



ADVANCEFUEL

Good Practices Along the Renewable Fuels Value Chain

ADVANCEFUEL demonstrates good practice cases in both the plant and biorefinery as well as the policymaking area for the production and development of advanced renewable fuels. The aim is to inform about the current state of industry and in policy making and how the growing market uptake of advanced renewable fuels from renewable sources (RESfuels) for the European road, aviation and marine transport sectors can be facilitated.



Good practices of plants & biorefineries

ADVANCEFUEL presented 10 plants in Europe from pilot, demonstration and commercial development stages through an environmental, economic and social lens to identify good practices of production and implementation of RESfuels along the full value chain. Practices are measured by greenhouse gas emissions savings and sustainability measures, total production capacity and gross added value, and total employment generated by the plants.

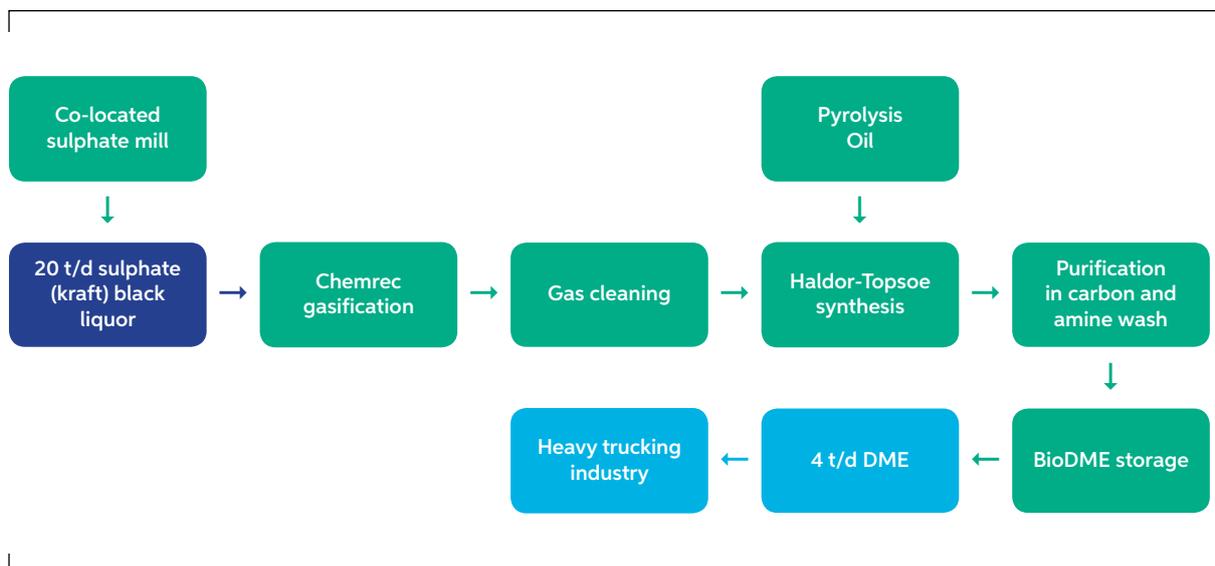
FIGURE 1. **ADVANCED BIOFUELS PLANTS IN THE EU**



BIODME Thermochemical Pilot Plant

Plant Description: The BioDME plant in Piteå, Sweden, converts sulphate (kraft) black liquor from a nearby sulphate mill into methanol and dimethylether (DME) through the Chemrec engineered gasification and Haldor-Topsoe syngas technology with pyrolysis oil. It is able to produce 4 tons per day with an investment cost of €20 million for the construction of the plant. DME has similar properties as LPG with very low particle emissions and has been tested a on 10 different Volvo trucks.

FIGURE 2. BIODME PITEÅ VALUE CHAIN



Environmental, Economic and Social Performance

- DME from black liquor produces 1 g CO₂ eq/km for around 275 MJ/100km compared to conventional fuels with around 150 g CO₂ eq/km for 200 MJ/100km
- Field tests indicates fuel with good environmental properties, low PM matter and absence of soot

ENVIRONMENTAL →

RED/National indicators

- According to RED II targets, dimethylether (DME) from black-liquor gasification integrated with pulp mill should reduce CO₂ emissions by 89%

- Operational capacity of the pilot plant was 3MW which represent 20 tonnes of dry black liquor per day to produce 1.8MV of syngas and is now producing 4 tonnes of DME per day

ECONOMIC →

- According to IRENA, installed capacity in 2017 for liquid biofuels in Sweden was 515,000 MW

- 19 full-time staff members as researchers and technicians at the plant

SOCIAL →

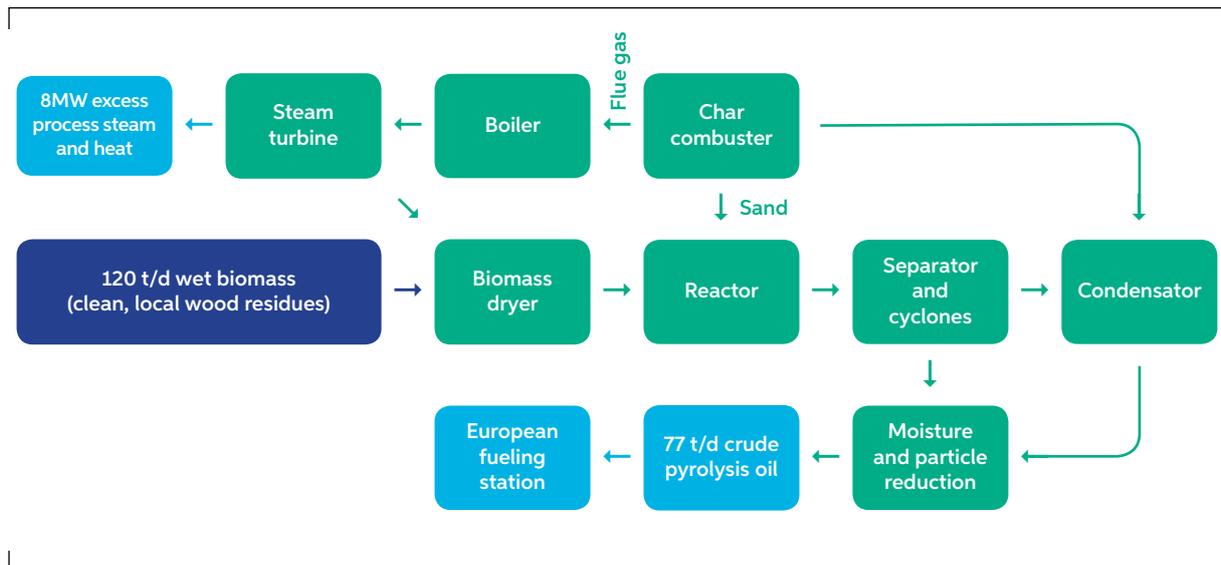
- Sweden produces 7,600 direct and indirect jobs in the liquid biofuels industry



EMPYRO Thermochemical Demonstration Plant

Plant Description: The Empyro plant in Hengelo, Netherlands, converts wood residues into crude pyrolysis oil through liquid pyrolysis, oil being the main product and pyrolysis gases are used to generate additional steam and power. The end product is designed to be compatible with diesel and gasoline.

