EXECUTIVE SUMMARY

THE STATE OF RENEWABLE ENERGIES IN EUROPE

EDITION **2019**

19th EurObserv'ER Report

ENERGY INDICATORS

18%

Share of energy from renewable sources in gross final energy consumption in the EU 28 in 2018

32.1%

Share of renewable energy in the electricity generation of EU 28 in 2018

19.7%

Share of renewable energy in the heating and cooling consumption in the EU in 2018

102.9 Mtoe

Renewable heat and cooling consumption in the EU 28 in 2018

1 051.5 TWh

RES electricity generation in the EU 28 in 2018

MAIN TARGET – A SURGE IS EXPECTED IN 2019 AND 2020

With two years to go before the deadline, the Member States' energy trajectories are well underway. It is becoming increasingly clear which countries will meet their binding commitments on renewable energy and which are lagging too far behind to meet their targets. Through its Shares tool, Eurostat has published its results for the renewably-sourced energy share that meets the 2009/28/EC directive criteria. The renewable energy share of gross final energy consumption was put at 18% in 2018, which is half of a percentage point more than in 2017.

RENEWABLE HEAT IS STRUGGLING TO IMPROVE ITS FIGURES

According to the Eurostat data made available through its SHARES (Short Assessment of Renewable Energy Sources) tool (updated on 28 January 2020), renewable heat (and cooling) consumption rose slightly from 102.4 to 102.9 Mtoe (by 0.5 Mtoe). This indicator includes both the energy directly used by end-users in industry and "other sectors" (e.g.: residential, commercial, agriculture, forestry, fishing and other non-specified sectors such as military), in addition to the heat produced by the processing sector (derived heat) and the renewable output yielded by heat pumps.

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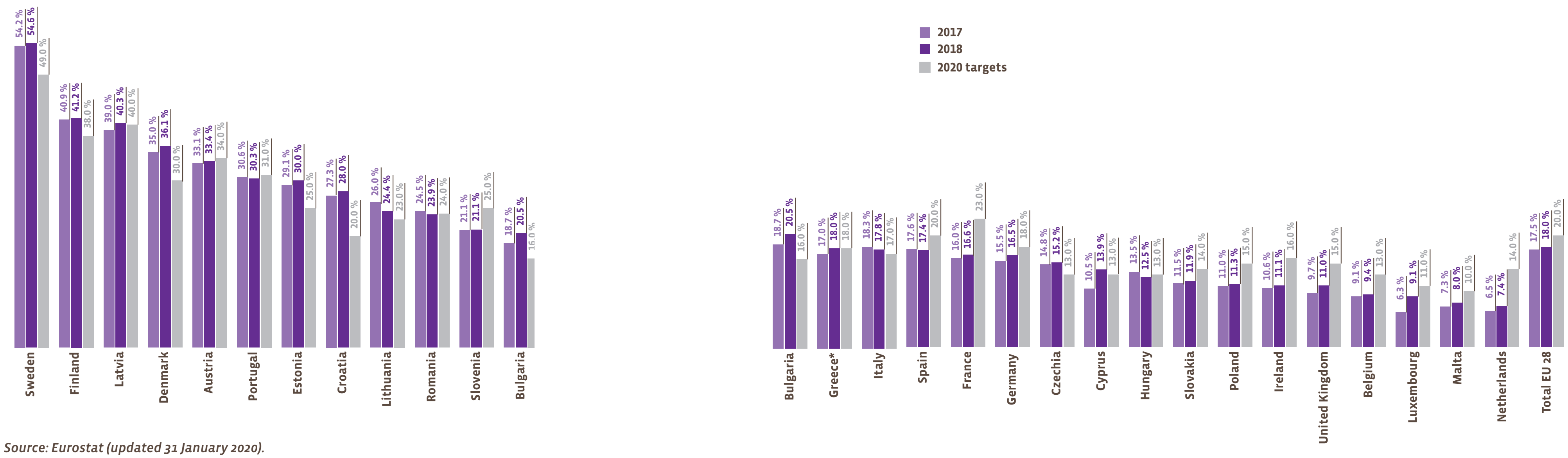
Share of energy from renewable sources in gross final energy consumption in 2017, 2018 and 2020 targets



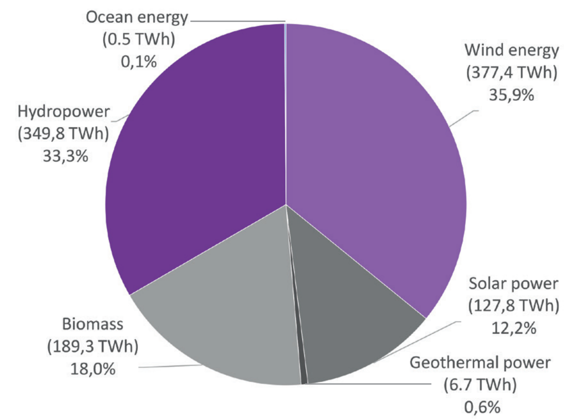
Source: Eurostat (updated 31 January 2020).
** Year 2018 (estimated, provisional for Greece).*

