

Implementation of bioenergy in the European Union - 2021 update

Country Reports

IEA Bioenergy: 10 2021



This report was prepared from the 2021 IEA World Energy Balances and Renewables Information, combined with data and information provided by the IEA Bioenergy Executive Committee and Task members¹. Reference is also made to FAOstat and Eurostat data. All individual country reports were reviewed by the delegates to the IEA Bioenergy Executive Committee, who have approved the content. General background on the approach and definitions can be found in the central introductory report for all country reports.

Edited by: Luc Pelkmans, Technical Coordinator IEA Bioenergy

Contributions: Maria Georgiadou (European Commission, DG Research & Innovation), Eric Fee (European Commission, DG Energy)

HIGHLIGHTS

- Renewables make up 15% of *total energy supply* in the EU28² in 2019. The renewable energy share in *final energy consumption* is 19%³. Around 60% of renewable energy is from biomass.
- Solid biofuels (for residential use, industry use, and use for transformation to power and/or heat) represent almost 70% of bioenergy supply. Liquid biofuels, biogas, and renewable waste each represent around 10%.
- Electricity production in the EU can be divided in three parts: fossil based at 40%, nuclear power at 25% and renewable power at 35% in 2019. Fossil power is largely based on natural gas and coal, with a fast-declining share of coal in recent years, which is partly compensated by an increase in natural gas power.
- Renewable power consists of a stable amount of hydropower, a slightly growing amount of biomass-based electricity (producing 6% of EU power, often in CHP mode) and fast increasing shares of wind and solar power.

¹ While data for 2020 are starting to become available at national level, it was decided to consider trends up to 2019 for good comparability and benchmarking between the different IEA Bioenergy member countries. Care should also be taken when using 2020 data for analysing trends as these data are distorted by the COVID19 Pandemic.

² In 2020 the United Kingdom withdrew from the EU, so the EU currently has 27 Member States. As all data are up to 2019, in this report we will still consider the EU28 (i.e., including the UK).

³ The difference between the share of renewables in supply and consumption relates to unused heat from power plants (which is counted in energy supply, but not in final consumption).

- Heat and transport energy are still dominated by fossil fuels. Bioenergy/biofuels are the main sources of renewable energy in these sectors.
- Fuel/heat consumption (excl. electric heating) in the EU is still for more than 70% based on fossil fuels, with 15% direct use of biomass for heat. Distributed heat represents 12% of heat provision, of which almost one third is based on biomass.
- Diesel is the dominating fuel in the EU transport system. Between 2004 and 2010 there was a strong increase of biofuels up to a combined level of 4% (by energy) of transport energy. However, these levels stalled between 2010 and 2016 while fossil fuel consumption further increased. In recent years growth of biofuels has resumed again.
- On average, biodiesel represented 6.4% by energy of EU28 diesel consumption in 2019. Bioethanol on average represented 3.7% by energy of gasoline consumption. About 30% of biofuels consumed in the EU28 in 2019 are qualified as 'advanced biofuels', meaning that they are produced from residues and waste (particularly used oils for biodiesel).

PROFILE

Population and land use

The European Union (EU) is a political and economic union of European member states. Up to 2019 the EU had 28 member states⁴. The EU28 has a total land area of 4.13 million km² and a population of 448 million people, which represents an average population density of 109 persons per km². Climate conditions are diverse, from temperate maritime in the southwest, Mediterranean in the south, continental climates in central Europe and boreal climates in the north.

Around 40% of the land area in the EU are woodlands (forest land and permanent crops). A similar share of the land area is agricultural land, of which 60% cropland and 40% grasslands.

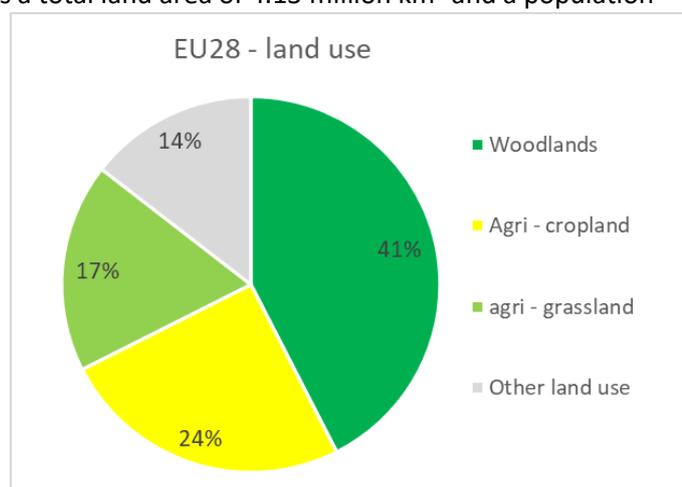


Figure 1: Land use in the EU28 (2018 figures - Source: Eurostat)

Final energy consumption

Overall final energy consumption in the EU28 (also including non-energy use of oil, natural gas, and coal in industry) equates 2.55 tonnes of oil equivalent (toe) per capita. Industry, transport, and residential/services each represent around one third.

⁴ In 2020 the United Kingdom withdrew from the EU, so the EU currently has 27 members states. As all data are up to 2019, in this report we will still consider the EU28 (i.e., including the UK).

Table 1: Distribution of the final consumption of energy carriers by sector in the EU28 (2019 figures - Source: IEA (2021) World Energy Balances and Renewables Information)

Final consumption energy carriers	Toe/capita (2019)	% of total	Median* (toe/capita)
Industry (energy use)	0.58	23%	0.67
Industry (non-energy use)	0.22	9%	0.21
Transport	0.74	29%	0.69
Residential	0.62	24%	0.57
Commercial & public services	0.31	12%	0.34
other	0.08	3%	
Total	2.55		2.34

* Median of the 25 member countries of IEA Bioenergy⁵

POLICY FRAMEWORK IN THE EUROPEAN UNION

TARGETS AND STRATEGIES

The Renewable Energy Directive of 2009 (2009/28/EC) established a European framework for the European Member States for the promotion of renewable energy, setting mandatory national renewable energy targets for achieving an overall 20% share of renewable energy in the EU final energy consumption by 2020, with a sub-target for the transport sector of 10% renewables. The Renewable Energy Directive also established sustainability criteria for transport biofuels that must be met by any biofuel used to count towards this target. This included requirements in terms of GHG reduction and land use restrictions.

In 2018 the Renewable Energy Directive was updated in Directive (EU) 2018/2001, stating a 2030 renewable energy target of 32% and a target of 14% renewable energy in transport, including limits on crop-based biofuels and a specific target for advanced biofuels. The sustainability criteria for biofuels were further strengthened and extended to solid and gaseous biomass fuel.

In 2020 the European Commission adopted the Green Deal, which aims to make the European Union climate neutral by 2050. In April 2021 European Parliament and Council agreed on an intermediate target of 55% GHG reduction by 2030. For the achievement of the 2030 target, the European Commission adopted a set of policy proposals in July 2021 under the “Fit-for-55” Package.