FIGURE 3. EMPYRO HENGELO VALUE CHAIN



Environmental, Economic and Social Performance

- Total emissions from production while using forest residues amount to 8.70 g CO₂-eq/MJ pyrolysis oil, when placed against fossil fuel comparators, this figure represent an emissions saving of 90.4% when replacing electricity
- The plant uses clean woody biomass from local sources and recycles extracted minerals back into soil

ENVIRONMENTAL →

RED/National indicators

- According to RED II targets, greenhouse gas emissions savings from waste wood producing Fischer-Tropsch diesel in free-standing plant is 85%

- The demonstration/commercial plant operates at a capacity of 120 tonnes per day of clean wood residues to produce 77 tonnes per day of crude pyrolysis oil, as well as 8MW of by-product

ECONOMIC →

- According to Eurostat Shares of Renewables, the Netherlands' share of compliant biofuels in transport in 2017 was 303 ktoe

- The project creates approximately 100 person-years of work

SOCIAL →

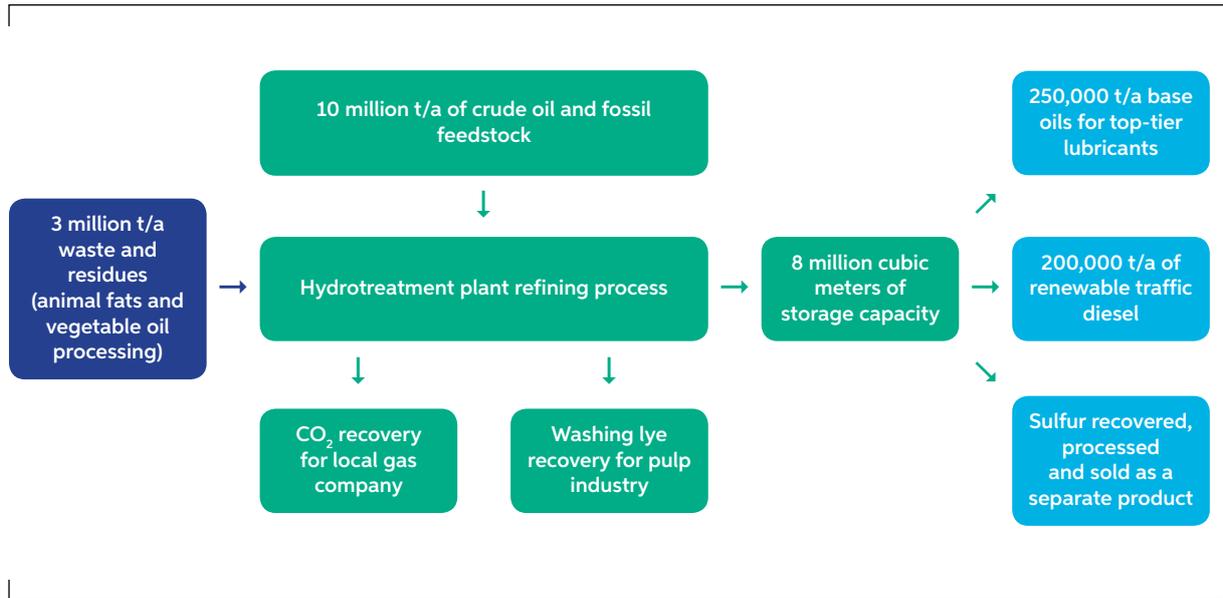
- The Netherlands produces 400 direct and indirect jobs in the liquid biofuels industry



NESTE Thermochemical Commercial Plant

Plant Description: The Neste Porvoo, Finland, and Rotterdam, Netherlands, plants convert various vegetable oils and waste streams into renewable biodiesel through hydrogenated vegetable oil processing.

FIGURE 4. NESTE PORVOO VALUE CHAIN



Environmental, Economic and Social Performance

- Neste states that its Renewable Diesel is made from 100% renewable raw materials which achieve between up to a 50 to a 90% reduction in greenhouse gas emissions over its lifecycle compared to conventional fossil diesel

ENVIRONMENTAL →

RED/National indicators

- According to RED II targets, greenhouse gas emissions savings from waste cooking oil biodiesel is 84% and pure vegetable oil from palm oil (with methane capture at oil mill) has a default value of 57.2 g CO₂eq/MJ for total CO₂ emissions

- The commercial Neste plants in Porvoo and Rotterdam produce 200,000 tonnes a year and 1,000,000 tonnes a year, respectively, from various vegetable oils and waste streams

ECONOMIC →

- According to Eurostat Shares of Renewables, Finland's share of compliant biofuels in transport in 2017 was 390 ktoe, while the Netherlands' was 303 ktoe

- Both refineries are situated in industrial port areas which employ thousands and benefit collaborations and partnerships within the renewable energy sector

SOCIAL →

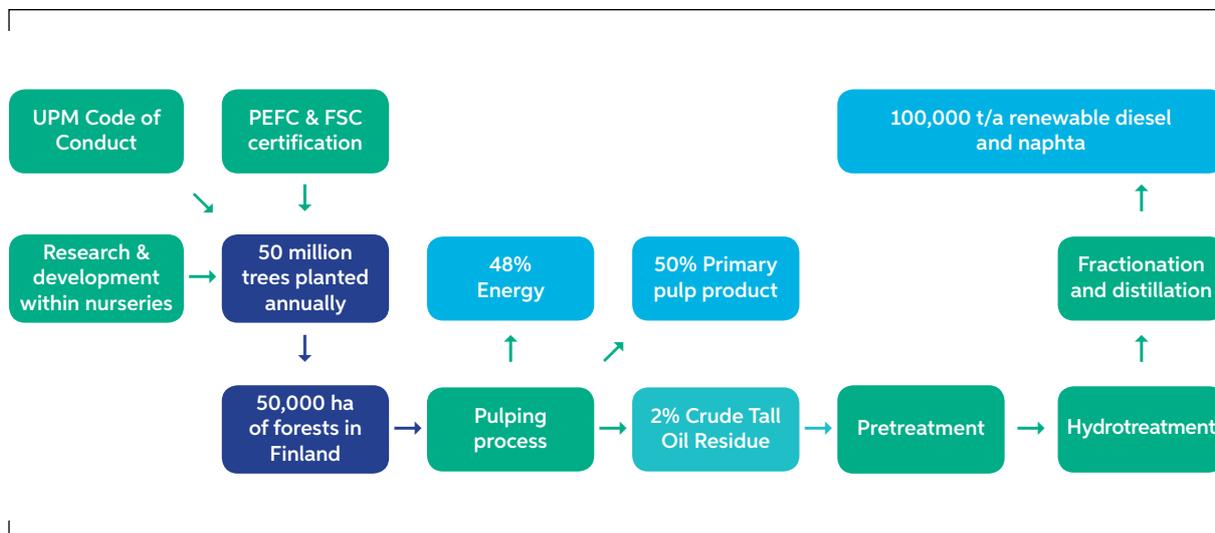
- Finland produces 2,900 direct and indirect jobs in the liquid biofuels industry, while the Netherlands produces 400



UPM Thermochemical Commercial Plant

Plant Description: UPM’s biorefinery in Lappeenranta, Finland, produces 100,000 tonnes per year of renewable diesel and renewable naphtha, both drop-in fuels compatible within the existing European distribution network and without any limits to blending with either diesel or gasoline, respectively. The production pathway of these advanced biofuels is possible because of the plant’s colocation with a pulp and paper mill factory, which produces a certain surplus amount of crude tall oil. The plant is at a commercial development stage thanks to a financing of €179 million and has been in operation for more than 10,000 hours.