THE 1000-TWH RENEWABLE ELECTRICITY THRESHOLD HAS BEEN WELL AND TRULY OUTSTRIPPED

This is the best renewable energy headline 2018 has to offer. Real (non-normalised) gross renewable electricity output surged between 2017 and 2018. For the first time it sailed past the 1 000 TWh output threshold to reach 1 051.5 TWh in 2018, which represents 8.0% growth over 2017. ☐

2

Renewable electricity generation (in TWh) and share of overall renewable generation (in %) in 2018 in the EU 28



Source: EurObserv'ER

SOCIO-ECONOMIC INDICATORS

1 512 900

FTE in renewable energy sector in the EU in 2018

€ 158.9 billion

RES turnover in the EU 28 by renewable technologies in 2018

360 600

Jobs in EU solid biomass sector in 2018

325 300

Jobs in EU wind sector in 2018

€ 43.9 billion

Turnover of wind power sector in the EU in 2018

EMPLOYMENT

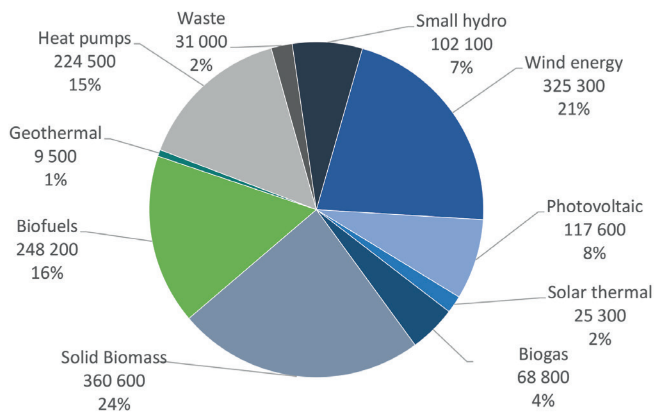
Overall, around 1.51 million persons are directly or indirectly employed in the European Union renewable energy sector. This represents a gross growth of 67 000 jobs (+4.6%) between 2017 and 2018.
20 out of 28 Member States either increased or maintained their number of renewable energy jobs. The top 5 countries in terms of employment are: Germany (263 700 jobs, 17% of all EU renewable employment), Spain (167 100 jobs, 11%), France (151 600 jobs, 10%), the UK (131 900 jobs, 9%), and Italy (121 400 jobs, 8%).

The largest growth in employment were found in Bulgaria (+18 400 new jobs, equal to +81%), Austria (+14 900, equal to +62%), and Poland (+11 900 jobs, equal to +16%). The greatest losses were observed in Germany (-27 000 jobs, equal to -9%), Italy (-8 500, -7%) and Finland (-3 400 jobs, equal to -7%).
Solid biomass (360 600 jobs, 24% of the total EU) retained its title as the largest sector in terms of renewable energy induced employment, ahead of wind power (325 300 jobs, 22%), and biofuels (248 200 jobs, 16%). The most significant upward jump in employment per technology was in the heat pumps sector with an additional 33 000 jobs (+17%), followed by PV that saw an addition of 26 700 new jobs (+29%). The biofuel sector also grew by 17 800 FTE (+8%).

TURNOVER

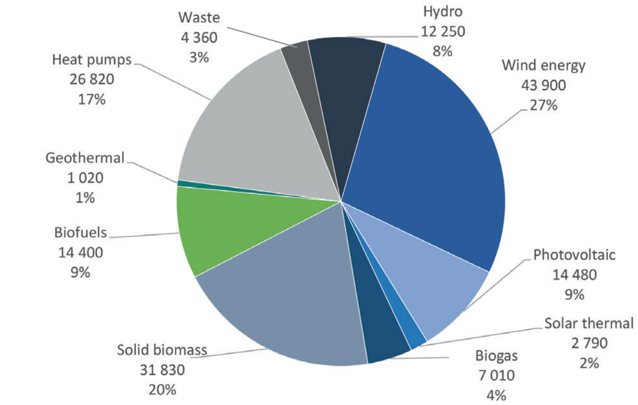
In total the renewable energy related industry turnover in EU 28 Member States in 2018 amounted to around €158.9 billion, representing a gross growth of around €4.2 billion against 2017 (+2.7%).
18 out of 28 EU Member States either increased or maintained their industrial turnover created by renewable energy sources.
The top 5 Member States in terms of turnover are Germany (€35.5 billion), France (€19.8 billion), Spain (€15.0 billion), Italy (€14.0 billion) and the United Kingdom with €13.3 billion.
The largest growth in turnover according to the EurObserv'ER modelling was observed in Austria (+€2.4 billion), France (+€1.4 billion), and the Netherlands (+€1.3 billion). The largest dips in turnover occurred in Germany (-€3.7 billion), Finland (-€530 million), and Denmark (-€520 million).
The largest renewable energy technologies in terms of industry sector turnover were wind power with €43.9 billion, followed by solid biomass (€31.8 billion), and heat pumps (€26.8 billion). The so-called "Green Deal" announced by the new EU Commission shall put the EU on track to further reduce emissions. It raises hopes for a continued upward development of renewable energy sources in the EU over the coming decade and along with that, even more positive socioeconomic indicators. □

