IEA Bioenergy

European Union – 2018 update

Bioenergy policies and status of implementation

Country Reports

IEA Bioenergy: 09 2018

This report was prepared from the 2018 OECD/IEA World Energy Balances, combined with data and information provided by the IEA Bioenergy Executive Committee and Task members. Reference is also made to Eurostat. 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[1] for all country reports.

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POLICY FRAMEWORK IN THE EU

The Renewable Energy Directive (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[2]. The Renewable Energy Directive also established sustainability criteria for transport biofuels that have to be met by any biofuel used to count towards this target, including a lifecycle greenhouse gas emission reduction of at least 35% until 2017 and 50% (to 60% for new installations) afterwards. Within this Directive, member countries of the European Union were obliged to draft and submit to the European Commission National Renewable Energy Action Plans (NREAPs)[3] outlining the pathway which will allow them to meet their 2020 renewable energy targets. Summarizing the individual NREAPs, the split in sectors is envisaged as displayed in Table 1.

Table 1: *EU´s 2020 renewable energy targets.*

Sector	Share in gross final consumption per sector
Overall target	20%
Heating and cooling	21%*
Electricity	34%*
Transport	10%[2]

** derived from NREAP projections*

[1] Available at https://www.ieabioenergy.com/iea-publications/country-reports/2018-country-reports/

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

[3] NREAPs of all European Member States are available at: https://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans

Alongside the Renewable Energy Directive, the amended Fuel Quality Directive (FQD) 2009/30/EC requires the road transport fuel mix in the EU to be 6% less carbon intensive than a fossil diesel and gasoline baseline by 2020.

In September 2015, the Renewable Energy Directive (as well as the Fuel Quality Directive) has been amended by Directive (EU) 2015/1513 to reduce the risk of indirect land use change and to prepare the transition towards advanced biofuels. The amendments include

- a limit of 7% of the share of biofuels from crops grown on agricultural land that can be counted towards the 2020 renewable energy targets,
- an indicative 0.5% target for advanced biofuels as a reference for national targets,
- a requirement that biofuels produced in new installations (which have started operation after October 5, 2015) achieve a minimum GHG saving of 60% compared to fossil fuels,
- stronger incentives (higher multiplication factors) for the use of renewable electricity in transport.

In terms of solid and gaseous biomass sources in electricity, heating and cooling, the European Commission presented a report in 2010 (COM(2010)11), issuing non-binding recommendations for Member States on sustainability criteria for biomass. These recommendations are meant to apply to energy installations of at least 1MW thermal heat or electrical power. In 2014, the Commission published a Staff Working Document (SWD(2014)259) on the state of play of sustainability of solid and gaseous biomass for electricity, heating and cooling in the EU. It concluded that EU demand for solid and gaseous biomass for bioenergy production is likely to continue to be met largely through domestic raw material up to 2020, the majority providing significant GHG savings compared to fossil fuels. So no binding EU-wide sustainability requirements were proposed at that time. It was announced that these would be revisited in the post 2020 policy framework.

Meanwhile, the post-2020 policy framework is being prepared. In October 2014 the European Council agreed on the 2030 Climate and Energy Policy Framework, including the following targets for 2030: a binding target for GHG reduction of at least 40% compared to 1990, a share of renewable energy in final energy demand in the EU of at least 27%, and an indicative target for energy efficiency improvement of 27% - the energy efficiency target may be adjusted to 30% after a review in 2020.

On November 30, 2016, the European Commission presented a proposal for a **recast of the Renewable Energy Directive**, as part of the broader 'Clean Energy for all Europeans' package. This was the basis for negotiations between the European Council and the European Parliament. A final compromise document on the recast of the Renewable Energy Directive ('RED II') was agreed among EU Institutions on June 14, 2018[4]. Some key elements:

- The agreement raises the overall EU renewable energy target by 2030 to 32%.