FIGURE 5. UPM LAPPEENRANTA VALUE CHAIN



Environmental, Economic and Social Performance

- 80% of lower GHG emissions than fossil diesel
- Tailpipe emissions reduced by at least 10% percent compared conventional diesel fuel
- 50% biofuel blend in dredging vessel (maritime) yields a reduction of 600 tonnes in CO₂
- 255,000 hectares in Uruguay have been established on formerly degraded grasslands

ENVIRONMENTAL →

- Operational capacity of 100,000 tonnes per annum of renewable diesel and renewable naphtha to be dropped-in or blended

ECONOMIC →

- UPM Lappeenranta employs 250 direct and indirect employees

SOCIAL →

RED/National indicators

- According to RED II targets, default value for greenhouse gas emissions saving Fischer-Tropsch diesel from black liquor gasification integrated with pulp mill is 89%
- Additionally, a bonus of 29 g CO₂eq/MJ is attributed when land was severely degraded land

- According to Eurostat Shares of Renewables, Finland’s share of compliant biofuels in transport in 2017 was 390 ktoe

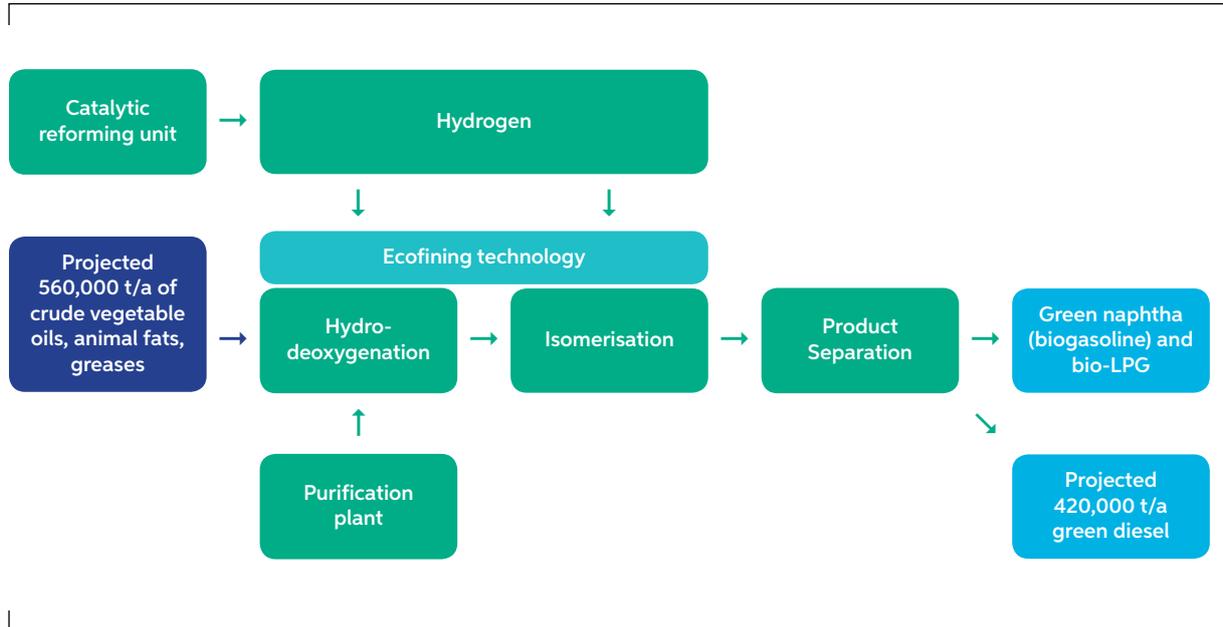
- Finland produces 2,900 direct and indirect jobs in the liquid biofuels industry



ENI GREEN Thermochemical Commercial Plant

Plant Description: Eni’s Green Refinery Project in Venice, Italy, converts vegetable oils, animal fats and greases into hydrocarbon fuels, naphtha and LPG and jet fuel through an ecofining process which involves de-oxygenation, isomerization and product separation. The produced green diesel is of high-quality, free of aromatic compounds and high cetane levels which makes it entirely compatible with diesel.

FIGURE 6. ENI GREEN VALUE CHAIN



Environmental, Economic and Social Performance

- Eni Diesel is 15 percent more renewable than regular diesel, and cuts unburnt hydrocarbons and carbon monoxide by up to 40 per cent
- Production cycle helps to reduce CO₂ emissions by an average of 5 per cent

ENVIRONMENTAL →

RED/National indicators

- According to RED II targets, if produced with no net carbon emissions from land use change, default value for greenhouse gas emissions saving from waste cooking oil biodiesel is 84% and hydrotreated oil from waste cooking oil is 83%

- The Eni Venice Green plant is projected to produce more than 420,000 tonnes per year of green diesel amount from 11,575 barrels per day of feedstock

ECONOMIC →

- According to Eurostat Shares of Renewables, Italy’s share of compliant biofuels in transport in 2017 was 1,060 ktoe

- Eni Green Project has established collaborations with the academic community including the sponsorship of masters and PhD theses

SOCIAL →

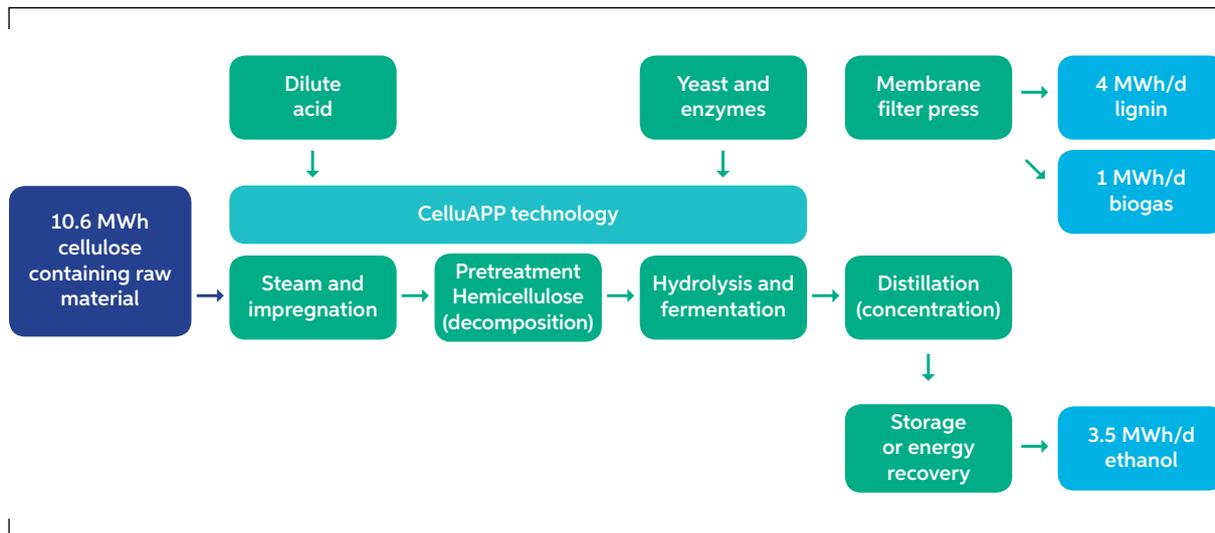
- Italy produces 6,500 direct and indirect jobs in the liquid biofuels industry



SEKAB Biochemical Pilot Plant

Plant Description: The SEKAB plant in Domsjö, Sweden, utilises its own CelluAPP technology to pretreat feedstock with heat and catalyst, steam explosion, batch enzyme hydrolysis with detoxing technology, separation of sugars, and fermentation with yeast or bacteria for the production of 99% ethanol with a final distillation process.

