Japan's Mikawa Power Plant is the first solid biofuels plant to be fitted with a carbon capture and storage (BECCS) system. The plant uses palm kernel shells as the primary fuel source.

+2.2%

The evolution of inland consumption from solid biofuels in the EU 28 between 2018 and 2019

SOLID BIOFUELS BAROMETER

A study carried out by EurObserv'ER.

EurObserv'ER

Solid biofuels energy consumption was 2.2% higher in 2019, reaching 102.6 Mtoe in the EU28 countries, according to EurObserv'ER. Leaving aside the UK, the consumption figure was 94.5 Mtoe and posted 1.8% growth. The increment can be ascribed to both a significant rise in the electricity output of several countries and also to about 1.1% of additional heat consumption with or without the UK's consumption.

106.0 TWh

The electricity production from solid biofuels in the EU 28 in 2019

80.4 Mtoe

The heat consumption from solid biofuels in the EU 28 in 2019

SOLID BIOFUELS BAROMETER – **EUROBSERV'ER** – DECEMBER 2020

Biochar production for carbon storage purposes opens up a potentially new activity sector to bioenergy players.

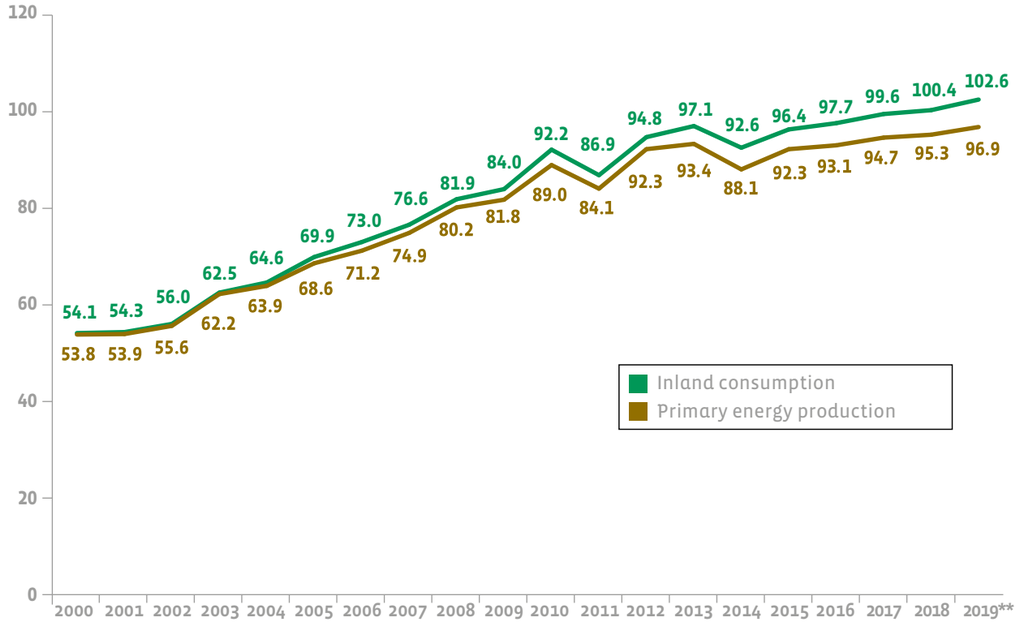
Solid biofuels is an umbrella term for all solid organic components to be used as fuels. They include wood, timber industry by-products (wood chips, sawdust, etc.), wood pellets, black liquor from the paper industry, straw, bagasse, animal waste and other solid plant residues including the renewable portion of solid industrial waste. Energy recovery from solid biofuels is mainly used to produce heat and electricity. Charcoal is also an element of solid biomass but is accounted for separately and is not included in the indicators of this barometer; thus, they cover solid biofuels, excluding charcoal. By way of illustration, about 400 ktoe of final charcoal energy is consumed in the European Union. Lignocellulosic biomass (cereal straw, forest waste, etc.) can also be converted into 2nd-generation liquid biofuel or gas, such as hydrogen or methane. Biogas output from thermal processes currently monitored in four European Union countries (Finland, Spain, Italy, and Belgium), amounted to about 164.7 ktoe in 2019. This output is associated with that of biogas and is therefore excluded from the solid biomass energy indicators.

THE CONSUMPTION TREND IS INFLUENCED BY THE CLIMATE CONTEXT

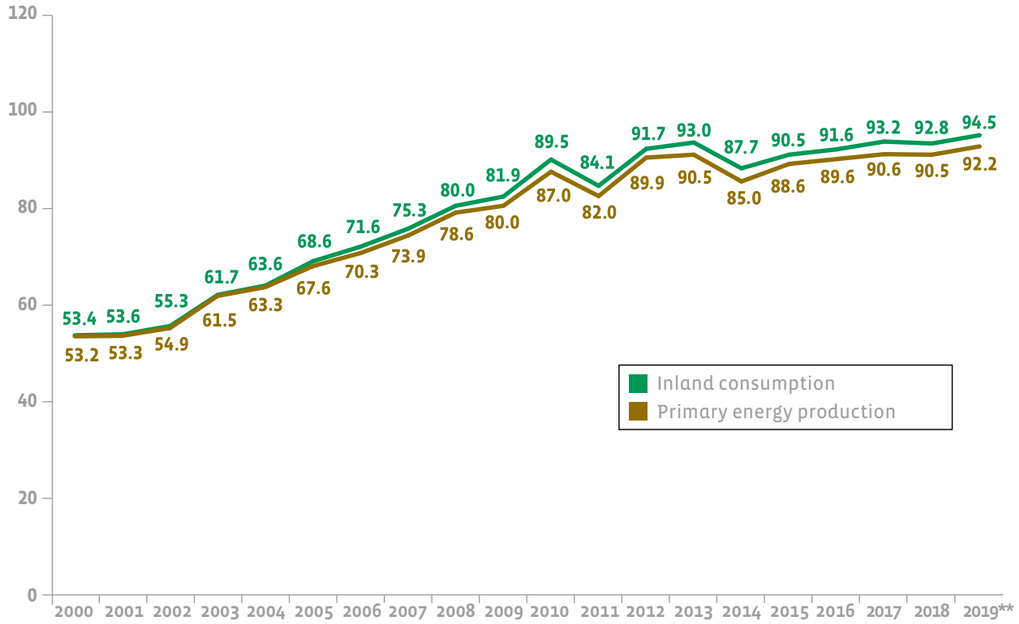
Heat and electricity supply shape the European Union's solid biofuels energy consumption trend. Developments in the main outlet for biomass energy, heat supply, are particularly climate sensitive during the heating season. In recent years, climate change has made a particularly strong impact on the solid biofuels sector and will continue to do so for the foreseeable future. This clouds the readability of governments' actions to encourage the use of solid biofuels for heating purposes. Additionally, the heat energy production indicators do not give due credit to the technological progress made to improve efficiency, domestic heating appliance combustion efficiency and also that of plants and boiler houses supplying district heating networks. The World Meteorological Organization reports that climate change pursued its