The Fit-for-55 Package includes a proposal for the revision of the Renewable Energy Directive including the following key elements:

- An increase in renewable energy share target to 40%
- Target to reduce transport GHG intensity by 13%
- Subtargets for RFNBOs⁶ (2.6%) and advanced biofuels (2.2%) by 2030
- Strengthened sustainability criteria also applying to installations larger than 5MW
- Delegated Act on cascading use of biomass; no support for saw & veneer logs, stumps/ roots

⁵ Comparative figures of the different IEA Bioenergy member countries are discussed in the central Countries’ Report.

⁶ RFNBO: Renewable Fuels of Non-Biological Origin

- From 2027 no support for installations producing electricity from forest biomass in electricity-only-installations⁷

Directly relevant for biofuels in the aviation sector is the ReFuelEU Aviation Regulation proposal which includes a 5% blending requirement of sustainable aviation fuels by 2030 for all departures from EU airports. The proposal foresees incremental increases in the blending mandate, reaching 63% by 2050. This is accompanied by the proposal for revising the Energy Taxation Directive to increase tax on fossil aviation fuel to EUR 10.75 per GJ by 2030, while applying a zero minimum tax rate to sustainable aviation fuels. Furthermore, the Commission proposal for revision of the ETS Directive includes phasing out of free ETS allowances for airlines by 2026.

The Commission proposal for the FuelEU Maritime Regulation includes a fuel standard for maritime shipping fuel, reducing on board GHG intensity by 6% by 2030 and incrementally reaching 75% GHG intensity reduction by 2050. This is accompanied by including maritime shipping in the proposal for the ETS revision as well as minimum taxation rates on fuels for intra-EU vessels in the revision proposal for the Energy Taxation Directive. Relevant for road transport biofuels is the Commission proposal for the revision of the CO₂ emission standards for passenger cars and lightweight commercial vehicles, requiring newly registered vehicles to reduce tailpipe CO₂ emissions by 55% by 2030 and 100% by 2035. Accompanying this measure is the expansion of emissions trading to include fuel suppliers of road transport under the Commission proposal for revision of the ETS.

The Commission proposals are still to undergo review and adoption by European Parliament and Council.

Table 2: renewable energy and climate targets in the EU28.

Sector	Share of renewables in gross final consumption per sector	GHG reduction target compared to base year 1990
Overall target	20% by 2020	-20% by 2020
	40% by 2030	-55% by 2030
		-100% by 2050
Transport	10% ⁸ by 2020	-6% by 2020 (GHG intensity) -13% by 2030

Apart from energy legislation, bioenergy and biofuels are influenced by a number of existing EU policies and initiatives on research and innovation, sustainable transport, agriculture and rural development, and the bioeconomy, e.g., the Strategic Energy Technology (SET) Plan of the European Commission comprising a key action on "renewable fuels and bioenergy" and the EU Bioeconomy Strategy.

The EC Bioeconomy Strategy and Action Plan was developed in the context of the Europe 2020 Strategy, which considers the bioeconomy to be a key element for the sustainable, smart and green

⁷ except in regions identified in a "territorial just transition plan" approved by the Commission and for biomass carbon capture and storage.

⁸ For reaching the transport targets, multiplication factors can be applied for several types of options (advanced/waste-based biofuels, renewable electricity in transport). So, the target can be reached with an actual share lower than 10%.

economic growth of Europe, while comprehensively addressing societal challenges: ensuring food security, managing natural resources sustainably, reducing dependence on non-renewable resources, mitigating and adapting to climate change as well as creating jobs and maintaining European competitiveness.

THE CONTRIBUTION OF BIOENERGY IN ENERGY SUPPLY

TOTAL ENERGY SUPPLY

The total energy supply (TES) of the EU28 in 2019 amounted to 65.8 exajoules (EJ). It is still for around 70% dominated by fossil fuels, particularly oil and gas, which represent 33% (21.9 EJ) and 26% (16.8 EJ) of total energy supply, respectively. Coal represents around 11% of TES (7.3 EJ). Nuclear energy represents almost 14% of TES (9.0 EJ). Renewable energy sources have a share of 15% or 10.0 EJ. Around 63% of renewable energy supply in 2019 came from biomass (6.3 EJ), followed by wind energy (1.6 EJ), hydropower (1.2 EJ), solar energy (0.7 EJ) and geothermal energy (0.3 EJ).

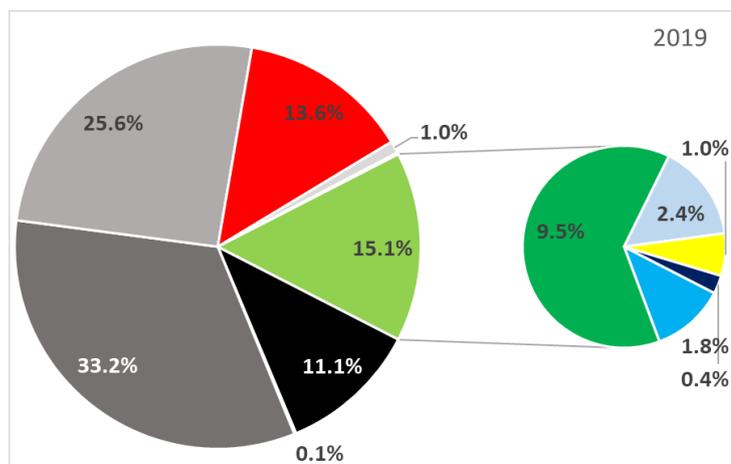
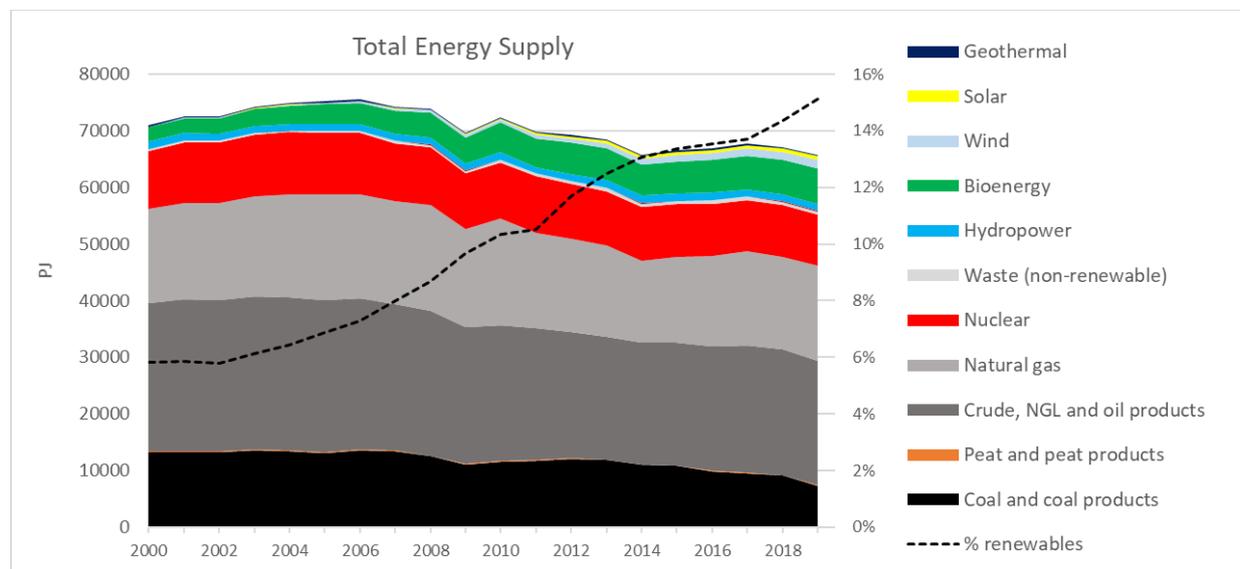


Figure 2: Total energy supply⁹ and the contribution of different energy sources in the EU28, with distribution in 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

⁹ Total energy supply refers to the use of resources. In terms of the role in the energy system this distribution overestimates the role of resources producing electricity with a high share of unused waste heat (like nuclear plants).