FIGURE 7. SEKAB DOMSJÖ VALUE CHAIN



Environmental, Economic and Social Performance

- SEKAB’s own sustainability criteria involves at least 85% reduction of fossil carbon dioxide as compared to petrol and zero tolerance for the felling of rainforests
- SEKAB ethanol has near-zero particle pollution and low nitrogen oxide emissions

ENVIRONMENTAL →

RED/National indicators

- According to RED II targets, default value for greenhouse gas emissions saving from sugarcane ethanol is 70%

- The SEKAB plant produces 3.5 MWh per day of ethanol from 2 tonnes per day of dry feedstock
- Additionally it produces by-products of 4 MWh per day of lignin and 1 MWh per day of biogas

ECONOMIC →

- According to IRENA, installed capacity in 2017 for liquid biofuels in Sweden was 515.000 MW

- Extensive collaborations with research institutes, universities, government agencies, vehicle manufacturers and other companies with the forestry and chemical industries, as well as forestry and processing industry

SOCIAL →

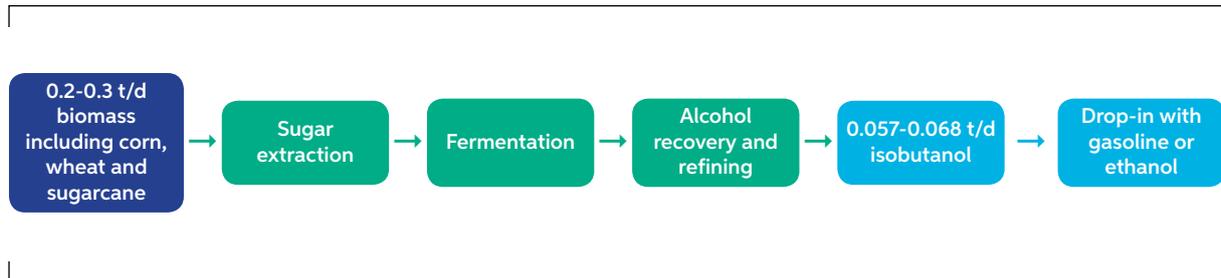
- Sweden produces 7,600 direct and indirect jobs in the liquid biofuels industry



BUTAMAX Biochemical Demonstration Plant

Plant Description: The Butamax joint venture pilot demonstration plant in Hull, UK, constructed by BP and DuPont, developed modified genes to expand enzyme conversion of sugar to biobutanol in higher quantities and less time, producing bio-isobutanol which can be blended with gasoline in higher concentrations than other biofuels.

FIGURE 8. BUTAMAX HULL VALUE CHAIN



Environmental, Economic and Social Performance

- According to Butamax, bioisobutanol can displace 16% of every gallon of hydrocarbon gasoline, which means saving 17 billion gallons of gasoline per year and replacing it with a renewable fuel
- Biobutanol degrades relatively quickly under both aerobic and anaerobic conditions

ENVIRONMENTAL →

RED/National indicators

- According to RED II, butanol made from renewable sources yields an energy content of 33 MJ/kg, compared to petrol which is 43 MJ/kg. Butanol is thus closer to gasoline than ethanol is in terms of energy content, which implies a higher change of replacing fossil fuel energy

- The Butamax demonstration plant was able to convert 0.2-0.3 tonnes per day of unmodified yeast into 0.057-0.068 tonnes per day of isobutanol

ECONOMIC →

- According to Eurostat Shares of Renewables, The United Kingdom's share of compliant biofuels in transport in 2017 was 1,016 ktoe

- The pilot employed over 30 direct technology and operations team members

SOCIAL →

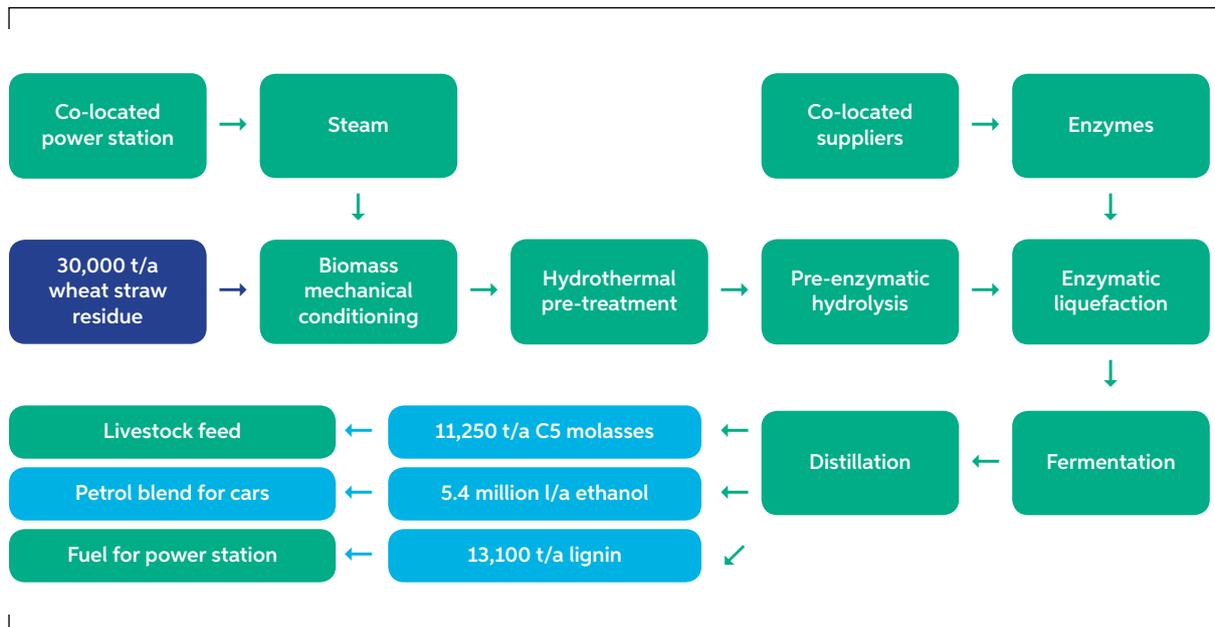
- The United Kingdom produces 10,000 direct and indirect jobs in the liquid biofuels industry



INBICON Biochemical Demonstration Plant

Plant Description: The Inbicon plant in Kalundborg, Denmark, has demonstrated two process configurations: one converting wheat straw into second generation bioethanol, lignin and C5 molasses based on C6 fermentation and one based on C5 and C6 fermentation through biomass mechanical conditioning, hydrothermal pre-treatment and pre-enzymatic hydrolysis for continuous liquefaction.