- Each Member State shall endeavour to increase energy from renewable sources in heating and cooling by an indicative yearly average of 1.3 percentage points.

- Each Member State shall set an obligation on fuel suppliers to ensure that renewables will reach a level of at least 14% in final energy consumed in road and rail transport by 2030, supplemented by a set of facilitative multipliers.
    - Within this target, there is a sub-target for advanced biofuels produced from a specified list of feedstocks (Annex IX, part A). These fuels must reach at least 0.2% of transport energy in 2022, 1% in 2025 and 3.5% by 2030. Advanced biofuels will be double-counted towards both the 3.5% target and towards the 14% target.
    - Biofuels from used cooking oil and animal fats (Annex IX, part B) not part of the 3.5% advanced biofuels target. They are still double counted towards the 14% target, but

[4] http://data.consilium.europa.eu/doc/document/ST-10308-2018-INIT/en/pdf

their contribution is capped at 1.7% in 2030.
    - Conventional biofuels (from food/feed crops) will be capped EU-wide at a maximum of 7%, with potential member state caps below 7% (depending on their share in 2020).
    - The counting of biofuels with a high risk of indirect land use change (ILUC) will be freezed at 2019 levels and gradually phased out from 2023 towards 2030.
    - Biofuels supplied in the aviation and maritime sector can be counted towards the target, with a multiplication factor of 1.2 (not for food/feed crop based biofuels).

- The RED II further strengthens sustainability criteria for biofuels used in transport, and extends these also to solid and gaseous biomass fuels used for power, heating and cooling production, particularly for larger installations (>20 MW thermal input for solid biomass; >2 MW thermal input for gaseous biomass). For forest biomass, a risk based approach will be applied to minimise the risk of using forest biomass derived from unsustainable production and alignment with land use and land use change and forestry (LULUCF) requirements, thereby ensuring proper carbon accounting (considering legislation and forest management systems in the country of origin). Suppliers of bioenergy will have to comply with the sustainability criteria in order for the biofuels and bioenergy to account towards the renewable energy target and to be eligible for financial support by public institutions.

The recast directive would enter into force on 1 January 2021, when the existing RES Directive would be repealed.

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 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.

TOTAL PRIMARY ENERGY SUPPLY (TPES) AND THE CONTRIBUTION OF BIOENERGY

The total primary energy supply of the 28 members of the EU in 2016 amounted to 66.9 exajoule (EJ) with fossil fuels (oil, gas, coal) still contributing more than 70%. Oil products account for a third (22.0 EJ), natural gas accounts for a quarter (16.0 EJ) and coal products for around 15% (9.8 PJ). Nuclear energy in nuclear power stations represents 13.7% of total primary energy supply or 9.2 EJ. Renewable energy sources have a share of 13.6% or 9.0 EJ – 8.8% bioenergy and 4.8% other renewable energy sources.