Graph. n° 1

Solid biofuels primary energy production and inland consumption growth figures for the EU 28 since 2000 (in Mtoe)*



Solid biofuels primary energy production and inland consumption growth figures for the EU 27 since 2000 (in Mtoe)*



Excluding charcoal. **Estimate.* ***Sources: years 2000-2016 Eurostat, years 2017, 2018 and 2019 EurObserv'ER.*

relentless march through 2019 and 2020. It says that 2020 is on track to become one of the three warmest years ever observed and that the last six years since 2015 are the hottest on record. The WMO's provisional report on the State of the Global Climate, shows that despite COVID 19-related lockdowns, GHG concentrations continue to rise. Thus, many generations to come will be subjected to additional warming because of the long atmospheric lifetime of CO_2. Across Europe, the winter of 2018-2019 was another mild one. Apart from the month of January 2019, which saw seasonal norms, temperatures were much higher than average as early as February and maintained their highs through to the winter. The European programme Copernicus reports that all four seasons in Europe were warmer than usual in 2019, with three exceptionally warm periods in February, June, and July. Unfortunately, the winter of 2019-2020 was even milder. The Copernicus Climate Change Service reports that it was the warmest on record in Europe, especially in the north and east, 3.4°C warmer than the average winter between 1981 and 2010. Exceptionally mild and highly abnormal temperatures were recorded in the Baltics. This bodes for a sharp drop in solid biofuels consumption for heating purposes for 2020, all the more so as temperatures remained particularly warm in Europe towards the end of the year. The month of November was on average one of the two warmest ever observed in Europe. Therefore, the Member States' 2020 renewable energy targets are likely to be knocked off course, in an energy context that will no doubt be severely affected by the spring and autumn waves of COVID-19.

Tabl. n° 1

Primary energy production and gross inland consumption of solid biofuels* in the European Union in 2018 and 2019**(in Mtoe)

	2018		2019**	
	Production	Consumption	Production	Consumption
Germany	12.420	12.790	12.778	12.922
France***	10.246	10.341	10.194	10.411
Sweden	9.223	9.312	9.458	9.583
Finland	8.852	8.881	8.949	9.006
Italy	7.066	8.511	7.256	8.741
United Kingdom	4.745	7.589	4.710	8.099
Poland	6.147	6.347	6.208	6.596
Spain	5.441	5.441	5.528	5.528
Austria	4.617	4.633	4.621	4.568
Romania	3.443	3.463	3.443	3.447
Czechia	3.070	2.981	3.370	3.247
Denmark	1.631	3.094	1.554	3.049
Portugal	2.648	2.429	2.830	2.537
Hungary	2.132	2.151	2.058	2.068
Belgium	1.228	2.000	1.198	1.880
Netherlands	1.342	1.199	1.440	1.553
Bulgaria	1.524	1.441	1.620	1.524
Latvia	2.445	1.494	2.451	1.489
Croatia	1.496	1.259	1.572	1.331
Lithuania	1.286	1.285	1.247	1.262
Estonia	1.648	1.036	1.803	1.084
Slovakia	0.908	0.889	0.884	0.884
Greece	0.782	0.834	0.771	0.810
Slovenia	0.567	0.567	0.565	0.565
Ireland	0.250	0.273	0.237	0.262
Luxembourg	0.106	0.107	0.128	0.124
Cyprus	0.023	0.024	0.023	0.024
Malta	0.000	0.001	0.000	0.002
Total EU 28	95.285	100.371	96.896	102.596
Total EU 27 (from 2020)	90.540	92.782	92.186	94.498

**Excluding charcoal. **Estimate. ***Overseas departments included for France.*
Source: EurObserv'ER 2020.

EU28 CONSUMPTION EXCEEDS 100 MTOE

EurObserv'ER concludes from the official data available early in December 2020, that at 102.6 Mtoe, primary energy consumption from solid biofuels in the EU28 exceeded 100 Mtoe in 2019, showing an annual increase of 2.2% over 2018. Consolidated statistics released by some countries (including Germany, the UK, Denmark, and the Netherlands) indicate that at the end of the day, the 100 Mtoe figure had been narrowly passed in 2018 as consumption was measured at 100.4 Mtoe. Incidentally, consumption rose in all the top seven solid biofuels consumer countries. The biggest increases can be credited to the UK (509 ktoe), the Netherlands (354 ktoe), Sweden (272 ktoe), Poland (249 ktoe), Italy (230 ktoe), the Czech Republic (267 ktoe), Germany (131 ktoe) and Finland (125 ktoe), often resulting from increased electricity production. Leaving aside the UK, which officially left the EU on 31 January 2020, Member States' consumption settled at 94.5 Mtoe in 2019 (92.2 Mtoe in 2018), which is a 1.8% increase over 2018.

Primary energy production from solid biofuels, namely solid biofuels taken from European Union soil, also increased, albeit at a slower pace than its consumption. It rose to 96.9 Mtoe in the EU28 (1.7% more than in 2018) and to 92.2 Mtoe in the EU27 (1.8% more than in 2018). The difference, which accounts for net imports, plus or minus stock variations, was primarily driven by wood pellet and wood chip imports from the USA, Canada, and Russia.