FIGURE 9. INBICON KALUNDBORG VALUE CHAIN



Environmental, Economic and Social Performance

- Total CO₂ reduction from using bioethanol, lignin and C5 molasses is 85%
- Integration of the plant with a power station permits usage of heat energy in the form of steam while the power plant reduces over 25,000 tonnes of CO₂ by using the biofuel

ENVIRONMENTAL →

- The Inbicon plant produces a total of 5.4 million litres per annum of ethanol from 30,000 tonnes per annum of feedstock
- Additionally it produces 11,250 tonnes per annum of C5 molasses and 13,100 tonnes per annum of lignin

ECONOMIC →

- 30 employees at the plant and 60 employed at Inbicon

SOCIAL →

RED/National indicators

- According to RED II targets, default value for greenhouse gas emissions saving from wheat straw ethanol is 83%

- According to Eurostat Shares of Renewables, Denmark's share of compliant biofuels in transport in 2017 was 218 ktOE

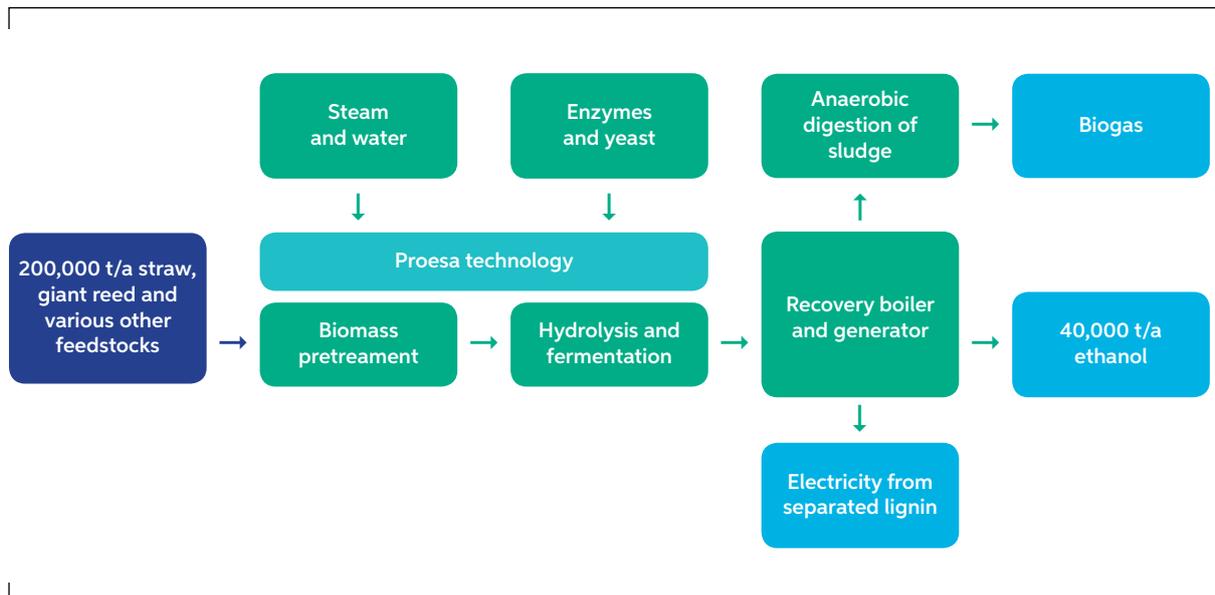
- Denmark produces 200 direct and indirect jobs in the liquid biofuels industry



ENI VERSALIS Biochemical Commercial Plant

Plant Description: The Eni Versalis plant in Crescentino, Italy, produces cellulosic ethanol, green electricity and biogas from agricultural residues (rice and wheat straw), energy crops (reed, switchgrass and woody crops) and forestry residues through the Proesa technology which handles the pretreatment of biomass before enzymatic hydrolysis and fermentation.

FIGURE 10. ENI VERSALIS CRESCENTINO VALUE CHAIN



Environmental, Economic and Social Performance

- 20,000 tonnes of ethanol from a biorefinery saves 72,000 tons of CO₂ through bioethanol production which represents a >70% GHG reduction compared to gasoline
- Wheat straw and giant reed grown within 70 km of the factory

ENVIRONMENTAL →

RED/National indicators

- According to RED II targets, if produced with no net carbon emissions from land use change, default value for greenhouse gas emissions saving from wheat straw ethanol is 83%

- The plant converts over 200,000 tonnes of biomass to produce a capacity of 40,000 tonnes of bioethanol per year

ECONOMIC →

- According to Eurostat Shares of Renewables, Italy's share of compliant biofuels in transport in 2017 was 1,060 ktoe

- The Eni Versalis plant generates approximately 100 direct and 200 indirect jobs

SOCIAL →

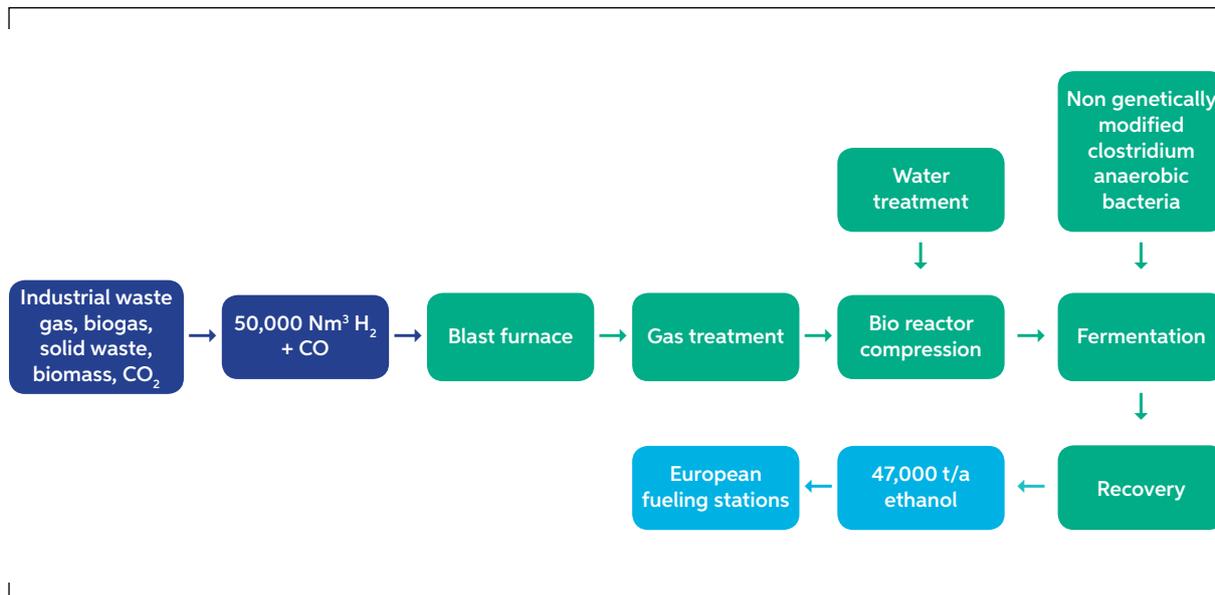
- Italy produces 6,500 direct and indirect jobs in the liquid biofuels industry



LANZATECH Biochemical Commercial Plant

Plant Description: The LanzaTech plant in Ghent, Belgium involves a process of biological conversion of carbon to products through gas fermentation in the form of microbes that grow on gases. As such it is able to convert waste gases such as carbon dioxide hydrogen and carbon monoxide into bioethanol, ready for blending with gasoline or drop in jet fuel.