3
Renewable energy employment by technology in the EU-28 in 2018 in FTE (Total: 1.512 million)



Source: EurObserv'ER

4
Renewable energy turnover by technology in the EU-28 in 2018 (Total: € 158.9 billion)



Source: EurObserv'ER

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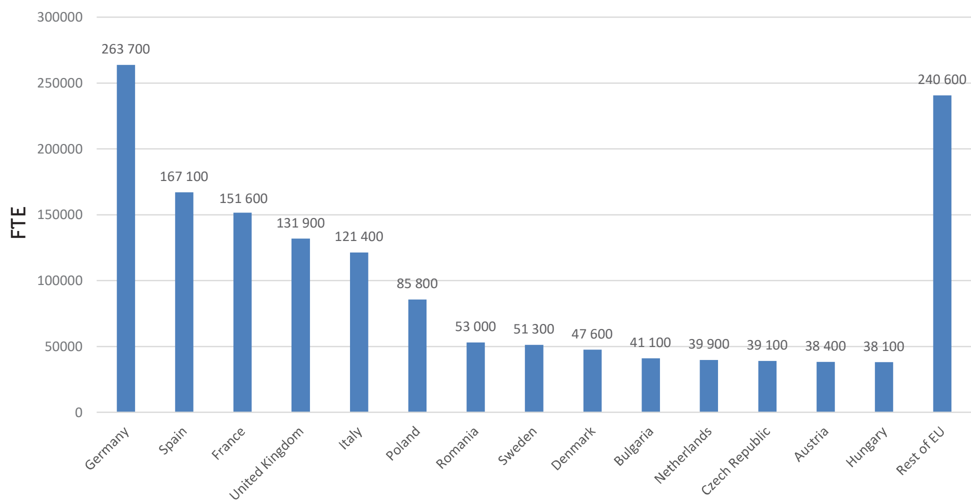
Renewable energy employment by country in the EU-28 in 2018



Source: EurObserv'ER

INVESTMENT INDICATORS

€ 31.5 billion

Investments in RES capacity (asset finance) 2018

€ 24.4 billion

Investment in wind capacity (asset finance) in 2018

€ 0.8 million

Investment expenditures per MW of solar PV in 2018

€ 1.34 million

Investment expenditures per MW of onshore wind in 2018

€ 2.4 billion

Venture capital (VC) and private equity (PE) investments in 2018

INVESTMENT IN RENEWABLE ENERGY CAPACITY

The indicators on investment in renewable energy projects capture asset finance for utility-scale renewable energy generation projects. Aggregating asset finance for all RES sectors shows that investment in energy generation capacity increased notably between 2017 and 2018. Investments totalled almost €27 billion in 2017 compared to €31.5 billion in 2018.
After a large slump of investments in 2017 compared to the previous year, investments into biomass power plants increased again in 2018. In 2018 biomass investments totalled €902 million, which corresponds to an increase by 41% compared to the €638 million in 2017.
For a second time in a row, investments in geothermal capacity increased in the EU, namely from €133 million in 2017 to almost €300 million in 2018. As in the last editions, investment costs for utility-scale RES capacity in the EU were compared to selected trading partners of the EU, namely China, Canada, India, Japan, Norway, Russia, Turkey and the United States. The analysis of investment costs shows a heterogeneous picture across RES technologies in the EU. Overall, the analysis shows that in the two sectors with the highest investments in the EU, onshore wind and solar PV, investment costs per MW of capacity seem to be below the average of the considered non-EU countries, at least in 2018. Investments expenditures per MW of onshore wind capacity in the EU dropped by more than 2% from €1.37 million in 2017 to €1.34 million in 2018. In the EU solar PV sector, the investment costs dropped by almost 25% from €1.06 million per MW to only €0.80 million. For biomass, investment expenditures per MW seem to have been higher in the EU in 2017, but on a similar level to the analysed non-EU countries in 2018.