EurObserv'ER distinguishes the two types of final energy use from solid biofuels: namely electricity (table 2) and heat (for space heating or process heat). Solid biofuels heat is further broken down depending on whether it comes from the processing sector, i.e., distributed via district heating networks (table 3) or used directly by the end consumer (in the residential or industrial sectors) (table 4). According to EurObserv'ER, consumption of solid

Tabl. n° 2

Gross electricity production from solid biofuels* in the European Union in 2018 and 2019** (in TWh)

	2018			2019**		
	Electricity only plant	CHP plant	Total	Electricity only plant	CHP plant	Total
United Kingdom	23.115	0.655	23.770	25.046	0.889	25.935
Finland	1.429	10.392	11.821	1.318	10.999	12.317
Sweden	0.000	10.195	10.195	0.000	11.129	11.129
Germany	5.500	5.700	11.200	5.100	6.000	11.100
Poland	1.500	3.833	5.333	1.584	4.663	6.247
Denmark	0.000	4.417	4.417	0.000	4.353	4.353
Italy	2.168	2.024	4.191	2.129	2.068	4.197
Spain	3.289	0.932	4.221	3.009	0.876	3.885
France***	0.557	3.249	3.806	0.506	3.377	3.884
Austria	0.985	2.981	3.966	0.783	2.993	3.775
Belgium	2.177	1.307	3.484	1.990	1.302	3.292
Netherlands	0.434	1.078	1.512	0.878	1.960	2.838
Portugal	0.840	1.717	2.557	1.040	1.709	2.749
Czechia	0.003	2.118	2.121	0.002	2.397	2.399
Hungary	1.103	0.696	1.799	1.094	0.690	1.784
Bulgaria	0.721	0.559	1.280	0.877	0.679	1.556
Estonia	0.271	0.952	1.223	0.279	0.982	1.261
Slovakia	0.000	1.070	1.070	0.000	0.801	0.801
Latvia	0.000	0.570	0.570	0.000	0.575	0.575
Croatia	0.000	0.313	0.313	0.000	0.487	0.487
Romania	0.021	0.346	0.367	0.023	0.375	0.398
Ireland	0.321	0.013	0.334	0.329	0.017	0.346
Lithuania	0.000	0.355	0.355	0.000	0.331	0.331
Luxembourg	0.047	0.095	0.142	0.047	0.159	0.206
Slovenia	0.000	0.142	0.142	0.000	0.151	0.151
Greece	0.012	0.000	0.012	0.009	0.016	0.024
Total EU 28	44.494	55.708	100.202	46.043	59.976	106.019
Total EU 27 (from 2020)	21.379	55.052	76.432	20.997	59.087	80.084

**Excluding charcoal. **Estimate. ***Overseas departments included for France.*
Source: EurObserv'ER 2020.

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A test facility has been operating on the Värtan biomass cogeneration plant site in Stockholm since December 2019, capable of compressing CO_2 to its liquid state to be stored in rock formations.

biofuels heat used directly by the end consumer across the EU28, increased slightly (by 0.6% over 2018) to 68.9 Mtoe in 2019. Its EU27 level is similar (rising by 0.5%) to 65.8 Mtoe. Much of this increase can be ascribed to rising wood pellet consumption (see below).

The amount of solid biofuels heat sold to district heating networks (produced by the processing sector) increased by more than half a million toe to 11.5 Mtoe in 2019 in the EU28 and 11.4 Mtoe in the EU27, thanks largely to the commissioning of new combined heat and power (CHP) plants (in the Netherlands and France) and a pick-up in activity in Finland and Denmark. As for the solid biofuels electricity production trend, it is mainly driven by a few Member States' policies to abandon coal by converting or adapting all or some of their power (or CHP) plants to use solid biofuels fuels (pellets, wood chips, etc.). This trend is also led by variations in demand in Northern Europe that put pressure on CHP plants. Solid biofuels electricity output across the European Union of 28, was put at 106 TWh in 2019, which is a 5.8% year-on-year increase (by 5.8 TWh). The biggest increases were posted by the UK (2.2 TWh), the Netherlands (1.3 TWh), Sweden (0.9 TWh), Poland (0.9 TWh) and Finland (0.5 TWh). Leaving out the UK, which is the most active biomass electricity producer country, output by the EU27 settled at 80.1 TWh (a 3.7 TWh rise) which equates to 4.8% annual growth.

RISING WOOD PELLET CONSUMPTION

Data published by the EPC (European Pellet Council) in the 2020 Bioenergy Europe Statistical Report focusing on the wood pellet sector, shows that EU28 wood pellet consumption in 2019 continued to increase, reaching 27.7 million tonnes (Mt), i.e., an additional 1.8 Mt of consumption (6.8% growth between 2018 and 2019). The report asserts that the EU28 is the world's biggest user of pellets, putting global consumption at 37.2 Mt… a 7% increase. The EU28 produces 17.7 Mt of pellets distributed as follows: 2.8 Mt in Germany (16.8% rise), 1.6 Mt in Sweden (11.4% fall), 1.6 Mt in Latvia (1.9% rise) and 1.6 Mt in France (6.7% rise). Most of the imports from outside the EU28 come from the USA, Canada, Russia, and other European countries. The top five European wood pellet consumer countries are the UK with 9.2 Mt (8.2% rise), Italy with 3.4 Mt (9.8% rise), Denmark with 3 Mt (6.4% fall), Germany with 2.3 Mt (5% rise) and France with 1.8 Mt (15.4% rise).

Growth in pellet consumption in the residential and commercial sectors was down on its 2018 level for two main reasons. In most of Europe, the energy needs of the 2018-2019 heating season were similar to those of 2017-2018. However, there was very low demand for energy in the 2019-2020 heating season. Secondly, according to the report, European sales of pellet-burning stoves did not increase by leaps and bounds. Yet, Italy and France have the two most proactive residential/commercial market segments.

Wood pellet consumption for heating needs (residential and commercial sector, and heat produced in CHP plants) increased by 4.6% between 2018 and 2019 to reach 16.4 Mt. The main consumer countries are Italy (3.4 Mt), Denmark (2.3 Mt), Germany (2.3 Mt), and France (1.8 Mt). The use of wood pellets for heating varies by individual country. In Italy and France, most of it is used for residential heating, a little less than 60% is earmarked for CHP plants in Denmark, with just under 40% for residential heating. In Germany more than 70% is used for residential heating and just under 30% for commercial heating. Sweden spreads wood pellet use more evenly between residential, commercial and CHP plants. The report claims that industrial use of wood pellets (electricity and heat) has surged again. In the EU28, consumption increased by 8.3% to 13.2 million tonnes. UK consumption alone stands at about 8.5 Mt (8.9% more than in 2018), ahead of Denmark at 2 (4.6% less than in 2018), Belgium at 1 Mt (9.1% less), the Netherlands at 0.8 Mt (128.6% more) and Sweden at 0.6 Mt (5.5% more). Power generation was the factor behind the sharp increase in the UK's and the Netherlands' consumption figures (plants described later).