FIGURE 11. LANZATECH GHENT VALUE CHAIN



Environmental, Economic and Social Performance

- 120,000 tonnes per year of CO₂ reductions were reported for the first phase of the plant
- GHG emissions savings of over 60% compared to fossil fuel

ENVIRONMENTAL
→

- The commercial demonstration facility integrated with a steel plant is expected to produce 143 tonnes per day, or 47,000 tonnes per annum of bioethanol from 50,000 Nm₃ per hour of waste gases including carbon dioxide hydrogen and carbon monoxide

ECONOMIC
→

- The new installation created 500 construction jobs over a period of two years while there are between 20 to 30 new permanent direct jobs at the biorefinery

SOCIAL
→

RED/National indicators

- No RED targets specific to converting waste gases into ethanol

- According to Eurostat Shares of Renewables, Belgium's share of compliant biofuels in transport in 2017 was 465 ktoe

- Belgium produces 900 direct and indirect jobs in the liquid biofuels industry



Policy Facts on Advanced Biofuels in European countries

ADVANCEFUEL analysed renewable fuel policies in the European Union and 10 different countries such as Denmark, Finland, Germany, the Netherlands, Italy, Slovakia, Sweden, United Kingdom. Policy mechanisms employed and respective special provisions for aviation, marine and heavy-duty road transport for markets in initial, early and mature development stages are presented and assessed for their transferability. The preliminary assessment of good practice performance done jointly with interviewed stakeholders is measured against the quality of policy integration, strategy for market segments with limited alternatives for decarbonization and stakeholder engagement.

Enabling environment created by the policy framework:

- Under RED II Member states have flexibility on implementation choices of transport mandate and sustainability criteria compared to RED.
- Provides long-term certainty for investors
- Puts the consumer at the centre of the energy transition with a clear right to produce own renewable energy
- Increases competition
- Accelerates the uptake of renewables in transport sectors
- Strengthens the sustainability
- Promotes the innovative technologies provides long-term certainty for investors

Policy related key barriers for the uptake of advanced biofuels

- Lack of harmonised regulations on sustainable farming practices for residual biomass, dedicated energy crops and forest management practices
- Lack of harmonised regulations throughout EU concerning fuel taxes, biofuel tax reductions, obligation systems, RESFuel Blends and fuel standards.
- Absence of structural mechanism to bridge the gap between renewable and fossil-based fuels
- Absence of dedicated policy support for RES-T in the form of incentives and dedicated national and EU level targets
- Long term policy support to provide stability and security for the industry (including pricing and regulation of (competing) fossil fuels).
- Lack of certification required to ensure market share of CO2 as feedstock for renewable fuels.





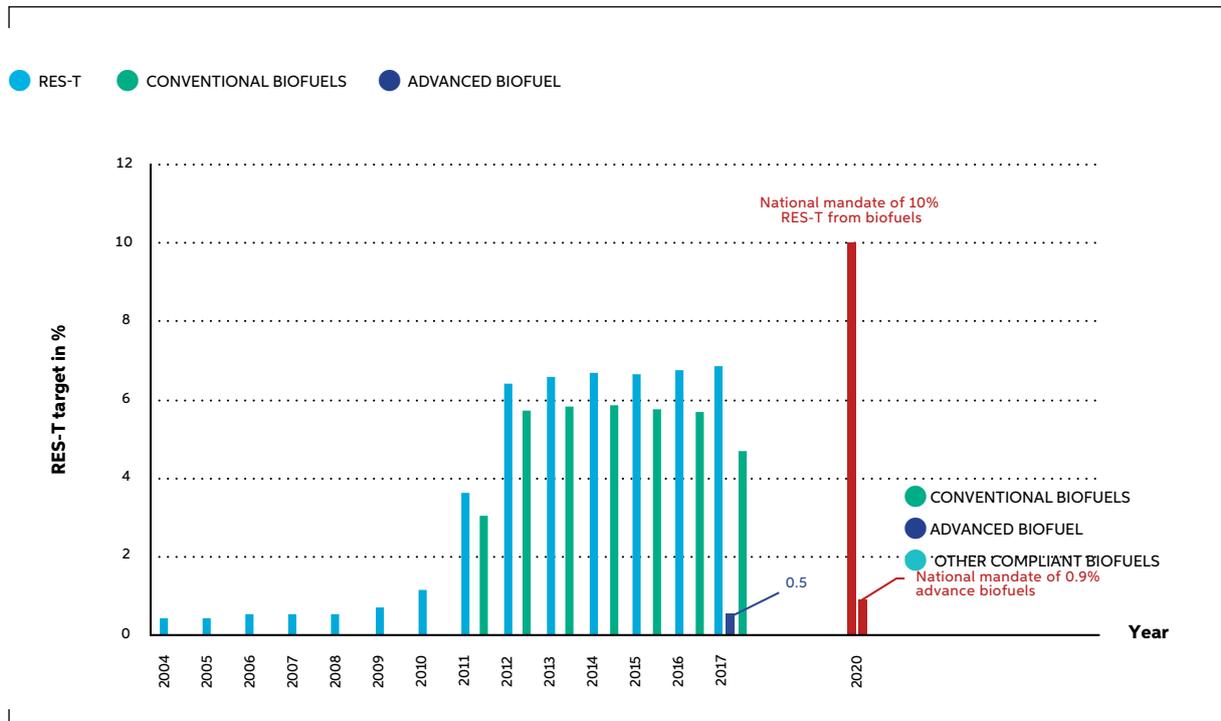
Denmark (DK)

Current State of Art¹:

Denmark is leading by example and has surpassed their national binding target for 2020 in 2015 and aims to be 100% carbon neutral by 2050. Denmark implemented the biofuel mandate of 5.75% for road and rail transportation starting from 2009. Following this we can see the consumption trend of biofuel increased from 0.69% in 2009 to 6.41% in 2012. However, looking at the consumption trend of renewable transport fuels (RES-T) from 2012 to 2017, it has not increased significantly. In 2017 the RES-T share is 6.85% and advanced biofuel share of RES-T is only 1% which shows that they need to push the consumption of RES-T to reach the EU mandate. 90% of the total biofuel consumption in 2017 comes from conventional biofuels and 10% comes from advanced biofuels (Eurostat, SHARES 2017), which means there is lot of room for advanced fuel to increase their contribution. Their national mandate for RES-T is 10% by 2020 and they also introduced a mandate for advanced biofuels, which is 0.9% starting from 2020.

Overall RES share for 2017: 35.77% Overall RES-T share for 2017: 6.85% RES target for 2020: 30%

FIGURE 12. EVOLUTION OF RES-T TARGET FOR DENMARK



Source : SHARES Renewable 2017, Eurostat

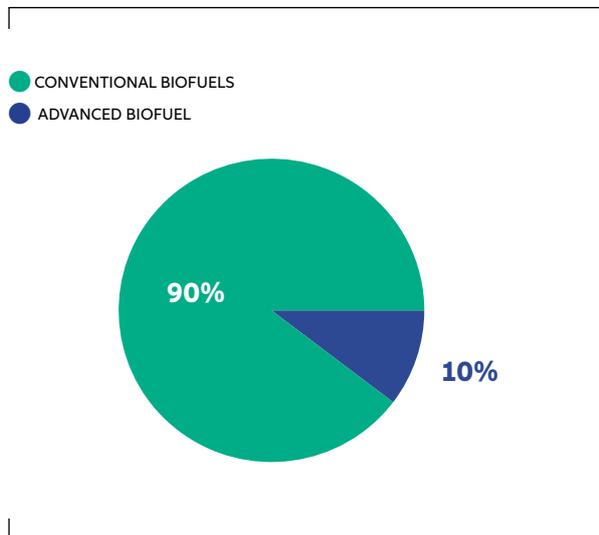
¹ All the number and facts in these factsheets are from Eurostat, SHARES, 2017; Denmark's NREAP Re-port; ICCT report Advanced Biofuel Policies in Select EU Member State: 2018 Update



Barriers to uptake advanced biofuel:

