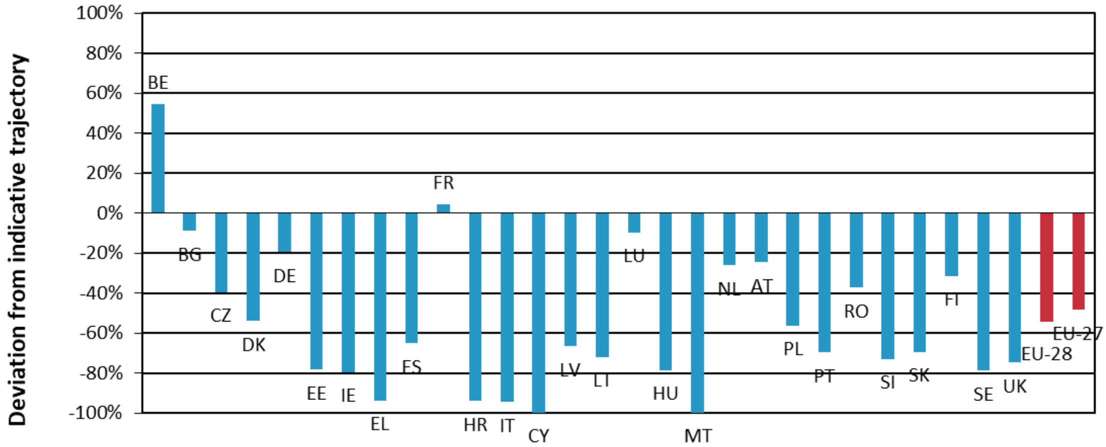

Figure 56. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative sectoral trajectory (NREAP) for bioethanol/bio-ETBE

Biodiesel

At EU-28 level, a total of 14,218 ktoe of biodiesel was consumed in 2019, thus biodiesel continued to be the largest contributor to the RES-T sector. However, much higher consumption was expected and therefore the EU as a whole lags behind the (aggregated) NREAP trajectory. Only eight MS were above their planned trajectory in 2019. A very large positive deviation is observed in Sweden, where 1,198 ktoe were reported as actual consumption versus 235 ktoe planned. In absolute numbers, the largest consumers are France with 2,537 ktoe, Germany with 1,902 ktoe, Spain with 1,501 ktoe, the UK with 1,267 ktoe and Italy with 1,246 ktoe. Despite the high absolute number in Germany, it lagged behind its NREAP trajectory. The largest negative deviations can be observed in Estonia and in Cyprus, of which Cyprus has the lowest contribution among all MS with 11 ktoe actual deployment (versus 23 ktoe planned). Malta contributed also only 11 ktoe in 2019, but it is on track with its planned contribution of 3 ktoe.

[138] https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Biofuels%20Annual_The%20Hague_EU-28_7-15-2019.pdf

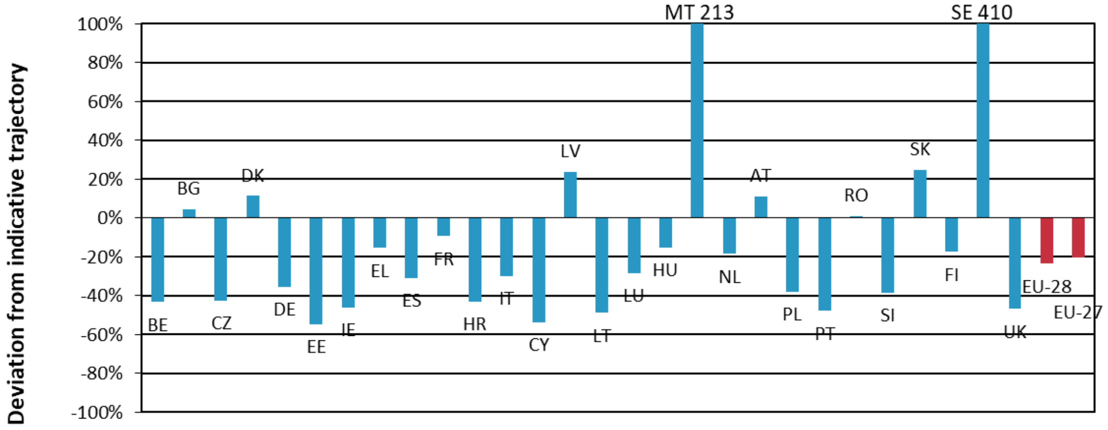

Figure 57. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative sectoral trajectory (NREAP) for biodiesel[139]