ELECTRICITY – THE DRIVING FORCE FUELLING THE INCREASE IN SOLID BIOFUELS CONSUMPTION

THE NETHERLANDS ENJOYED A SHARP RISE IN SOLID BIOFUELS CONSUMPTION

In the EU27, the Netherlands spearheaded solid biofuels energy consumption in 2019. According to Statistics Netherlands, solid biofuels consumption increased by 29.5% in

Tabl. n° 3

Gross heat production from solid biofuels* in the European Union in 2018 and in 2019** (in Mtoe) in the transformation sector

	2017			2018		
	heat only plant	CHP plant	Total	heat only plant	CHP plant	Total
Sweden	0.685	1.799	2.484	0.662	1.823	2.485
Finland	0.691	0.903	1.594	0.747	0.894	1.641
Denmark	0.498	0.866	1.363	0.493	0.927	1.420
France***	0.574	0.552	1.126	0.600	0.613	1.213
Austria	0.541	0.353	0.894	0.536	0.357	0.893
Germany	0.150	0.423	0.573	0.155	0.437	0.592
Lithuania	0.396	0.135	0.532	0.397	0.140	0.537
Italy	0.080	0.458	0.538	0.078	0.445	0.523
Poland	0.068	0.252	0.320	0.080	0.297	0.377
Estonia	0.127	0.189	0.316	0.143	0.215	0.358
Latvia	0.124	0.185	0.310	0.154	0.194	0.347
Netherlands	0.030	0.131	0.161	0.056	0.194	0.250
Czechia	0.033	0.129	0.162	0.038	0.145	0.183
Bulgaria	0.006	0.103	0.109	0.007	0.131	0.138
United Kingdom	0.098	0.000	0.098	0.100	0.000	0.100
Hungary	0.040	0.058	0.098	0.040	0.059	0.099
Slovakia	0.042	0.080	0.122	0.032	0.061	0.093
Croatia	0.000	0.056	0.056	0.000	0.085	0.085
Luxembourg	0.004	0.032	0.036	0.004	0.054	0.059
Romania	0.014	0.043	0.057	0.014	0.043	0.057
Slovenia	0.010	0.019	0.029	0.012	0.023	0.035
Belgium	0.000	0.006	0.006	0.000	0.008	0.008
Total EU 28	4.211	6.772	10.983	4.350	7.144	11.494
Total EU 27 (from 2020)	4.113	6.772	10.885	4.250	7.144	11.394

Excluding charcoal. **Estimate. * Overseas departments included for France.*
Source: EurObserv'ER 2020.

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a single year, rising from 1.2 Mtoe in 2018 to just under 1.6 Mtoe in 2019 (by 354 ktoe). The main underlying reason for this is that wood pellet imports shot up to 780 000 tonnes in 2019 (164 000 tonnes in 2018), while the country exported 187 000 tonnes in 2019 (185 000 tonnes in 2018). It uses a wide variety of mainly EU sources for these wood pellet imports such as Latvia (181 000 tonnes), Estonia (128 000 tonnes), Lithuania (18 000 tonnes), Belgium (131 000 tonnes), Portugal (77 000 tonnes) and Germany (51 000 tonnes). Its imports from outside the EU are sourced from Russia (102 000 tonnes), the USA (90 000 tonnes) and Canada (20 000 tonnes). This additional consumption of pellets was solely directed to supply RWE's two coal-fired power plants, Amers 9 (652 MW) and Eemshaven (1554 MW) and the 1100-MW Uniper MPP3 plant (Maasvlakte Power Plant 3) which have been converted into biomass cofiring plants. The Amers 9 plant can now run on 80% biomass fuel, while the Eemshaven and MPP3 are 15% biomass fuelled.

According to Statistics Netherlands, solid biofuels electricity production increased by 87.7% between 2018 and 2019 to 2.8 TWh, 2 TWh of which was produced by cogeneration. Heat production from the processing sector also surged by 55.6% to 250 ktoe (including 194 ktoe produced by cogeneration). The Netherlands announced that by 2030 it would shut down all of its remaining coal-fired plant capacities (i.e., 4.8 GW), following the passing of a draft law to prohibit the use of coal for generating electricity in December 2019. This ban will be rolled out in two phases. The oldest plants will close on 1 January 2025 and the more recent plants on 1 January 2030.

Tabl. n° 4

Heat consumption from solid biofuels* in the countries of the European Union in 2018 and 2019**

	2018 Total	2018 of which final energy consumption	2018 Of which derived heat***	2019 Total	2019 of which final energy consumption	2019 Of which derived heat***
Germany	10.127	9.554	0.573	10.242	9.649	0.592
France****	9.278	8.152	1.126	9.361	8.149	1.213
Sweden	7.576	5.092	2.484	7.625	5.140	2.485
Italy	7.211	6.673	0.538	7.423	6.900	0.523
Finland	7.115	5.521	1.594	7.228	5.587	1.641
Poland	5.270	4.950	0.320	5.272	4.895	0.377
Spain	4.099	4.099	0.000	4.223	4.223	0.000
Austria	3.907	3.014	0.894	3.898	3.005	0.893
Romania	3.424	3.368	0.057	3.417	3.360	0.057
United Kingdom	3.194	3.096	0.098	3.275	3.175	0.100
Czechia	2.486	2.324	0.162	2.695	2.511	0.183
Denmark	2.542	1.179	1.363	2.522	1.102	1.420
Portugal	1.764	1.764	0.000	1.812	1.812	0.000
Hungary	1.678	1.580	0.098	1.599	1.500	0.099
Latvia	1.306	0.996	0.310	1.313	0.965	0.347
Belgium	1.287	1.281	0.006	1.222	1.214	0.008
Croatia	1.131	1.075	0.056	1.185	1.100	0.085
Bulgaria	1.144	1.035	0.109	1.160	1.022	0.138
Lithuania	1.163	0.632	0.532	1.149	0.611	0.537
Netherlands	0.819	0.658	0.161	0.922	0.672	0.250
Greece	0.827	0.827	0.000	0.789	0.789	0.000
Estonia	0.737	0.421	0.316	0.770	0.412	0.358
Slovenia	0.538	0.509	0.029	0.534	0.499	0.035
Slovakia	0.580	0.459	0.122	0.493	0.400	0.093
Ireland	0.203	0.203	0.000	0.185	0.185	0.000
Luxembourg	0.077	0.040	0.036	0.083	0.024	0.059
Cyprus	0.021	0.021	0.000	0.021	0.021	0.000
Malta	0.001	0.001	0.000	0.002	0.002	0.000
Total EU 28	79.506	68.523	10.983	80.418	68.924	11.494
Total EU 27 (from 2020)	76.312	65.427	10.885	77.143	65.749	11.394

Excluding charcoal **Estimate **** Gross heat production in the transformation sector. **** Overseas departments included for France*
Source: EurObserv'ER 2020.