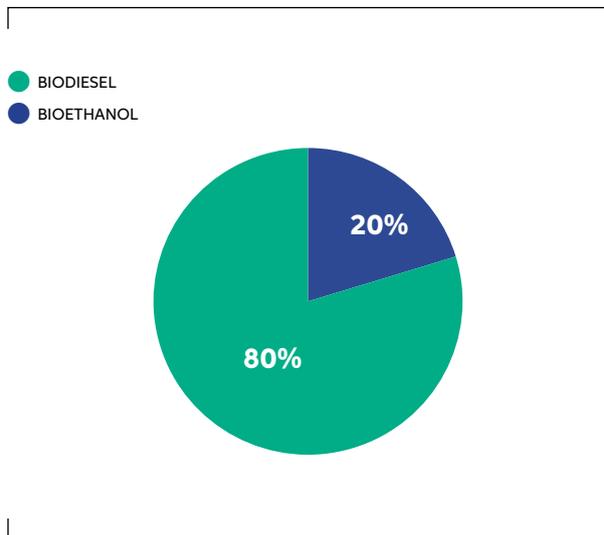
- Transport sector of Denmark will most likely import ethanol up to 2020 as there are concerns of environmental sustainability in using energy crops to produce biofuel. (Danish Energy Agency (DEA), March 2017, Analysis of Bioenergy in DE)
- Danish energy companies who imports wood residues and wood pellets will face challenges related to the environmental sustainability with RED II sustainability criteria (DEA, March 2017, Analysis of Bioenergy in DE)

FIGURE 13. COMPLIANT BIOFUELS CONSUMPTION FOR TRANSPORT IN 2017 DENMARK (218 KTOE TOTAL)



Source : SHARES Renewable 2017, Eurostat

FIGURE 14. BIOFUEL CONSUMPTION FOR TRANSPORT IN 2017 FOR DENMARK



Source : EurObserv'ER 2017

Enabling policy instruments in place for 2030:

- Denmark’s biofuels quota scheme
- Liquid biofuels exempted from carbon as well as energy tax whereas fossil GHG emissions has carbon tax €23.3 per ton CO₂e in 2018.
- Direct subsidies and support schemes.
- Biomethane receives feed-in premium tariff which in 2018 as €0.6 per litre of diesel equivalent when injected into the natural gas grid or to €0.4 per litre of diesel equivalent when sold directly as a transportation fuel.
- Long-term strategy introduced in 2018 place where biofuels will be mainly used in heavy-duty vehicles and aviation. Under this strategy 530 million is allocated for biogas expansion for the period up to 2030 and €67 million plan for sustainable transportation development between 2020 and 2024.
- Danish Energy Agency works with public support which is very important for the information provisions mechanisms and establishing collaboration among stakeholders from different sectors.
- Act on Sustainable Biofuels to regulate the sustainability criteria of biofuels
- The Danish Energy Agency also encourages the voluntary certification schemes.





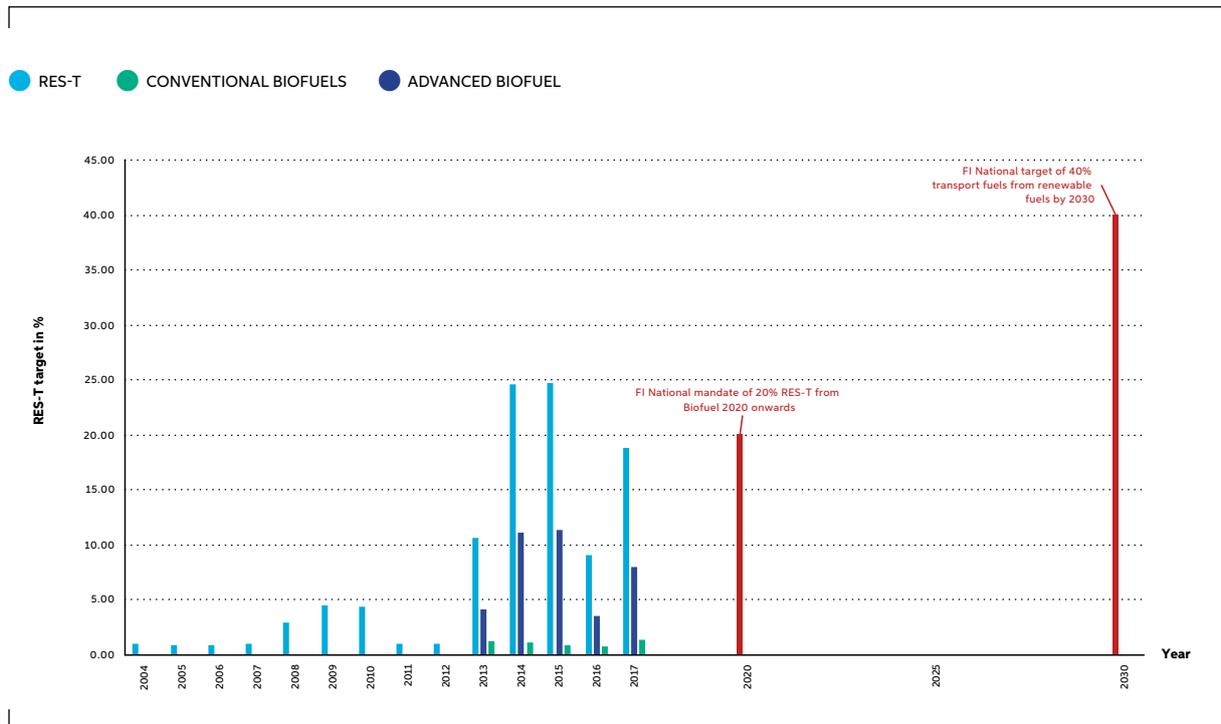
Finland (FI)

Current State of Art²:

Finland achieved their 2020 renewable energy target under 2009 RED by 2014 and set new target of 38% by 2020. The Finnish Government set target to reduce their GHG emission by 80-95% by 2050 compared to 1990 levels under the Climate Change Act under their national Energy and Climate Strategy 2015. This strategy supports the non-ETS (emission trading scheme) sectors like transport to use waste streams in the production of transport fuel and investment subsidies are in place promote commercialisation of new technologies to produce advanced transport biofuels. For the road transport, the share of biofuel distribution obligation is increased from 13.4 % to 30% by 2030. According to the National Energy and Climate Strategy 20302 the additional demand for transport biofuel is expected to come from advanced biofuels produced in Finland. 80% of this demand will be fulfilled by those biofuels which has the largest production volumes which are defined as drop-in biofuels.