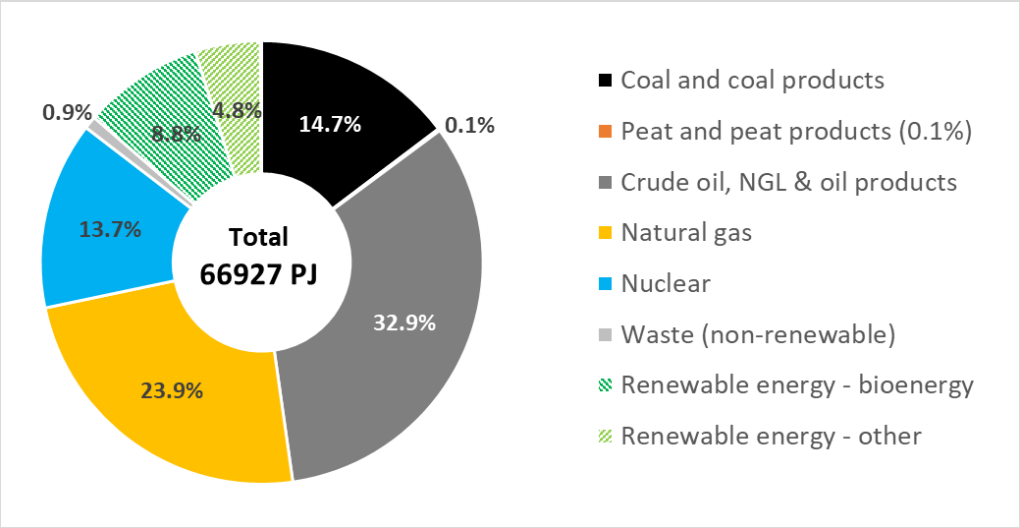

Figure 1: Total primary energy supply[5] in the EU in 2016 (Source: World Energy Balances © OECD/IEA 2018)

Compared to 5 years earlier (2011) the share of coal reduced from 16.9% to 14.7%, while the share of oil, natural gas and nuclear reduced only slightly (around 0.5 percentage point). In the same period the share of renewable energy increased from 10.4% to 13.3%.

Bioenergy represents around two thirds of the total primary energy supply of renewable energy sources in 2016, with 5,881 PJ. Hydropower amounts 1,260 PJ, wind energy 1,090 PJ, solar energy 560 PJ and geothermal energy 279 PJ. Energy from tide, wave and ocean energy represents only 2 PJ.

[5] TPES underestimates the actual role of pure electricity sources like PV, wind or hydro energy, and overestimates the role of resources producing electricity with a high share of unused waste heat (like nuclear, coal).

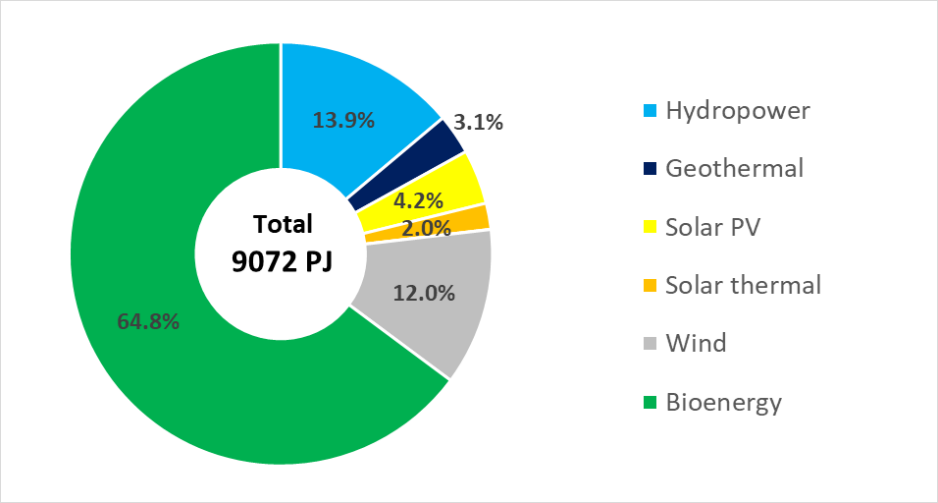

Figure 2: Total primary energy supply of Renewable Energy Sources in the EU in 2016 (Source: World Energy Balances © OECD/IEA 2018)

Most of the bioenergy consumed in the EU comes from solid biofuels; their share accounts for 70% of the total use of bioenergy or 4,115 PJ, of which 1,812 PJ in residential applications. The second largest item is biogas (695 PJ), followed by biodiesel (473 PJ), renewable municipal waste (432 PJ) and biogasoline (112 PJ).