Overall TES declined between 2005 and 2014 from 75 EJ to 66 EJ, and more or less stabilized since. **Oil** supply dropped between 2005 and 2012 from 27 EJ to 22 EJ and has also stabilized around 22 EJ. **Natural gas** slightly declined from 18 EJ to 15 EJ in the 2005-2014 timeframe. By 2019 levels have increased again up to 17 EJ. **Coal** used to be quite stable around 13 EJ up to 2007, but has consistently declined since, down to 7.3 EJ in 2019. **Nuclear** energy declined slightly from 11 EJ in the 2000s to 9 EJ currently.

The share of **renewable energy** in TES continuously increased in the past decades from 6% in the early 2000s to 15% in 2019. Since 2017 there is a clear acceleration in renewable energy, mainly in bioenergy, wind and solar energy.

Figure 3 shows the evolution of the different bioenergy carriers. Overall use of bioenergy has continued to grow in the past decades, from 2.5 EJ to more than 6 EJ. Solid biofuels remain dominant reaching 4.3 EJ, or almost 70% of bioenergy supply. 13% of bioenergy comes from liquid biofuels (0.8 EJ), 11% from biogas (0.7 EJ) and 7% from renewable waste (0.44 EJ).

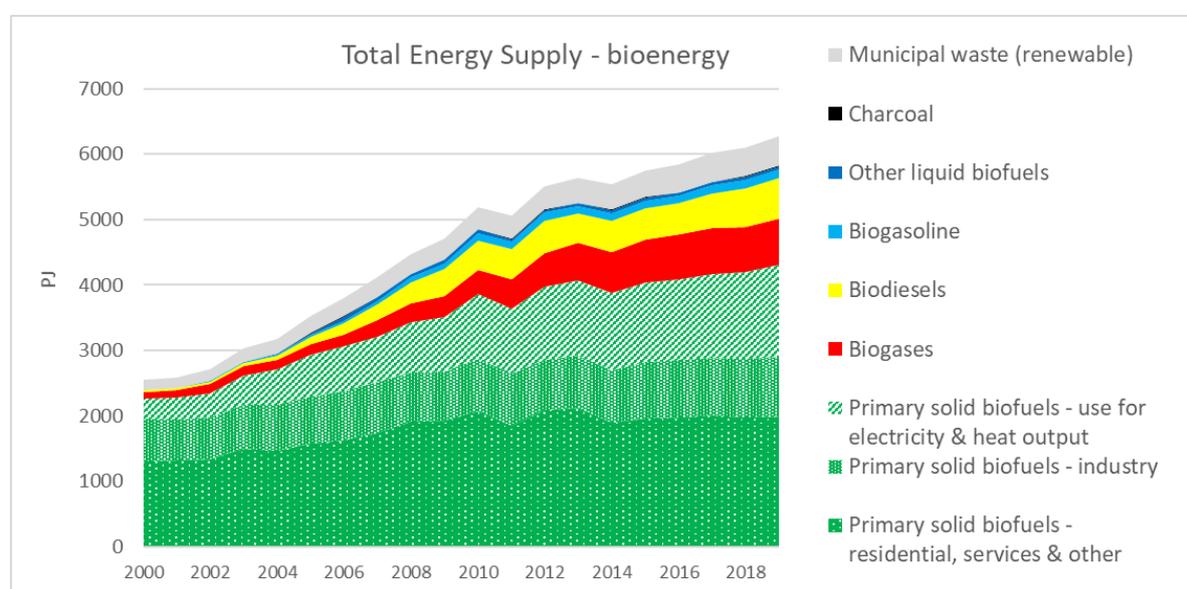


Figure 3: Development of total energy supply from bioenergy in the EU28 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

Evolution of the bioenergy carriers:

- The use of solid biomass in residential applications and industry has been fairly stable around 2.8-2.9 EJ together. On the other hand, the use of solid biofuels for electricity and heat production has steadily increased in the past decades, from 0.3 EJ in 2000 to 1.4 EJ in 2019.
- Liquid biofuels saw a strong growth between 2004 and 2010 from 0.1 EJ to 0.6 EJ. Levels have rather stabilized between 2010 and 2016 around 0.6 EJ. In the past years (after the publication of the ILUC directive), growth has picked up again up to 0.8 EJ in 2019.
- Biogas had a strong growth between 2006 to 2013 from 0.2 to 0.6 EJ. In recent years there is still growth, but at lower pace, reaching 0.7 EJ in 2019.

- Renewable energy from MSW grew steadily from 0.16 EJ in 2000 to 0.44 EJ in recent years. There seems to be some stagnation in recent years (since 2017).

Table 3 displays the 2019 total bioenergy supply values on a per capita basis. Mind that half of the IEA Bioenergy member countries are also member of the EU28.

Table 3: Total energy supply per capita in 2019 for different bioenergy carriers

	Supply per capita	Median IEA Bioenergy members
Bioenergy	14.0 GJ/cap	10.6
Solid biofuels	9.6 GJ/cap	7.0
Renewable MSW	1.0 GJ/cap	0.8
Biogas	1.6 GJ/cap	0.7
Liquid biofuels	1.8 GJ/cap	1.5

Source: IEA (2021) World Energy Balances and Renewables Information

Table 4 indicates the amounts of the different bioenergy carriers compared to some relevant reference points, namely the amount of forest in the country (for solid biomass), the amount of generated MSW (for renewable MSW used for energy), the amount of natural gas consumed in the country (for biogas) and the amount of fossil oil products consumed (for liquid biofuels).

Table 4: Comparison of the supply of different bioenergy carriers in 2019 to specific reference points

	Compared to reference points		Median*
Bioenergy	9.5 %	of total energy supply	7.2 %
Solid biofuels	32.4 GJ/ha_forest	compared to the domestic hectares of forest land (excl. protected)	21.3 GJ/ha_forest
Renewable MSW	0.55 GJ/ton_MSW	compared to the total generated MSW in the country	1.4 GJ/ton_MSW
Biogas	0.042 GJ/GJ_NG	compared to natural gas supply	0.023 GJ/GJ_NG
Liquid biofuels	0.037 GJ/GJ_oil	compared to oil products supply	0.028 GJ/GJ_oil

Source: energy data from IEA (2021) World Energy Balances and Renewables Information; forest figures from FAOStat; waste figures from World Bank

* Median of the 25 member countries of IEA Bioenergy¹⁰

Specific comments in relation to the reference points:

¹⁰ Comparative figures of the different IEA Bioenergy member countries are discussed in the central Countries' Report.