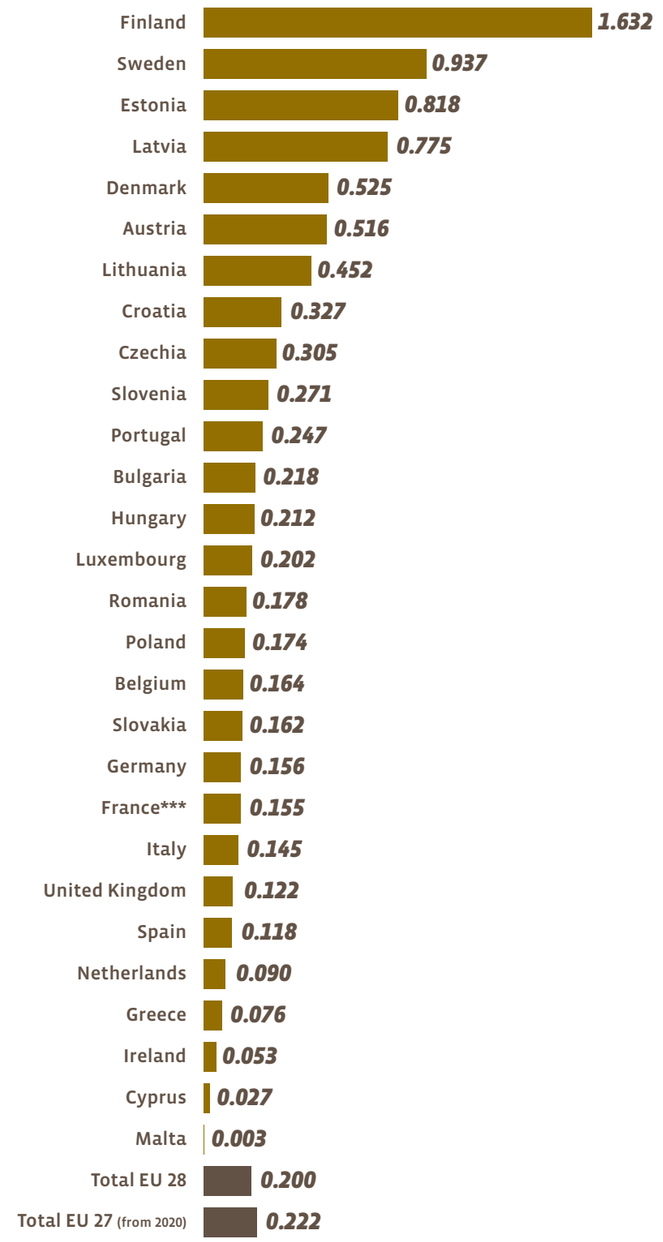
THE UK USES AN EXTRA HALF A MILLION TOE

The UK has led European solid biofuels energy consumption in recent years, and 2019 was no exception. Data released by BEIS, the Department for Business, Energy & Industrial Strategy, shows that the UK's total consumption increased to 8.1 Mtoe in 2019, i.e., 0.5 Mtoe (509 ktoe) more than in 2018. An increase in imports is the only explanation for this rise, as primary energy production from solid biofuels slipped (by 0.7% between 2018 and 2019) to 4.7 Mtoe.

The reason for the country's sharp increase in solid biofuels energy consumption is its decision to stop using coal for generating power by converting some of its power plants to run on wood fuels. The BEIS states that the electrical capacity of the country's solid biofuels power plants increased slightly in 2019 (by 4.5 MW) and that the high rise in electricity output can be put down to deploying the capacity that was newly installed in 2018, over a full year. This new capacity includes the Lynemouth power plant (420 MW), a coal-fired plant that was shut down in 2015 and re-opened in 2018 once it had been entirely converted to run on wood pellets. The year 2019 was also the first in which the fourth tranche of the Drax power plant (an additional 700 MW)

Graph. 2

Gross inland consumption of solid biofuels by toe per inhab in the European Union in 2019***



Excluding charcoal ** Estimate * Overseas departments included for France.*
Source: EurObserv'ER 2020.

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operated over a full year (its conversion was finalized in Q3 of 2018). After almost half a century of coal-fired electricity production, the Drax power plant operators announced that they would stop using coal once and for all in March 2021 – an important milestone in the company's aim to become carbon-neutral from 2030 through the implementation of carbon sequestering technologies from biomass combustion. The load factor of the UK's biomass power plants is put at 72.2% in 2019 (72.8% in 2018). Solid biofuels electricity production should increase again in the next two years once the new biomass cogeneration plant at Teeside (299 MW) comes on stream. It was scheduled to start up at the end of 2020 but was delayed by the COVID-19 pandemic.

SWEDEN, WHERE BIOMASS ENERGY ABOUNDS

Bioenergies are Sweden's main renewable energy source of final energy. A considerable share is taken up by solid biofuels. According to Statistics Sweden, solid biofuels consumption approached the 10-Mtoe threshold with 9.6 Mtoe in 2019, which is 2.9% more than in 2018. This additional consumption has essentially been harnessed to generate electricity. Output increased by 9.2% to 11.1 TWh in 2019 (a 0.9 TWh rise), produced exclusively in cogeneration plants. This is the third highest output level after the UK (25.9 TWh) and Finland (12.3 TWh). Statistics Sweden reports that the country's electrical capacity from solid biofuels fuels decreased slightly between 2018 and 2019 (by 84 MW), from 3 918 to 3 834 MW, while the latter had risen by 212 MW between 2017 and 2018. One of the country's most recent installations is the heating network of the municipality of Boras, which was boosted when the Sobacken cogeneration biomass plant (120 MWth and 45 MWe) came on stream in the spring of 2019. It will produce about 155 GWh of electricity and 375 GWh of heat per annum.