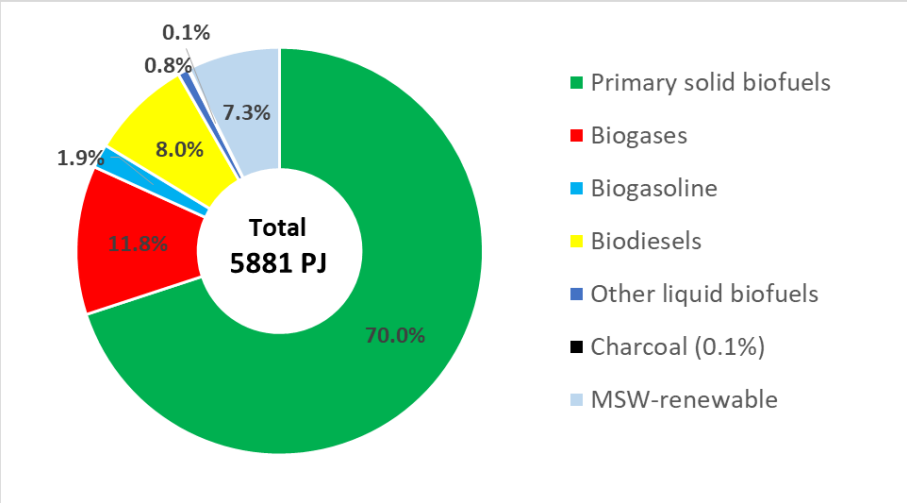

Figure 3: Total primary energy supply from bioenergy in the EU in 2016 (Source: 2018 World Energy Balances © OECD/IEA)

Bioenergy consumption levels in the EU doubled between 2000 and 2010; after stabilization in 2010-2011, a further growth of on average 3% per year was achieved between 2011 and 2016. In this period the share of bioenergy in TPES increased from 7.0% to 8.8%. Solid biomass had a modest average growth of around 2% per year between 2010 and 2016; for renewable MSW this was 4%, for biogas even 11%. Liquid biofuels stabilized between 600 and 650 PJ since 2010.

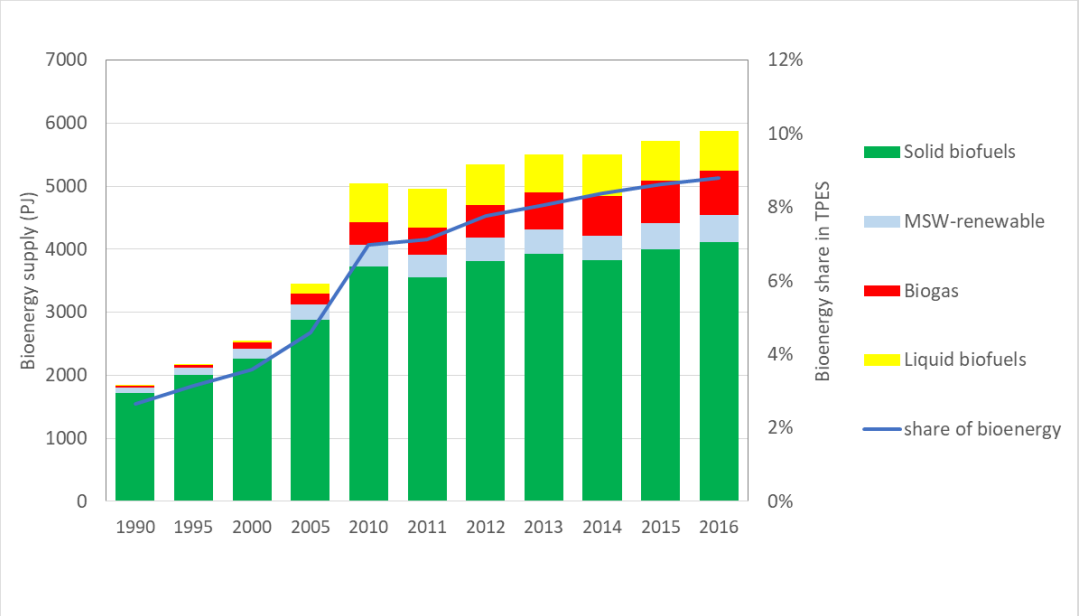

Figure 4: Development of total primary energy supply from bioenergy in the EU 1990 – 2016 (Source: World Energy Balances © OECD/IEA 2018)

Table 2 expresses the 2016 TPES figures per capita, considering the EU28 population of 511.3 million people.