- The use of solid biomass for energy is fairly modest compared to the forest area in the EU (~1.7 tons_{dry mass} of wood per hectare¹¹).
- The use of renewable MSW for energy production is also modest compared to the total generated MSW. There are quite big differences between different European countries.
- Liquid biofuels are still modest compared to fossil oil consumption.
- Biogas is also at modest levels compared to overall gas consumption. Some European countries are highly advanced in biogas deployment, while other countries still have high development opportunities

ROLE OF BIOENERGY IN DIFFERENT SECTORS

OVERVIEW

The overall 2019 share of renewables in **final energy consumption** among electricity, transportation and heat sectors is 19%, with bioenergy making up 11% of the energy share (Table 5). Mind that these figures are slightly higher than the shares in total energy supply (where unused waste heat, e.g., in fossil and nuclear power production, is also included).

Table 5: Role of bioenergy and renewable energy in electricity, transport energy and fuel/heat consumption, as well as total final energy consumption in 2019

Sector	Share of bioenergy	Share of renewable energy	Overall consumption
Electricity ¹²	6.1%	34.0% (10.1% hydro)	3218 TWh (11.6 EJ)
Transport energy (final consumption)	5.3%	5.8%	13.8 EJ
Overall fuel and heat consumption ¹³	Direct biomass: 15.1% Biobased heat: 3.2%	18.9%	20.5 EJ
TOTAL FINAL ENERGY CONSUMPTION*	11.4%	18.7%	45.7 EJ

Source: IEA (2021) *World Energy Balances and Renewables Information*

The following paragraphs will consider the evolutions in the different sectors.

¹¹ Counted with a typical calorific value of wood (dry mass) of 19 GJ/ton_{dry mass}

¹² Renewable electricity production compared to final consumption. Potential renewable shares of imported electricity are not included.

¹³ This includes final consumption of fuels and heat in industry, the residential sector, commercial and public services and agriculture/forestry. Transport fuels are excluded. Energy used for transformation and for own use of energy producing industries is also excluded. Electric heating (direct or through heat pumps) is not included in these figures as this is not separately reported.

ELECTRICITY

Electricity consumption in the EU28 is relatively stable around 3300 TWh and can be divided in three parts: (1) fossil power, in 2019 at 39% of power production; (2) nuclear power, in 2019 at 26%; and (3) renewable power, in 2019 at 34%.

Fossil power is steadily declining, with mainly coal power going down. **Coal** represented 30% of power production in the 2000s but has dropped to 15% in 2019. The reduction in coal power has accelerated in recent years. **Natural gas** power peaked at 23% of power generation in 2008 and declined to 15% in 2014. However, natural gas power has recovered again in recent years to 21% of power production, thereby compensating for some of the reduction in coal power. **Oil** only represented a maximum of 6% of power production in the EU in the early 2000s; this has dropped to 2% in recent years. The share of nuclear power declined slightly from 30% in 2005 to 25% in recent years. Mind that around half of nuclear power in the EU is generated in France.

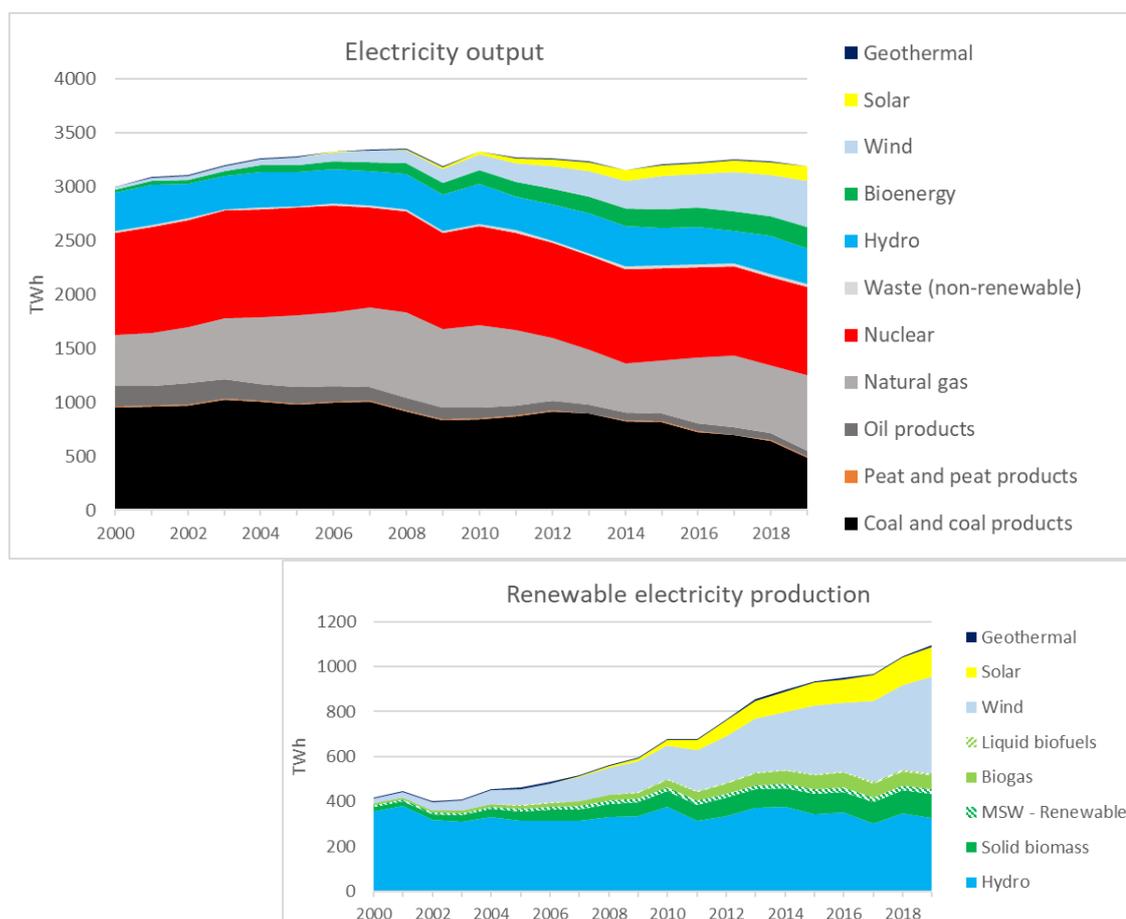


Figure 4: Evolution of the electricity mix in the EU28 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

Renewable electricity increased steadily from 15% of power production in the early 2000s to 34% in 2019. **Hydropower** used to be the dominating type of renewable power and has been fairly stable around 350 TWh (10% of power production) in the past decades. The main growth in renewable power has been in **wind energy**, steadily increasing from 60 TWh in 2004 up to 430 TWh in 2019, which represents 13% of power production in the EU. **Biomass**-based electricity represents 6% in 2019, split between solid biomass, biogas and renewable MSW. Biobased electricity also grew

steadily in the past decades, but at much lower pace than wind energy. **Solar** power had a strong increase since 2009 from 14 TWh to 130 TWh in 2019 (4% of power production in the EU).