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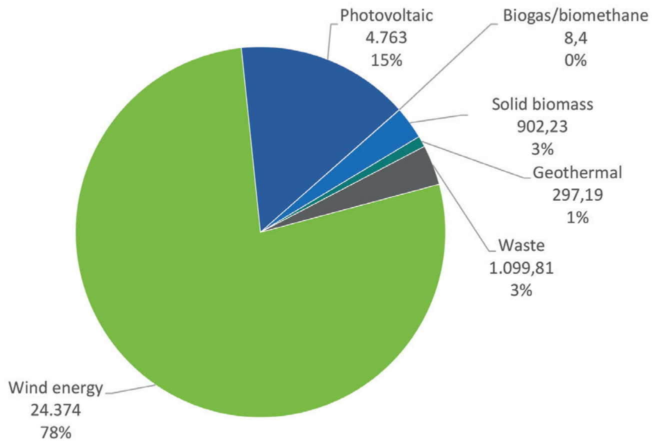
Asset finance - New Built (in mln €) in 2018 by technology



Source: EurObserv'ER

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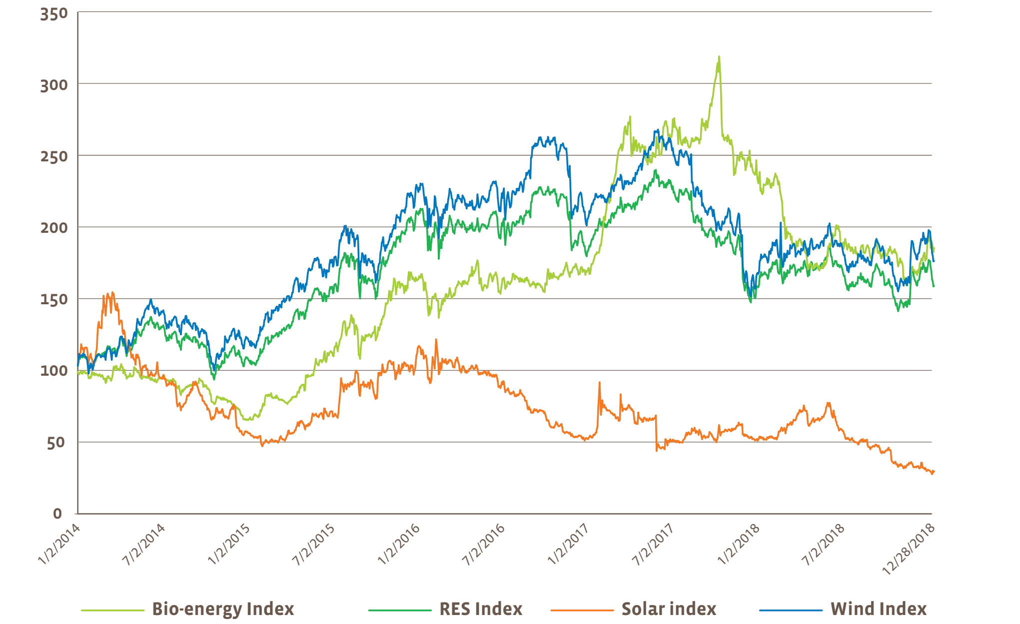
Evolution of the RES indices during 2014 to 2018



Source: EurObserv'ER

VENTURE CAPITAL & PRIVATE EQUITY

Between 2017 and 2018, total venture capital (VC) and private equity (PE) investments in renewable energy companies increased by 49%. In 2018, total VC/PE investments in the EU amounted to €2.4 billion compared to €1.6 billion in 2017. The development of VC/PE investments in the RES sectors surpasses the overall positive trend in VC/PE investments in the EU. According to the data of Invest Europe, overall EU-wide VC/PE investments (covering all sectors) increased by around 7%. The overall increase in VC/PE investments was driven by high increases in PE investments, while VC investments declined notably between the two years. When taking a more detailed look at the respective RES technologies, the highest VC/PE investments in both years can be observed in the solar PV sector, namely €1.03 billion in 2017 and even €1.59 billion in 2018. The second largest sector is wind, where, after a decline in VC/PE investments between 2016 and 2017, investments increased again in 2018 to €554 million.