Solid biofuels heat from the processing sector is also well established in Sweden, which boasted 2.5 Mtoe of production in 2019 (no change on its 2018 level). The energy mix of district heating networks is dominated by biomass. Direct end-user solid biofuels heat consumption only increased by 1% (48 ktoe growth). Sweden pioneered carbon taxing in the 1990s and its low-carbon transition programme is one of the most advanced of any industrialized country. In June 2017, Sweden's Parliament passed a framework law that came into force on 1 January 2018, obliging the government to toe the line by rolling out policies consistent with Parliament's climate target. The law states that part of the emission reduction could be covered by additional measures such as enhancing carbon sinks, namely the forests (by forest extension and better management) and setting up climate projects abroad. Thus, Sweden's forests should contribute more to the country's energy needs while strengthening their role as a carbon sink. When setting its budgets, the government is obliged to publish an accompanying climate report and action plan to support the budgets' consistency with the strategy. The law aims to force environmental transition on Swedish society and its business world. Sweden has set targets to achieve carbon neutrality in 2045, five years earlier than recommended by the Paris Accord, and reduce its GHG emissions by 85% from its 1990 level.

FINLAND'S CONSUMPTION MAKES THE 9-MTOE THRESHOLD

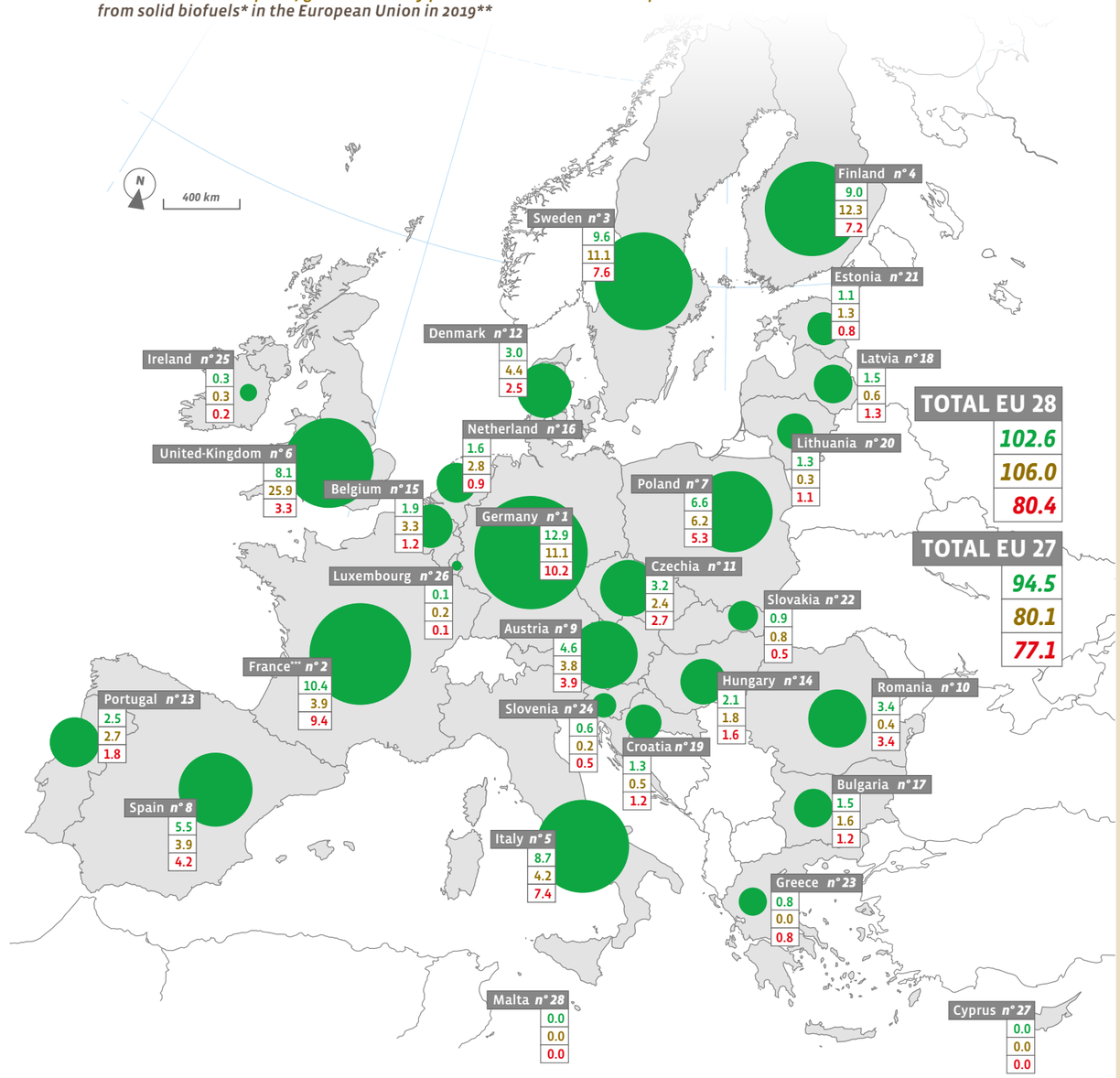
Finland is the most densely forested country in Europe with 86% of its landmass covered with trees and is the biggest per capita consumer of solid biofuels. Statistics Finland reports that annual solid biofuels consumption in 2019 increased by 1.4% to reach the 9-Mtoe threshold for the first time. Underpinning this increase are higher demand (2.9%) for solid biofuels by plants supplying district heating networks, resulting in over 1.6 Mtoe of additional output and a 4.2% increase in electricity production, primarily by CHP plants, with 12.3 TWh of output in 2019. The UK's departure from the EU hands Finland the top EU biomass electricity producer position.

The country's biomass heat production is bound to be boosted in 2020 when a new high-capacity heating plant comes on stream. The operator, Fortum, announced in May 2020 that the Kivenlahti plant (49 MWth) in the city of Espoo was entering its commercial phase. The plant, which will produce 350-380 GWh of heat (30-33 ktoe), will replace one of Fortum's two coal-fired boilers at the Suomenoja plant. In doing so, it will raise the Espoo heating network's "carbon-neutral" share to 40%. Kivenlahti's new boiler is a major step in the Espoo Clean Heat programme, that aims to generate fully carbon-neutral urban heating before the end of this decade and stop using coal in 2025.