Policy framework

The main relevant EU-level regulations impacting these evolutions are:

- Renewable Energy Directive (RED) - 2009/28/EC: overall target to reach 20% renewables by 2020, with country dependent targets.
- Effort Sharing Regulation (ESR) - 406/2009/EC & (EU) 2018/842: sets national targets for emission reductions from road transport, heating of buildings, agriculture, small industrial installations, and waste management (non-ETS)
- EU Emissions Trading System (EU ETS): The overall volume of greenhouse gases that can be emitted by power plants, industry factories and aviation sector covered by the EU ETS is limited by a 'cap' on the number of emission allowances. Within the cap, companies receive or buy emission allowances, which they can trade as needed. The cap decreases every year.
- Energy Efficiency Directive (EED) - 2012/27/EU: mandates energy efficiency improvements within the European Union. (*impact on electricity consumption*)

HEAT/FUEL

Figure 5 shows the role of different fuels/energy carriers for providing heat in different sectors (industry, residential sector, commercial and public services and other). It also includes heat sold to customers, e.g. through district heating. Fuel use by energy producing industries for transformation and for own use is excluded. Mind that electric heating (direct or through heat pumps) is not included in these figures as this is not separately reported in the IEA database.

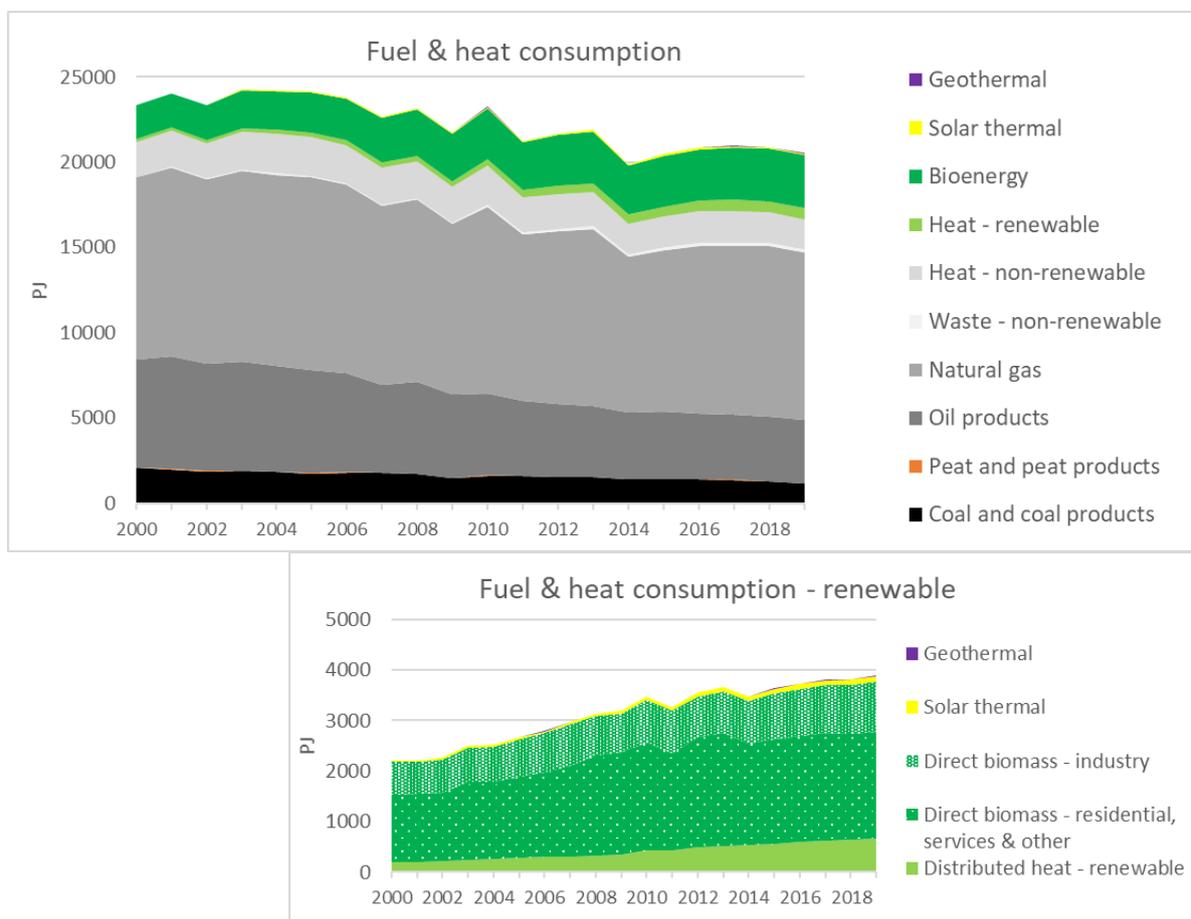


Figure 5: Evolution of fuel and heat consumption in the EU28 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

The overall consumption of fuel/heat in the EU28 slightly declined from 2005 to 2014 and seems to stabilize around 21 EJ in recent years. The provision of fuel/heat is still for more than 70% based on fossil fuels, with natural gas being the main energy source (48%). The direct use of biomass for heat represents 15% (3.1 EJ) in 2019 and is the main type of renewable in this sector.

Heat output generated and sold by CHP plants and heat plants (e.g. through district heating) represents around 12% of fuel/heat provided in the EU28. Overall levels of heat sales are fairly stable. Heat output is still for more than 60% fossil based, with a dominant role for natural gas, but also an important role for coal. The use of biomass for heat production increased over the years and now represents 27% of heat output.

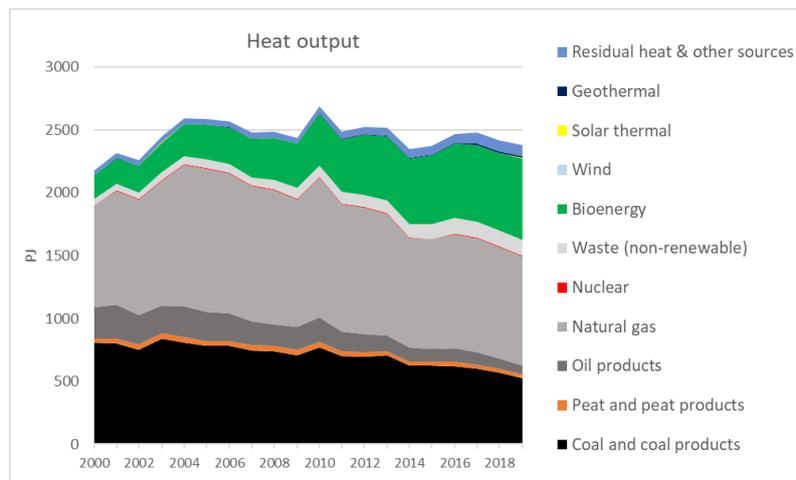


Figure 6: Evolution of fuels for heat output in the EU28 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

Policy framework

The main relevant EU-level regulations impacting these evolutions are:

- Renewable Energy Directive (RED) - 2009/28/EC: overall target to reach 20% renewables by 2020
- Combined Heat and Power (CHP) Directive - 2004/8/EC: creating a framework for the promotion and development of high efficiency cogeneration.
- Effort Sharing Regulation (ESR): sets national targets for emission reductions from road transport, heating of buildings, agriculture, small industrial installations and waste management (non-ETS)
- EU Emissions Trading System (EU-ETS): relevant for energy consumption in large industries
- Energy Efficiency Directive - 2012/27/EU: mandates energy efficiency improvements within the European Union.
- Energy Performance of Buildings Directive (EPBD) - 2002/91/EC: required that the MS strengthen their building regulations and introduce energy performance certification of buildings. The recast EPBD (2010/31/EU) broadened its focus on Nearly Zero-energy buildings.