PERFORMANCE OF RES TECHNOLOGY FIRMS AND ASSETS ON PUBLIC MARKETS

In order to capture the performance of RES companies, i.e. companies that develop / produce the RES technology, EurObserv'ER presents indices based on RES company stocks. Listed Wind, Solar, and Bio-Energy firms performed quite differentially in 2017 and, in particular, 2018. In the second half of 2018, the overall performance of EU solar firms on stock markets declined and the Solar Index closes at the lowest value since the beginning of 2014. The Wind Index grew substantially until the second quarter of 2017, but subsequently wind firms experienced a noticeable decline in their performance on stock markets. Bio-energy firms performed exceptionally well in 2017. After a significant drop in the first quarter of 2018, the Bio-Energy Index stabilised, but still closed notably below its 2018 starting point. □

RENEWABLE ENERGY COSTS, PRICES AND COST COMPETITIVENESS

RES-E

Energy costs for wind and solar PV reduced significantly since 2010

RES-H

LCoE for solid biomass heat is competitive in many EU countries

METHODOLOGY

The energy competitiveness of renewable energy technologies was assessed by presenting aggregate results for the European Union. The estimated renewable energy production costs are expressed in euro per megawatt-hour, €/MWh and are compared to conventional forms of energy. Comparing the levelised cost of energy (LCoE) allows for the presentation and subsequent analysis of different technologies in a comparable manner. The renewable energy technology LCoE analysis requires a significant amount of data and assumptions, such as the capital expenditures, operational expenditures, fuel costs, economic life, annual energy production, auxiliary energy requirements, fuel conversion efficiency, project duration and the weighted average cost of capital (WACC). A Monte Carlo (MC) approach is then applied to perform the LCoE calculation resulting in LCoE ranges. while technology costs were derived from (JRC 2018), fuel price assumptions were taken from (Elbersen et al, 2016) and interpolated from modelled data.

RENEWABLE ELECTRICITY

Whereas especially the costs of electricity from wind power and solar PV have strongly come down compared to the 2005 estimates, the difference from the 2018 price ranges compared to 2017 is estimated to be moderate. Note that for individual renewable projects cost reductions may be sharper (or less) than indicated here. The country variations among Member States are mostly a result of differences in assumed yield (for solar energy and wind power) and financing conditions. The graphs depicted here show aggregate values for the European Union as a whole. Both solar PV variants are assumed to have realised important cost reductions compared to 2005, making this technology more and more competitive. In the residential sector, PV is in multiple countries competitive compared to residential electricity prices. Wind energy investment costs are assumed to have decreased rapidly since 2005, both for onshore and offshore, resulting in lower LCoE levels.

RENEWABLE HEAT

For the technologies producing heat, the LCoE for solid biomass is overlapping the reference heat range, indicating it is competitive in many countries. The same is true for solar water heaters, but not in all countries of the European Union. According to the analysis, heat captured from ambient heat via heat pumps (through small-scale equipment) shows relatively high LCoE levels. Scaling up to collective systems, possibly in combination with district heating, may decrease the costs.

RENEWABLE TRANSPORT

LCoEs for biofuels for transport show quite a narrow range, above the reference transport fuel price levels. □

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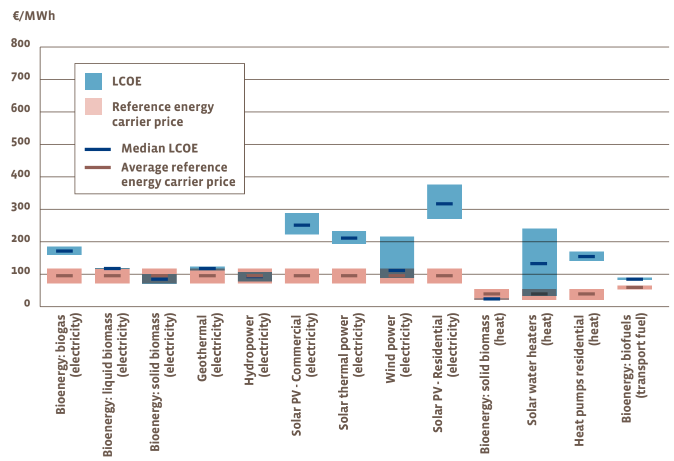
LCoE and reference energy carrier (€/MWh) EU ranges derived from Member State analysis for 2010



Source: EurObserv'ER

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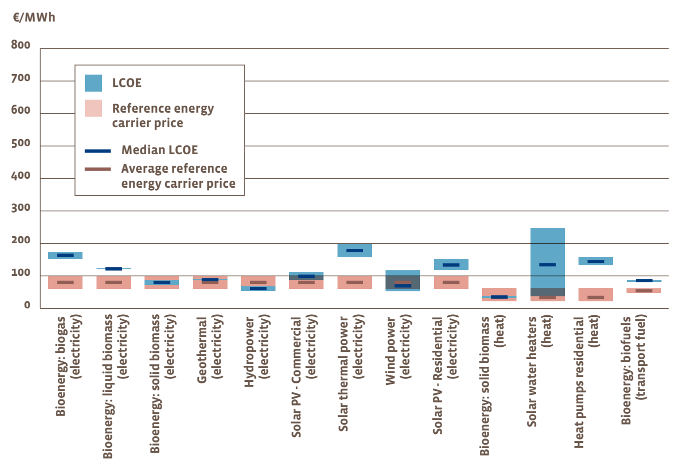
LCoE and reference energy carrier (€/MWh) EU ranges derived from Member State analysis for 2018