SOME BIOENERGY OPERATORS ARE AIMING FOR NEGATIVE EMISSIONS

Some bioenergy plant operators, primarily those geared to producing electricity, are contemplating a paradigm shift. Not only do they aim for the carbon neutrality of their energy production activity, but also to contribute negatively to GHG emissions. To do so, they are banking on the rollout of new technologies, such as Bioenergy with carbon capture and storage (BECCS) and the production of biochar, an organic coal resulting from biomass pyrolysis during the electricity production process. Biochar production for carbon storage purposes opens up a potentially new activity sector to bioenergy players, provided that they are paid for carbon storage and that it is prioritised by governments. More specifically, when the biomass used for energy is converted into biochar, it provides a channel for fixing the carbon and sequestering it in the soil. The Intergovernmental Panel on Climate Change (IPCC) lists this form of biomass energy with carbon capture and storage (BECCS), as a key carbon reduction technology. Biochar production involves partial combustion of the plant matter, when part of the carbon captured by the plant is immediately released as energy, optimally as heat, but also as electricity. But 50% or more of the carbon may remain in its new form as biochar. There is still energy in the biochar, and its energy value is similar to that of charcoal or coal.

Gross inland consumption, gross electricity production and heat consumption from solid biofuels in the European Union in 2019***



Key

12.9 Inland consumption of solid biofuels* in the European Union in 2019** (in Mtoe).

11.1 Gross electricity production from solid biofuels* in the European Union in 2019** (in TWh)..

10.2 Heat consumption from solid biofuels* in the European Union in 2019** (in Mtoe).

Excluding charcoal ** Estimate * Overseas departments included for France.* ***Source : EurObserv'ER 2020.***

The operator, Fortum, announced in May 2020 that the Kivenlahti plant (49 MWth) in the city of Espoo, Finland, was entering its commercial phase. The plant, which will produce 350-380 GWh of heat (30-33 ktoe), will raise the Espoo heating network's "carbon-neutral" share to 40%.

However, the question of its economic value must be raised. Namely, should full energy recovery be conducted until it is reduced to ashes, leaving little or no carbon, or should the combustion process be stopped, to enable the biochar to be restored to the soil, in the form of stable carbon? Biomass naturally decomposes into GHG, but biochar does not. When biochar is restored to the soil, carbon from photosynthesis can be stored in the soil while improving and fertilizing it. This option calls for responsible forestry resource management and timber harvesting to meet the needs of forest ecosystems.

Operators are also seeking to set up wide-scale bioenergy technologies with carbon capture and storage (BECCS). This process entails trapping the CO_2 molecules before, during or after combustion to prevent their release into the atmosphere and to stock the CO_2 in geological formations. There are three capture processes in development: "pre-combustion", capture prior to combustion; "post-combustion", capture after conventional combustion (with air), with little or no change to the combustion process; and "oxycombustion", capture after combustion in the presence of pure oxygen.

Until recently, most of the BECCS carbon storing technologies were used in biofuel production plants. According to the Global CCS Institute, Bioenergy and Carbon Capture and Storage 2019 Perspectives Study, five of the world's plants had BECCS technology (4 plants in the USA and 1 in Canada). Between them, they captured about 1.5 million tonnes of carbon. The biggest of them in Illinois, owned by Archer Daniels Midland, produces ethanol from cereals, and captures up to 1 Mtpa of CO_2.

Several solid biofuels energy projects are now in the development phase. One that moved into the commercial phase in November 2020, is the Mikawa Power Plant operated by Sigma Power Ariake Corporation (SPAC), a subsidiary of Toshiba ESS (Toshiba Energy Systems & Solutions Corporation), in Omuta (Fukuoka Prefecture, Japan). It is Japan's first bioenergy plant to be fitted with a carbon capture and storage system. This coal-fired plant was totally converted to biomass in 2018 and uses palm kernel shells as its main feedstock. Toshiba ESS has operated a pilot installation capable of capturing 10 tonnes of CO_2 per day since 2009. The new "Demonstration of sustainable CCS technology" project, whose construction started in February 2018 and has the backing of the country's Environment Ministry, will capture over 500 tonnes of CO_2 every day, i.e., over half the plant's CO_2 emissions. Other projects in development include the Norwegian Full-Chain CCS that seeks to integrate BECCS technology into a cement plant that co-fires 30% biomass and into a household waste-to-energy plant. The DRAX power plant in North Yorkshire (UK) also has a very ambitious project. It already has a pilot running capable of storing a tonne of carbon every day and was the first in the world to store carbon from 100% biomass feedstock. In December 2019, Drax Group Plc announced its aim to become carbon negative by 2030. The plant, whose conversion to biomass is almost complete, produces about 12% of the UK's power.

The energy utility Stockholm Exergi AB of Sweden, has set itself a new sustainability objective… to be climate positive by 2025. It aims to make Stockholm the world's first climate-positive capital. Stockholm Exergi AB announced it was launching a large-scale biochar production plant project and that furthermore, it was interested in the potential of BECCS technology. The initial long-term environmental target was to make the city of Stockholm's heating network climate neutral by 2030. The new target is to make the company's operations climate positive by 2025.

The Värtan biomass cogeneration plant is currently well-placed to be equipped with BECCS technology. A test facility has been operating on the power plant site since December 2019 capable of compressing CO_2 to its liquid state to be stored in rock formations. Stockholm Exergi's calculations demonstrate that 800 000 tonnes of CO_2 can be captured per annum on this site alone.

SOLID BIOFUELS FACILITATING CARBON NEUTRALITY

Although the consequences of climate change are now evident to all of us, the declared ambition for the next thirty years is nothing other than to achieve the carbon neutrality of the entire European economy, starting with the decarbonization of the heating, electricity production, and transport sectors. To reach this target, biomass energy technologies, and solid biofuels energy in particular, will be very much in demand because they are the easiest renewable energy production sectors to substitute fossil energies. They also have the capacity to become negative emission energy sources through the rollout of the new technologies described above, provided that economic incentives are implemented. Still, the future deployment of biomass energy will be subject to new rules following the recasting of the Renewable Energy Directive (2018/2001). The Directive sets out the legal framework applicable to renewable energies from 2021 to 2030 and in particular, those set in Article 29 relating to sustainability requirements and the GHG reduction criteria of liquid, solid and gaseous fuels. Sustainability criteria now apply to all bioenergy uses (biofuel, electricity, and heat). The Directive's target is to minimize negative environmental risks such as deforestation, biodiversity loss and minimize the risks of negative impacts on forest carbon sinks.