TRANSPORT

Figure 7 shows an overview of the energy used in transport in the EU28, split up by different fuels/energy carriers.

Diesel fuel is the dominating transport fuel in the EU, at a combined level of fossil diesel and biodiesel of 64% of overall transport energy consumption. Gasoline represents a quarter. Other oil-based fuels (aviation fuels for domestic flights within countries) represent 2.7%, LPG 1.8% and natural gas 1.1%.

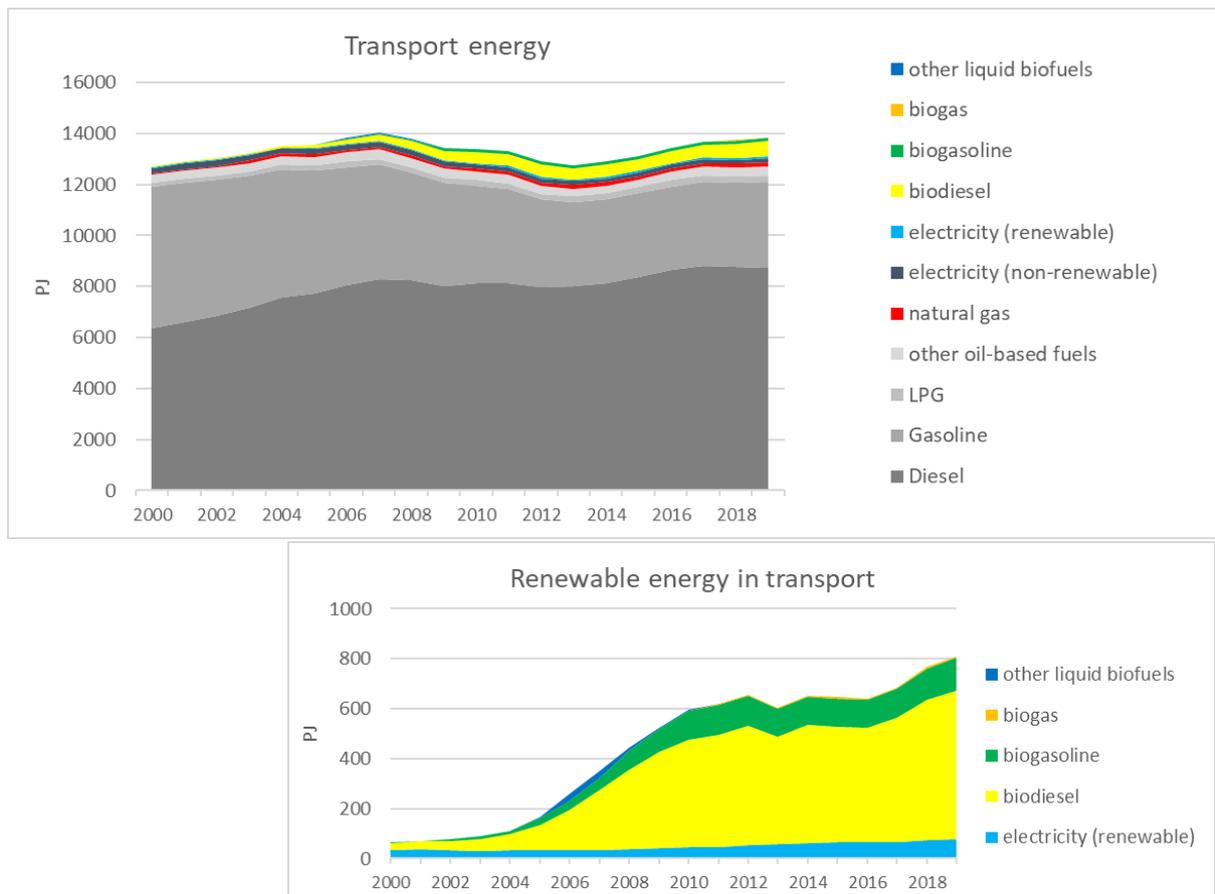


Figure 7: Evolution of transport fuels in the EU28 2000 - 2019 (Source: IEA (2021) World Energy Balances and Renewables Information)

In the early 2000s there was already some consumption of biodiesel, particularly in Germany and France. Between 2004 and 2010 there was a strong increase of biofuels up to a combined level of 4% (by energy) of transport energy. However, these levels stalled up to 2016, likely in relation to uncertainties regarding iLUC restrictions. In recent years (after publication of the iLUC Directive) growth has resumed again. On average biodiesel (FAME and HVO together) represented 6.4% by energy of diesel consumption in 2019. Bioethanol on average represented 3.7% by energy of gasoline consumption.

About 30% of biofuels consumed in the EU28 in 2019 are qualified as ‘advanced biofuels’, meaning that they are produced from residues and waste (particularly used oils for biodiesel). These can be double counted towards the 10% renewable energy in transport target at EU level.

Electricity (of which one third is renewable) represents a share of 1.7% of total transport energy use. This is mostly in rail - the use of electricity in road vehicles is still marginal in 2019 (0.08% of total transport energy use) but can be expected to grow in the coming years.

Policy framework

The main relevant EU-level regulations behind the evolutions in transport are:

- Biofuels directive - 2003/30/EC: Reference values for Member States: 2% share of biofuels in transport fuels in 2005, 5.75% in 2010.
- Energy taxation directive - 2003/96/EC: Possibility of tax reduction for biofuels, without overcompensation.
- Renewable Energy Directive (RED) - 2009/28/EC: Specific target of 10% renewable energy in transport by 2020 (with multiple counting of advanced biofuels and renewable electricity)
- Amended Fuel Quality Directive (FQD) - 2009/30/EC: By 2020 fuel suppliers should reduce the greenhouse gas intensity of their fuel (CO₂eq per MJ fuel) by 6% compared to 2010
- iLUC Directive (EU)2015/1513, amending the RED and FQD: Contribution of food-crop based biofuels limited to 7%; Higher accounting of renewable electricity in electric vehicles; Specific national targets for advanced biofuels
- Recast Renewable Energy Directive (RED2) – (EU)2018/2001 & Green Deal adaptations: relevant for future evolutions
- Deployment of the alternative fuels infrastructure Directive - 2014/94/EU
- Regulation setting CO₂ emission standards for cars and vans (*relevant to reduce overall energy consumption in transport*)

COMPARISON WITH RENEWABLE ENERGY TARGETS

According to Eurostat¹⁴, the following renewable energy shares in *gross final energy consumption* were reached.

Table 6: Share of renewables in different sectors in the EU28, according to Eurostat, and compared to the 2020 target

	2005	2010	2015	2019	2020 target
Overall share	9.0%	12.9%	16.7%	18.9%	20%
In heating & cooling	10.9%	15.0%	18.7%	20.5%	
In electricity	14.8%	19.7%	28.8%	34.2%	
In transport	1.8%	5.2%	6.6%	8.9%	10%

Mind that some of these figures can differ from the IEA derived data because of different accounting rules. Particularly in transport the Eurostat shares are higher, which is due to the multiple counting

¹⁴ http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_ind_335a&lang=en

of advanced biofuels and renewable electricity towards the transport target. The heating & cooling figure in Eurostat also includes a contribution from heat pumps.