***Table 2**: Total primary energy supply per capita in the EU28 in 2016*

	GJ/capita
Total energy	130.9
Bioenergy	11.5
Solid biofuels	8.0
Renewable MSW	0.8
Biogas	1.4
Liquid biofuels	1.2

Source: World Energy Balances © OECD/IEA 2018

Role of bioenergy in different sectors

The EU has a share of almost 30% renewable electricity in 2016; one third of that is hydro, another third is wind energy, and one fifth is electricity from biomass.

The share of biofuels for transport amounts to 4.4%.

Overall, the direct share of biomass for heating in the different sectors is around 15%. Mind that heat output generated and sold by CHP plants and heat plants represents around 10% of fuel/heat provided, of which around 24% is produced from biomass. In the residential sector direct biomass represents about 20% of fuel/heat consumption.

Table 3: *Role of bioenergy and renewable energy in electricity production, transport energy consumption and fuel/heat consumption in 2016*

Sector	Share of bioenergy	Share of renewable energy	Overall production/ consumption
Electricity production	5.6%	29.5% (10.8% hydro) (9.4% wind)	3228 TWh (11,621 PJ)
Transport energy (final consumption)	4.4%	4.9%	13,374 PJ
Overall fuel and heat consumption[6]	Direct biomass: 15.0% Biobased heat: 2.4%	17.9%	20,190 PJ

Source: 2018 World Energy Balances © OECD/IEA 2018

According to Eurostat[7], the following renewable energy shares in gross final energy consumption were reached in the EU in 2016:

- Overall share: 17.0%
- In heating and cooling: 19.1%
- In electricity: 29.6%
- In transport: 7.1%

Mind that some of these figures can differ from the IEA derived data because of different accounting rules, particularly in relation to advanced biofuels and renewable electricity in transport.

Figure 5 shows the 10 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 seems to be on track to reach the 2020 renewable energy target of 20%. Some countries (e.g. Austria, Croatia, Denmark, Estonia, Finland, 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) still need to take important steps.

[6] 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.