As this very unusual year draws to a close, we have to admit that readability of the 2020 targets assigned by the previous renewable energy directive will be clouded. The two major pandemic waves that have hit economic activity and thus the Member States' energy needs, coupled with an unusually mild 2019-2020 winter that reduced heating and electricity needs, have knocked it off its normal path.

In the longer term, the future growth of solid biofuels heat and electricity production will depend on the implementation and strategic choices defined in the National Energy and Climate Plans 2030 (NECPs) by each Member State. Bioenergy Europe has made a preliminary analysis of these climate plans in its Statistical Report. Its projections show that bioelectricity as a whole (i.e., not only that sourced from solid biomass, but also biogas, liquid biomass, and renewable household waste) will increase by about 30% over the next decade to reach 17.4 Mtoe in 2030 in the EU27 (equating to 202.4 TWh). According to EurObserv'ER, solid biofuels alone accounted for about half of the bioelectricity produced by the EU27 countries in 2019. If biomass electricity production were to grow by 30%, that would imply a level of about 104 TWh by 2030.

It is harder to forecast the energy contribution of solid biofuels to the heat and cooling targets by the 2030 timeline. The use of solid biofuels heat tends to increase steadily in the industrial and processing sectors. This attests to the operators' and industrialists' willingness to substitute their use of fossil energies. In contrast, the trend in recent years of the residential sector is much less hard and fast. Its energy needs have been more heavily hit by a succession of mild winters. The temperature records made during the winter of 2019-2020 will have a decidedly strong impact on demand for solid biofuels heat in 2020. To recap, the new directive's stated target is that renewable heat and cooling should account for about 40% of renewable energy consumption by 2030, i.e., roughly twice the current percentage. Furthermore, the new RED directive sets an indicative target of an annual 1.3 percentage point increase in the renewable energy share of final heat consumption, taking the national renewable energy share in the heating and cooling sector in 2020 as the reference point. One caveat applies because the Directive provides for the possibility of integrating into this target the recovery of up to 40% of the mean annual increase as waste heat or cold. According to Bioenergy Europe, however, which has analysed the Member States' renewable energy targets in the heat and cooling sectors through their NECPs, relatively few of them appear to have based their 2030 heat and cooling targets on an annual 1.3 percentage point growth trajectory. Thus, there is uncertainty surrounding the total level of renewable heat production that will be vested in solid biomass by this timeline. Nonetheless, the association recalls that if properly handled, biomass heat offers the EU reliable, easily available, affordable, and efficient solutions to achieve carbon neutrality by 2050. □

Tabl. n° 5

Major European operators ***of biomass plants in 2019***

Operator	Country	Operational capacity (MW)	Biomass and cofiring plants	Production (TWh)
Orsted	Denmark	Cofiring plants with biomass conversion 1 665 MWe 2 339 MWth	Avedøre 1(Den), Avedøre 2 (Den), Asnæs 6 (Den), Herning (Den), Skærbæk 3 (Den), Studstrup 3(Den)	4.6 TWh (elec) 8.3 TWh (heat) (68% of total heat and power from sustainable biomass)
Drax Group	United-kingdom	2 600 MWe (Renewable biomass power capacity)	Drax power station (UK)	13.7 TWh (Renewable power in 2019)
Vattenfall	Sweden	CHP biomass plants and heat plants 224 MWe 2214 MWth	Lelystad (NL), Märkisches Viertel (GER) and in Sweden: Gotland, Vänersborg, Motala, Askersund, Lyviksverket – Ludvika, Craboverket – Fagersta, Idbäcksverket – Nyköping, Jordbro, Ekobacken, Fisksätra, Knivsta, Uppsala, Storvreta, Bollmora	0.4 TWh (elec)
Pohjolan Voima	Finland	Multifuel (biomass, peat, fossil) CHP plant 620 MWe 1 472 MWth	Hämeenkyrön Voima (Fin), Kymin Voima (Fin), Laanilan Voima (Fin), Kaukaan Voima (Fin), Alholmens Kraft (Fin), Porin Prosessivoima (Fin), Rauman Biovoima (Fin)	4.2 TWh (heat) 1.7 TWh (elec) all CHP plants (62 % wood-based fuel used)
Fortum	Finland	Bio CHP: 352 MWe, 848 MWth Multifuel (biomass-coal CHP): 399 MWe, 624 MWth	Biomass-CHP: Järvenpää (Fin), Joensuu (Fin), Pärnu (Est), Tartu (Est), Jelgava (Lat), Värtan KVV8 Brista 1 (Swe), Hässelby (Swe)Multifuel (biomass -coal) CHP: Częstochowa 5-(Pol), Zabrze (Pol), Naantali (Fin)	n.a.
RWE	Germany	660 MWe 350 MWth	Markinch CHP biomass plant (UK) Amer biomass and hard-coal fired power plant (NL)	n.a.
Engie	France	280 MWe (2019) 205 MWe (from August 2020)	Rodenhuize (Bel), Awirs (Bel)- closed the 31th August 2020	n.a.

Sources: Eurobserv'ER 2020, based on companies annual reports and communication.

Sources : AGEE-Stat (Germany), BEIS (United Kingdom), Terna (Italy), SDES (France), Ministry of Industry and Trade (Czech Rep.), Danish Energy Agency, Statistics Netherlands, GUS (Poland), Ministry for the Ecological Transition and the Demographical Challenge (Spain), Statistics Austria, SPF Economie (Belgium), Statistics Finland, Statistics Sweden, CRE (Greece), Central Statistical Bureau of Latvia, DGEG (Portugal), NSI (Bulgaria), SEAI (Ireland Rep.), Statistics Lithuania, Statistics Estonia, Statistical Office of the Republic of Slovenia, STATEC (Luxembourg), MRA (Malta), EurObserv'ER, Eurostat early estimate.

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