Figure 8 shows the 15-year evolution of the overall renewable energy share in gross final energy consumption for the EU28 as a whole, as well as for the 13 European Member States which are also member of IEA Bioenergy. The 2020 targets for the individual Member States are also displayed.

Overall, the EU28 as a whole is on track to reach the 2020 renewable energy target of 20%. Several countries (e.g., Austria, Croatia, Denmark, Estonia, Finland, Germany, Italy, and Sweden) have already achieved or are very close to achieving their 2020 target, while others (e.g., Belgium, France, Ireland, the Netherlands, the United Kingdom) may come somewhat short of reaching their 2020 target.

The actual achievement in 2020 is impacted by the drop in (fossil) energy use with the global pandemic. This has facilitated countries to take bigger steps in renewable energy shares in the year 2020. According to early estimates¹⁵, the EU27 (without the UK) has reached a renewable share of 21.3% of gross final energy consumption in 2020.

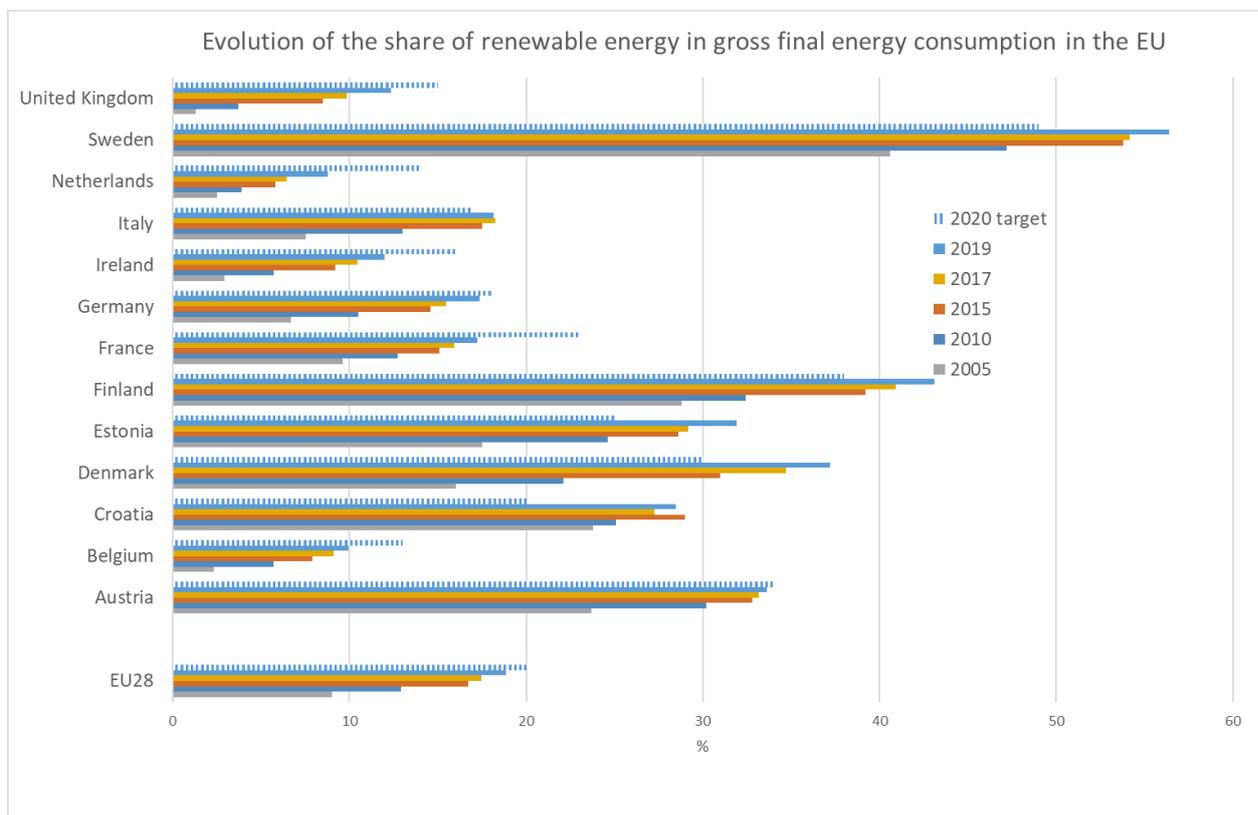


Figure 8: Evolution of the share of renewable energy in gross final energy consumption in the EU, and specific EU member states between 2005 and 2019 (Source: Eurostat)

¹⁵ <https://www.eea.europa.eu/data-and-maps/indicators/renewable-gross-final-energy-consumption-6/assessment>

RESEARCH FOCUS RELATED TO BIOENERGY

The EU has supported bioenergy-related research and technology development (RTD) under several successive **Framework Programmes**, covering the whole chain from feedstock production to end-use. Between 1998 and 2002 around 100 projects were supported under Framework Programme FP5 with a total budget of EUR 140 million. Priority during this time was given to research into thermal processes (heat and electricity production from biomass), yet eight projects on transport biofuels were supported. The following Framework Programme FP6, running from 2002 to 2006 funded 40 projects with a total amount of around EUR 150 million. In the area of biofuels seven projects with a clear focus on 2nd generation biofuel technologies were supported. Moreover, three Integrated Projects (IP) were established for hydrogen production, biorefineries and combustion/co-firing. A Network of Excellence (NoE) was set up to overcome barriers to bioenergy implementation. The first ERANET in Bioenergy was supported to coordinate and boost EU MS R&I in bioenergy. During FP6 the Biofuels Technology Platform (EBTP) was launched, which has become the core of the biofuels community in Europe. In 2016 the EBTP was merged with the European Industrial Bioenergy Initiative (EIBI) to form the European Technology and Innovation Platform Bioenergy (ETIP Bioenergy) which aims to implement the Strategic Energy Technology (SET) Plan of the European Commission and particular its key action on bioenergy and renewable fuels (see further). In the framework of the Intelligent Energy Europe Programme the EC is financing research aimed at overcoming non-technical barriers, which are impeding the market penetration of this type of renewable energy. The Framework Programme FP7, starting in 2007, has been focusing on advanced biofuels and renewable electricity production from biomass with about 300-million-euro EU funding. The predominance of biofuel projects was a direct result from the high oil prices during that period and an effort to push advanced biofuel technologies into the market. The follow-up of FP7, Horizon 2020, is the biggest EU Research and Innovation programme ever with nearly 80 billion euro of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market. Funding for bioenergy research is best placed under that part of Horizon 2020 that addresses societal challenges, in particular the challenge “Secure, Clean and Efficient Energy” with about 400-million-euro support on mostly advanced biofuels and bioenergy Total budget for energy in Horizon 2020 was around EUR 8.5 billion (11.4% of the total H2020 budget). The European Commission has announced the next R&I Framework programme Horizon Europe 2021-2027 with 95,5 billion euro budget and 15,1 billion for Cluster 5 ‘Climate, energy and mobility’ under Pillar II – Global Challenges and European Industrial Competitiveness Renewable energies and renewable fuels including advanced biofuels and non-biological synthetic renewable fuels are addressed under the Destination of Sustainable, secure and competitive energy supply. The first Work Programme 2021-2022 is published in June 2021 with a ring-fenced budget of around 100 million euro for advanced biofuels, non-biological renewable fuels, bioenergy and renewable energy carriers.