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

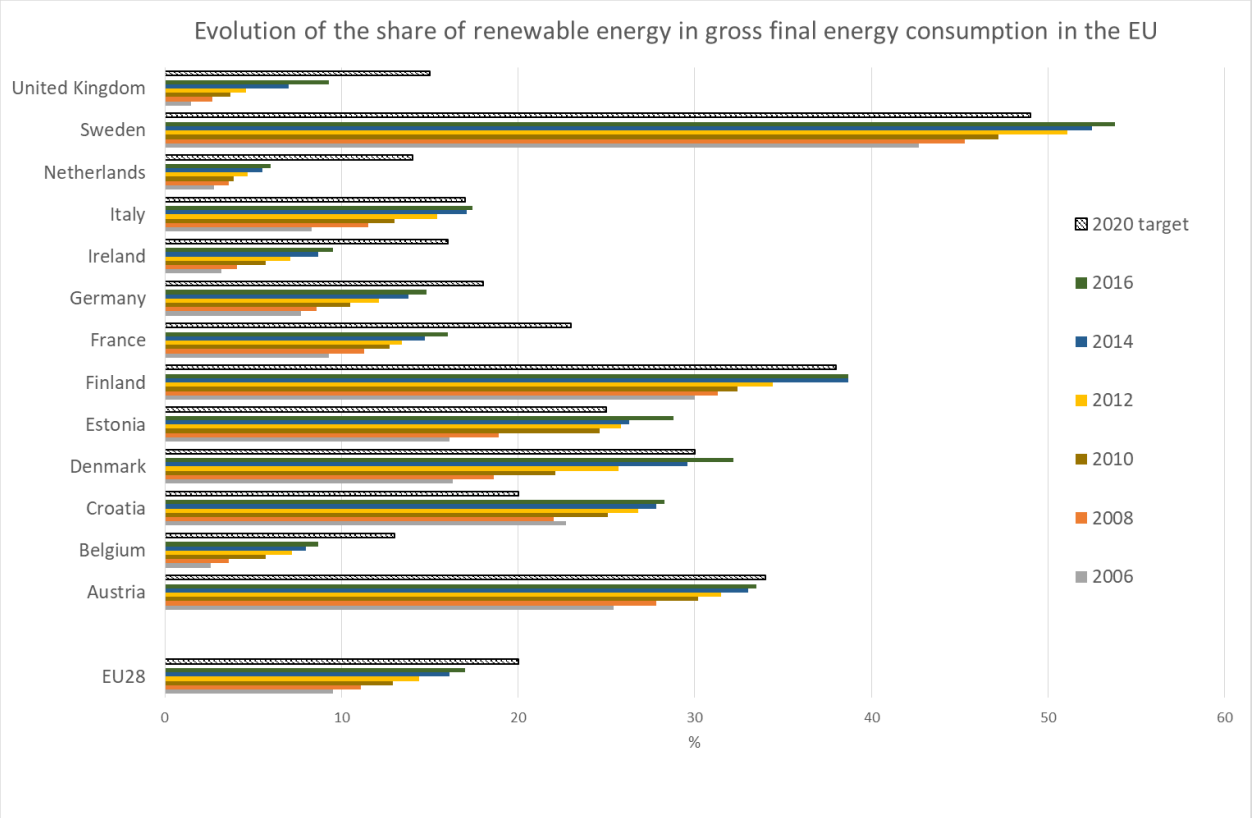

Figure 5: Evolution of the share of renewable energy in gross final energy consumption in the EU, and specific EU member states between 2006 and 2016 (Source: Eurostat)

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. 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. 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 EUR 80 billion 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". Total budget for energy in Horizon 2020 is around EUR 8.5 billion (11.4% of the total H2020 budget). The European Commission is currently working on a proposal for the framework programme that will succeed Horizon 2020.

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.[8]

Other financing mechanisms[9]:

- 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

[8] https://setis.ec.europa.eu/system/files/setplan_bioenergy_implementationplan.pdf
[9] http://www.etipbioenergy.eu/images/SPM8_Presentations/1_MG_ETIP%20Bioenergy%20SPM8_11-12%20April%202018%20final.pdf

European Investment Bank (EIB).

- The ETS Innovation Fund for first-of-a-kind investments in RES, CCS and low-carbon innovation in energy intensive industry with about 400 million CO_2 allowances from 2021. It will build on the NER300 programme which saw EUR 2.1 billion awarded to 38 innovative renewable energy and one CCS project.

LINKS TO SOURCES OF INFORMATION

The following websites provide useful information and data on EU renewable energy policy, production and consumption.

- EU Transparency Platform for Renewable Energy: https://ec.europa.eu/energy/en/topics/renewable-energy
- Directive 2009/28/EC on the promotion of the use of energy from renewable sources: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32009L0028
- A policy framework for climate and energy in the period from 2020 to 2030: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52014DC0015
- Compromise text for the recast of the Renewable Energy Directive: http://data.consilium.europa.eu/doc/document/ST-10308-2018-INIT/en/pdf
- Current policies at EU and Member State level: https://s2biom.vito.be/

EU initiatives on 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/
- European Technology and Innovation Platform Bioenergy (ETIP Bioenergy): http://www.etipbioenergy.eu/
- Bio-based Industries Joint Undertaking: https://www.bbi-europe.eu/
- ETS Innovation Fund: http://ner400.com/
- Innovfin Energy Demonstration Projects: http://www.eib.org/attachments/thematic/innovfin_energy_demo_projects_en.pdf