Renewable Electricity in Transport

Renewable electricity made the third-biggest contribution to the RES-T sector, following biodiesel and bioethanol/bio-ETBE, with 2,049 ktoe consumed in the EU-28 in 2019. This includes renewable electricity consumption in road, rail and all other transport modes. In absolute terms, the largest consumers were Germany (363 ktoe), Italy (338 ktoe), France (270 ktoe), Austria (202 ktoe) and Sweden (155 ktoe). Despite the high absolute values of the largest contributors, all these MS lagged behind with respect to its NREAP trajectory. The highest positive deviations can be observed in Poland, Estonia and Belgium, of which Estonia has reported only 1.5 ktoe consumption while 0.6 ktoe was planned for 2019. Cyprus and Malta have reported no to minor consumption although small amounts were planned. In general, consumption from renewable electricity increased slower than expected. As a result, only seven MS were on track with their plans, whereas on an aggregated EU-level consumption remains below the aggregated planned consumption. Nevertheless, as an increasing number of support programs are being prepared and available for electric mobility, growth rates are expected to rise steadily.

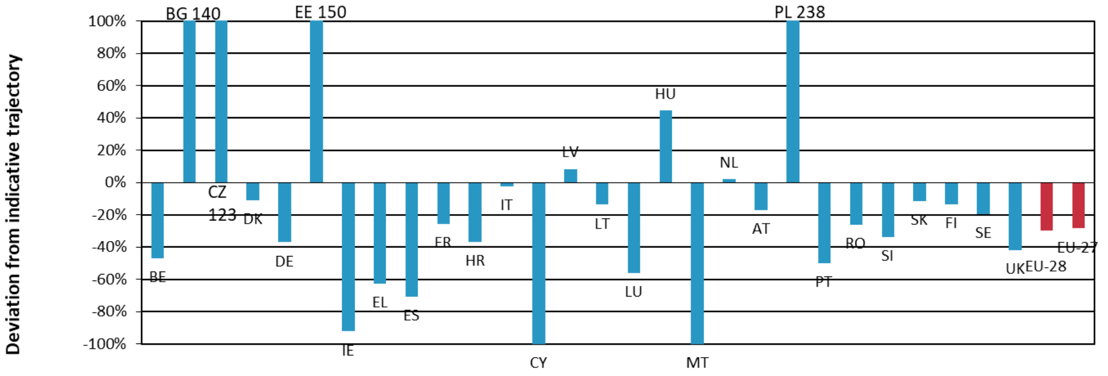

Figure 58. Deviation of actual 2019 deployment (Eurostat SHARES) from 2019 indicative sectoral trajectory (NREAP) for electricity in transport[140]

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[139] Remarkable data deviation between data source Eurostat Energy Balances and data source Progress Reports can be observed in the following MS and all have higher values in Eurostat Energy Balances: Belgium, Germany, France, Italy, Hungary, Malta, the Netherlands, Austria, and Sweden. Except for Belgium and France, the other MS reported substantially lower biodiesel consumption in the 5th Progress Reports in comparison to the 4th Progress Reports, whereas the reported consumption with other biofuels was higher. Therefore, it is assumed that these MS have categorized these two energy sources differently in the 5th Progress Reports.
MT changed its NREAP in 2017 stating new targets for biofuels in transport for the year 2020. However, as the updated NREAP does not contain a sectoral trajectory and a specification, data from its previous NREAP is used.