The **Bio-Based Industries Joint Undertaking (BBI JU)** is a €3.7 billion Public-Private Partnership between the EU and the Bio-based Industries Consortium. Operating under Horizon 2020, this EU body is driven by the Vision and Strategic Innovation and Research Agenda developed by the industry. The key is to develop new biorefining technologies to sustainably transform renewable natural resources into bio-based products, materials, and fuels. The programme has a threefold focus: (1) Feedstock: foster a sustainable biomass supply with increased productivity and building new supply chains; (2) Biorefineries: optimise efficient processing through R&D and demonstrate their efficiency and economic viability at large-scale demo/flagship biorefineries; (3) Markets, products, and policies: develop markets for bio-based products and optimise policy frameworks. The

programme anticipates an investment of €975 million of EU funds (Horizon 2020) and €2.7 billion of private investments.

The **Strategic Energy Technology Plan (SET-Plan)** of the European Commission aims to accelerate the development and deployment of low-carbon technologies. It seeks to improve new technologies and bring down costs by coordinating national research efforts and helping to finance projects. In September 2015, the Commission published a Communication defining the new European research and innovation strategy for the coming years. The Integrated SET Plan builds on the Energy Union strategy and highlights the areas where the EU needs to strengthen cooperation with SET Plan countries and stakeholders to bring new, efficient, and cost-competitive low-carbon technologies to the market faster and in a cost-competitive way. 10 priority actions were identified; key action No. 8 is on "Bioenergy and Renewable Fuels for Sustainable Transport", with R&I activities scheduled for (1) Advanced liquid and gaseous biofuels, (2) Other renewable liquid and gaseous fuels, (3) Renewable hydrogen, (4) High efficiency large scale biomass CHP and (5) Solid, liquid and gaseous intermediate bioenergy carriers. On 13 June 2018 the SET-Plan Steering Group approved the Implementation Plan of the SET-Plan Action 8. The Implementation Plan (IP) has three common goals for the field of Bioenergy at large: Improve performance (yield and efficiency) of production, reduce GHG emissions along the value chain and reduce cost. In order to capture the major segments of bioenergy, this IP describes targeted implementation approaches for renewable fuels for sustainable transport (automotive and aviation fuels, as well as hydrogen produced from renewable sources), bioenergy (biosolids, bioliquids, and biogases) and intermediate bioenergy carriers. Owing to the complexity, but also to the versatility of the value chain [Feedstocks → Conversion → Intermediate Carriers → Final Product] the IP describes 13 activities. They are structured along Technology Readiness level (TRL) and consequently divided into development, demonstration and scale-up. The estimated volume of investment, cumulative until 2030, is 2.29 billion € for development, whereas 104.31 billion € is foreseen for demonstration and scale-up activities. 73% of overall budget is scheduled to be provided by industry, 21% by Member States and 6% by the European Union. The reporting for the progress of the Implementation plans is continuous and available in SETIS¹⁶

Currently a discussion with MS is taking place for the update of the SET Plan to link to the new European Research Area policy¹⁷

Other financing mechanisms :

- The **Innovfin Energy Demonstration Projects** (EDP) facility for loans, guarantees or equity type investments to risky first-of-a-kind commercial scale energy demonstration projects, helping them to bridge the gap from demonstration to commercialisation. It is managed by the European Investment Bank (EIB).
- The **Innovation Fund** is one of the world's largest funding programmes for the demonstration of innovative low-carbon technologies. It will provide around EUR 10 billion of support over 2020-2030 for the commercial demonstration of innovative low-carbon technologies, aiming to bring to the market industrial solutions to decarbonise Europe and support its transition to climate neutrality. The goal is to help businesses invest in clean energy and industry to boost economic growth, create local future-proof jobs, and reinforce European technological leadership on a global scale. This is done through calls for large and small-scale projects focusing on:

¹⁶ [SET Plan implementation progress reports \(europa.eu\)](https://setis.ec.europa.eu/setis-portal/)

¹⁷ COM(2020) 628 final

- innovative low-carbon technologies and processes in energy-intensive industries, including products substituting carbon-intensive ones
- carbon capture and utilisation (CCU)
- construction and operation of carbon capture and storage (CCS)
- innovative renewable energy generation
- energy storage

LINKS TO SOURCES OF INFORMATION

The following websites provide useful information and data on EU Green Deal, Energy and Transport Policy, renewable energy policy, EU R&I policy, production, and consumption.

- Delivering the European Green Deal (July 2021): https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en
- EU Strategy for Energy System Integration - COM(2020) 299 final (July 2020): https://ec.europa.eu/energy/topics/energy-system-integration/eu-strategy-energy-system-integration_en#documents
- EU strategy on hydrogen - COM(2020) 301 final (July 2020): https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf
- EU Sustainable and Smart Mobility Strategy - COM(2020) 789 final (Dec 2020): https://transport.ec.europa.eu/transport-themes/mobility-strategy_en
- EU Transparency Platform for Renewable Energy: <https://ec.europa.eu/energy/en/topics/renewable-energy>
- Renewable Energy Directive - overview: https://ec.europa.eu/energy/topics/renewable-energy/renewable-energy-directive/overview_en
- Recast of Renewable Energy Directive (EU)2018/2001: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN>
- Renewable Energy Progress report COM/2020/952: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0952&from=EN>
- Horizon Europe <https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/reference-documents;programCode=HORIZON>
- Sustainable finance taxonomy - Regulation (EU) 2020/852 Implementing and delegated acts https://ec.europa.eu/info/law/sustainable-finance-taxonomy-regulation-eu-2020-852/amending-and-supplementary-acts/implementing-and-delegated-acts_en

EU initiatives relevant for bioenergy:

- Strategic Energy Technology Plan: <http://ec.europa.eu/energy/en/topics/technology-and->

[innovation/strategic-energy-technology-plan](#)

- Strategic Energy Technologies Information System (SETIS): https://setis.ec.europa.eu/index_en
- European Technology and Innovation Platform Bioenergy (ETIP Bioenergy): <http://www.etipbioenergy.eu/>
- Bio-based Industries Joint Undertaking: <https://www.bbi-europe.eu/>
- Innovation Fund: https://ec.europa.eu/clima/policies/innovation-fund_en
- Innovfin Energy Demonstration Projects: http://www.eib.org/attachments/thematic/innovfin_energy_demo_projects_en.pdf
- EU Biodiversity Strategy for 2030 - COM(2020) 380 final: https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en
- New EU Forest Strategy for 2030 - COM(2021) 572 final: https://ec.europa.eu/environment/strategy/forest-strategy_en
- Land use and forestry (LULUCF) regulation for 2021-2030: https://ec.europa.eu/clima/eu-action/forests-and-agriculture/land-use-and-forestry-regulation-2021-2030_en