Source: EurObserv'ER

AVOIDED FOSSIL FUEL USE AND RESULTING AVOIDED COSTS

351.3 Mtoe

of fossil fuels substituted by RES in 2018

€ 110.4 billion

Avoided annual expenses in fossil fuels in EU 28 through RES in 2018

LESS CONVENTIONAL ENERGY CARRIERS, AVOIDED BY RENEWABLE ENERGY

Avoided fossil fuels represent conventional non-renewable energy carriers not consumed – both domestic and imported fuels – due to development and use of renewable energy. Avoided costs refer to the expenses that do not occur as a result of avoided fossil fuels. These are estimated as follows: cumulative amounts of avoided fossil fuels multiplied by the corresponding fuel price levels observed in the various countries represent the avoided costs. Multiple methodological issues are mentioned in the State of Renewable Energies report.

The avoided fossil fuel costs are based on the country specific fuel prices derived from multiple sources (Eurostat, European Commission). Overall, fossil fuel prices in 2018 were higher than the prices in 2017.

In 2017 and 2018 renewable energy substituted around 329.9 Mtoe and 351.3 Mtoe of fossil fuels respectively. These figures correspond to an avoided annual cost of EUR 89.0 billion for EU28 collectively in 2017, increasing to EUR 110.4 billion in 2018. The largest financial contributions derive from renewable electricity and renewable heat (at approximately equal contributions together representing about 90% of the avoided expenses).
While the penetration of renewable energy (expressed in avoided fossil fuels) expanded by approximately 6.5% from 2017 to 2018, the cumulative effect of the avoided fossil fuel expenses is, with a 24% increase (€ 89.0 billion to €110.4 billion) more pronounced. Reason for this is the increasing fossil fuel prices in 2018 compared to 2017.

Among the RES technologies, solid biomass for heating purposes avoided the purchase of fossil fuels at an amount of €34.6 billion in 2018 (€28.4 billion in 2017). Next, hydropower has been responsible for €24.3 billion in 2018 (€20.4 billion in 2017, both for normalised production). Onshore wind is third in the row with €15.3 billion in 2018 (€12.1 billion in 2017, both for normalised production). □

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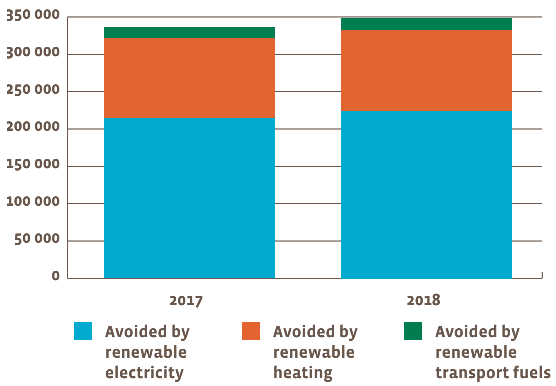
Avoided fossil fuels through renewables in 2017 / 2018 per sector (ktoe)



Source: EurObserv'ER based on EEA data

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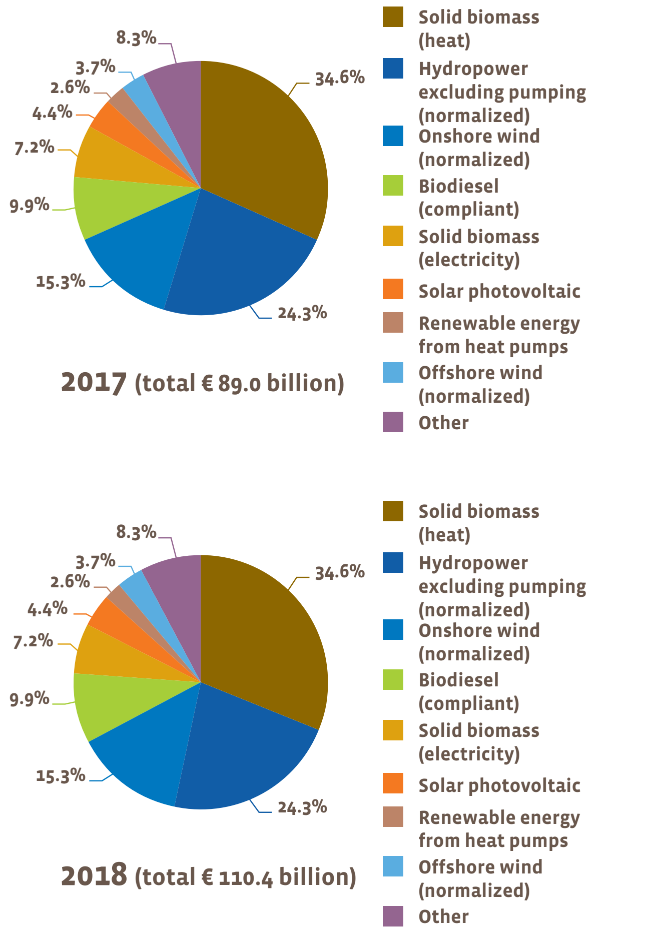
Avoided fossil fuel costs in EU-28 through renewables in 2017 and 2018