Other biofuels

The depolyment for this category includes biogas and other liquid biofuels (e.g. vegetable oils). Other biofuels consumption in the EU-28 has been increasing since 2010 and reached 161 ktoe in 2019. Sixteen MS had planned consumption in this category for 2019, of which only Estonia and Sweden show a positive deviation. This leads to a negative deviation at aggregated EU level. Although the highest positive deviation is observed in Estonia, in absolute terms only 5 ktoe consumption were reported for 2019 (while 0.3 ktoe were planned). Consumption ranging between 0.02 ktoe and 97 ktoe was recorded in only eight MS, of which Luxemburg and Finland had not planned any consumption. Italy, Austria and Romania have all reported a consumption of less than 1 ktoe, which was much less than their NREAP trajectories (45 ktoe, 87 ktoe and 6 ktoe respectively). The most ambitious NREAP trajectories were set by France (140 ktoe) and Germany (154 ktoe), while no actual deployment was reported by France and Germany's consumption only reached 57 ktoe.

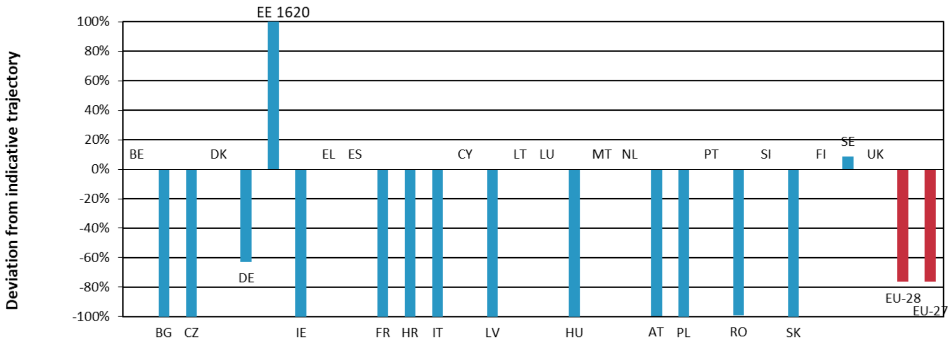

Figure 59. Deviation of actual 2019 deployment (Eurostat Energy Balances) from 2019 indicative sectoral trajectory (NREAP) for other biofuels[141]

Hydrogen

No Eurostat data is available for hydrogen from RES consumed in the transport sector. Also, all NREAPs indicative sectoral trajectories estimate zero deployment and all Progress Reports report zero consumption or provide no data. Therefore, an assessment of this technology is not performed.

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[140] Latvia has reported 8.9 ktoe being consumed in 2018 in the Progress Report while 4.56 ktoe was recorded in Eurostat SHARES. Malta has reported 0.04 ktoe in the Progress Report while no consumption was recorded in 2018 according to Eurostat SHARES.

MT changed its NREAP in 2017 stating new targets for renewable electricity in transport for the year 2020. However, as the updated NREAP does not contain a sectoral trajectory, data from its previous NREAP is used.

[141] After the update of the Progress Report template in 2017 with a more detailed list of fuels, the reported values for some categories (such as "Other Biofuels" and "Biodiesel") in the 5th Progress Report are incontinous in comparison to the values from the previous Progress Reports. A noticeable inconsistency is observed in the following MS: Denmark, Germany, Estonia, Italy, Hungary, Malta, the Netherlands, Austria and Sweden. Except for Denmark and Estonia, the other MS reported substantially lower biodiesel consumption in the 5th Progress Reports in comparison to the 4th Progress Reports, whereas the reported consumption for other biofuels was higher. Therefore, it is assumed that these MS have categorized these two energy sources differently in the 5th Progress Reports. For Estonia, a new support program for other biofuels has been executed in 2018 and 3.3 ktoe consumption was reported in the Progress Report, whereas no consumption was recorded in the Eurostat Energy Balances.

APPENDIX B APPENDIX B. LITERATURE REFERENCES

In this chapter the full references are provided for the literature as referred to in Chapter 3.

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