Source: EurObserv'ER based on EEA data

INDICATORS ON INNOVATION AND COMPETITIVENESS

Over 1 400

RET patents in EU in 2015

Over 7 800

RET patents in China in 2015

€m 2 372

Net exports of wind technologies in the EU in 2018

€m 2 911

Net imports of PV technologies to the EU in 2018

R&D INVESTMENTS

A closer look at the public R&D investment in all renewable energies technologies reveals that the EU 28 has the largest amount of public R&D spending in renewable energies technologies, closely followed by the U.S., which has increased its amount of spending between 2017 and 2018, while the value has slightly decreased in the EU28. Japan follows up the EU 28 at the third rank, while Germany, France and Korea score at ranks four, five and six. Yet, due to many missing values in the data, this table has to be interpreted with caution. The GDP shares display a very strong position of Denmark, and Norway and the Netherlands (2017), followed by Japan, Korea and Germany. The EU 28 scores in the midfield ahead of the U.S. Within the EU 28, the largest shares can be found in Denmark, the Netherlands, Germany, France and the UK. However, only a few countries display data in 2018, which makes comparisons difficult.

PATENT FILINGS

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INTERNATIONAL TRADE

Denmark scores ahead of the remaining countries, i.e. goods related to RET technologies have a large weight in Denmark's export portfolio. Positive specialization values can also be found for Luxembourg, China (2017), Japan, Spain, Hungary, the Netherlands, Germany, the U.S., Croatia and Portugal while all other countries (besides the «rest of the world» group) show a negative specialization regarding the export of goods related to RET technologies in 2018. □

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Public R&D investments in renewable technologies

		Public R&D Exp. (in € m)		Share of Public R&D Exp. by GDP	
		2017	2018	2017	2018
EU 28	Germany	n.a.	197.7	n.a.	0.0066%
	France	127.2	128.0	0.0059%	0.0058%
	UK	94.7	84.5	0.0045%	0.0039%
	Italy	40.5	42.8	0.0025%	0.0026%
	Denmark	28.3	42.5	0.0104%	0.0154%
	Slovakia	n.a.	0.8	n.a.	0.0010%
	Spain	23.6	n.a.	0.0021%	n.a.
	Malta	0.0	n.a.	0.0005%	n.a.
	Netherlands	60.8	n.a.	0.0087%	n.a.
	Romania	2.5	n.a.	0.0015%	n.a.
	EU 28 Total	728.6	664.7	0.0051%	0.0046%
Other Countries	United States	570.2	639.7	0.0033%	0.0037%
	Japan	n.a.	348.3	n.a.	0.0083%
	Korea	100.3	105.8	0.0074%	0.0077%
	Canada	78.1	71.5	0.0053%	0.0049%
	Norway	55.5	49.2	0.0152%	0.0133%
	Australia	n.a.	35.1	n.a.	n.a.
	Turkey	14.1	20.8	0.0016%	n.a.
	New Zealand	1.5	n.a.	n.a.	n.a.

Source: JRC SETIS, Eurostat, WDI Database ; Note : the sum across technologies is only given, if data of all RET in one country are available, i.e. as soon as one RET is missing, the data are indicated as n.a.

FLEXIBILITY OF THE ELECTRICITY SYSTEM

Number of countries having used more than 75% of the following flexibility mechanisms during critical hours in 2018:

8
Generation Flexibility

7
Transmission Flexibility

1
Market Flexibility

2
Operation Flexibility

FLEXIBILITY INDICATORS

To depict the flexibility of a power system in critical hours four indicators are employed that cover generation, transmission, intraday market and operational balancing. A detailed description of the methodological approach can be found under: www.eurobserv-er.org. In the following, the generation and transmission flexibility indicator is depicted.

TRANSMISSION FLEXIBILITY

To measure up-flexibility, we calculate the share of the used dispatchable generation capacity in critical hours to the estimated available total flexible generation capacity. The results are depicted in Figure 13. Compared to 2017, the use of flexible generation capacities during critical hours has increased. Seven of the investigated EU MS, namely Belgium, Bulgaria, Spain, Finland, France, Poland and Slovenia used (almost) their total estimated generation flexibility potential during critical hours. Apart from Lithuania all EU MS increased their shares. In total, eight countries remained at or below the 50% -threshold of their generation flexibility potential in 2018.

GENERATION FLEXIBILITY

A further option to compensate unforeseen changes in generation or load, is the transmission - cross-border exchanges. To depict the application of this mechanism, the hourly import flows in critical hours are compared to the maximum hourly import flows within the respective year. Figure 14 shows the up-flexibility (imports) needed in critical hours during 2017 and 2018. The closer the bars are to the 100% line (orange line), the more available capacity of the interconnections has been used in the critical hours. In 2018, the utilized transmission flexibility between neighboring EU MS has increased. The Netherlands (91%), Slovenia (90%) and the United Kingdom (89%) depict the highest ratios, which states that these countries used around 90% of their power flows in times when power was scarce. In total 18 of the 25 investigated countries depict transmission flexibility indicators of 50% or higher. Another EU MS that depict a significant growth is Slovenia, which almost tripled its ratio from 35% in 2017 to 90% in 2018. Countries like Bulgaria (56%), Germany (46%), Denmark (62%), Estonia (61%) and Sweden (69%) depict transmission ratios that have increased by at least 50%. In contrast, France (35%), Ireland (38%) and Spain (39%) following Romania, display rather low levels of the indicator, suggesting a low level of adjustments through imports during critical hours. □

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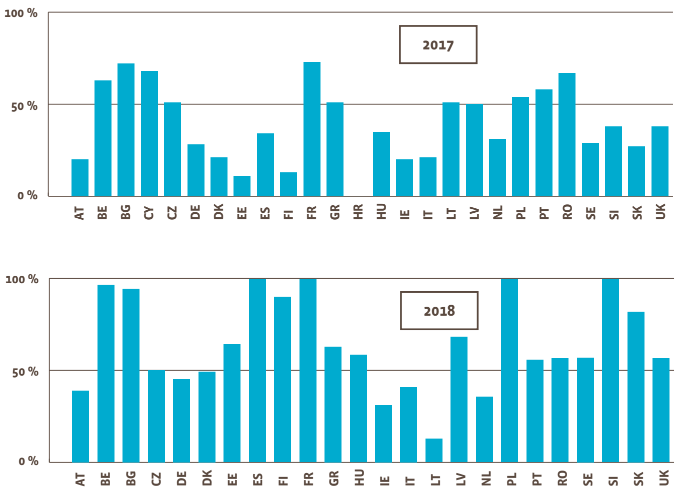
Flexible generation in critical hours to available flexible generation (%) in 2017 and 2018



Source: EurObserv'ER - own assessment based on ENTSO-E data downloaded 10/2019. Note: no data available for CY, HR, LU and MT. Updates on generation capacity with data of net generation capacity in 2017 and installed generation capacity in 2018, due to incomplete data for installed generation capacity in 2018 and no data availability of net generation capacity in 2018.

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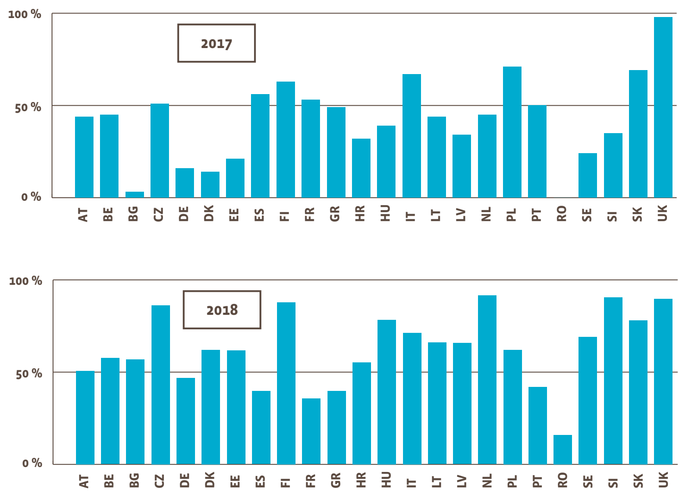
Transmission up-flexibility in critical hours



Source: EurObserv'ER - own assessment based on ENTSO-E data downloaded 10/2019. Note: no data for CY, IE, LU and MT. In 2017 also no data for IE and LU.

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