Overall RES share for 2017: 41.01% Overall RES-T share for 2017: 18.33% RES target for 2020: 38%

FIGURE 15. EVOLUTION OF RES-T TARGET FOR FINLAND



Source : SHARES Renewable 2017, Eurostat

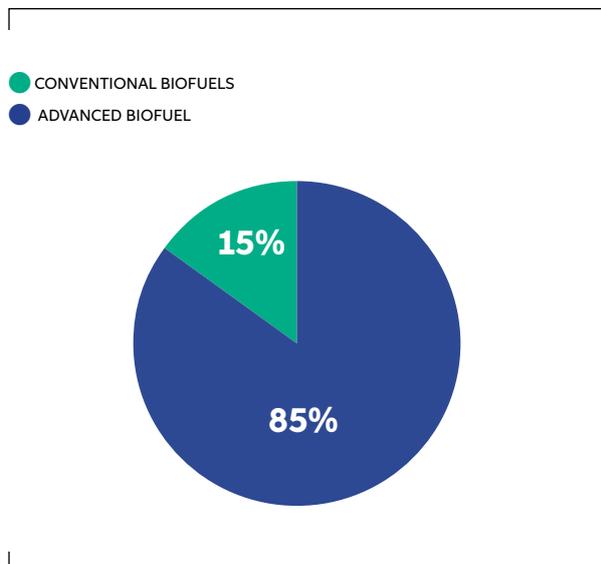
² All the numbers and facts here are referenced from 'Government report on the National Energy and Climate Strategy for 2030' Publications of the Ministry of Economic Affairs and Employment 12/2017. Eurostat SHARES, 2017 and EurObserv'ER, 2017



Barriers to uptake advanced biofuel:

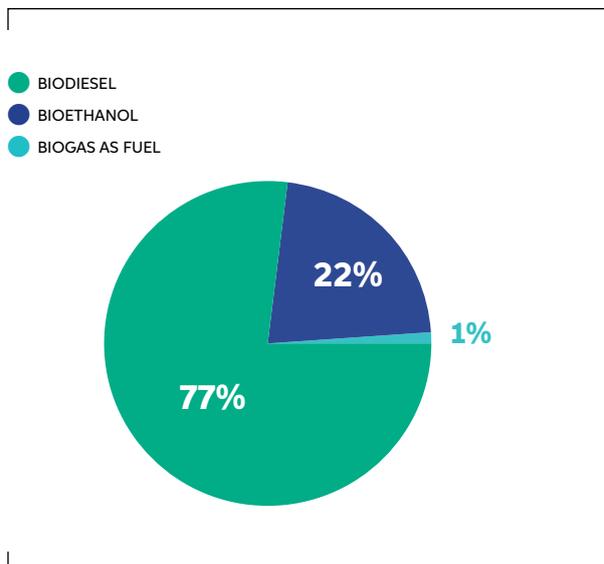
- Advanced biofuel offers a potential for increasing the FI’s share of renewable energy in transport sector first for road and then for aviation and freight. However, the increase in biofuel use will also be restricted by the demand for biomass in other applications. Imports of raw materials will be an alternative, but sustainability criteria introduced by RED II will introduce some challenges.

FIGURE 16. COMPLIANT BIOFUELS CONSUMPTION FOR TRANSPORT IN 2017 FINLAND (390 KTOE TOTAL)



Source : SHARES Renewable 2017, Eurostat

FIGURE 17. BIOFUEL CONSUMPTION FOR TRANSPORT IN 2017 FOR FINLAND



Source : EurObserv'ER 2017

Enabling policy instruments in place for 2030:

- The Finnish Act on the promotion of the use of biofuels for transport (446/2007)
- Finland’s biofuel quota obligation system ensures a certain percentage of the total annual sale of fuels.
- Sustainably sourced biofuels are subject to 50 % less CO2 tax
- Biofuels which can be double-counted under the RES Directive are not subject to any CO2 tax.
- FI has the effort sharing target of 16% reduction by 2020 and 39 % reduction in GHG emissions by 2030 compared to 2005. The low-carbon economy roadmap is proposed by the Commission in 2011.
- Finland’s National Energy and Climate Strategy 2030, focuses on sector specific plans for reducing their carbon emissions. Finland’s transport sector accounts for approx. 40 % of effort sharing sector emissions, estimated 2.6–3.6 Mt emission reduction by 2030. The strategy emphasizes that since transport plays a key role in achieving the emission reduction target, this creates market opportunities for the promotion of the technology of liquid biofuels and biogas which are advanced biofuels produced in Finland.





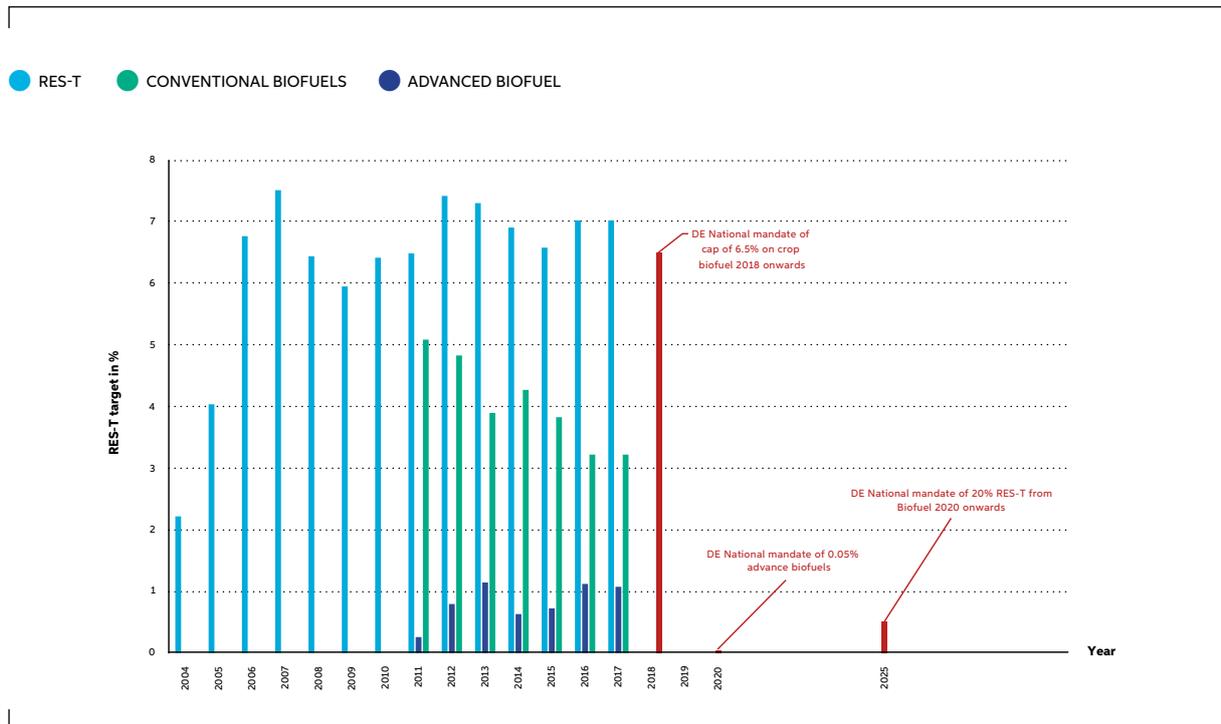
Germany (DE)

Current State of Art³:

Germany is one among top 10 consumers of transportation biofuels in EU. Together with Italy, the Netherlands, Sweden and the United Kingdom they consumed 46% of the total EU biofuels in 2016. GHG emissions from transport is recorded as 163mtoe in 1990 and has roughly remained similar until 2017 which is 171mtoe. This is because improved energy efficiency was able to balance out the increased volume of emission from transport but not enough to reduce. Under the Climate Action Plan 2050, Germany has emission targets set for all (Energy, Buildings, Transport, Industry, Agriculture, Waste and other). The target set for transport sector is reduction by 40-42% by 2030 compared to the level of 1990. To achieve these climate targets, Germany has established a GHG reduction quota of currently 4% and 6% from 2020. The average GHG savings of biofuels in the German market in 2017 was 81%. There will be a mandate for advanced biofuels starting from 2020.

Overall RES share for 2017: 15.45% Overall RES-T share for 2017: 7.03% RES target for 2020: 18%

FIGURE 18. EVOLUTION OF RES-T TARGET FOR GERMANY



Source : SHARES Renewable 2017, Eurostat

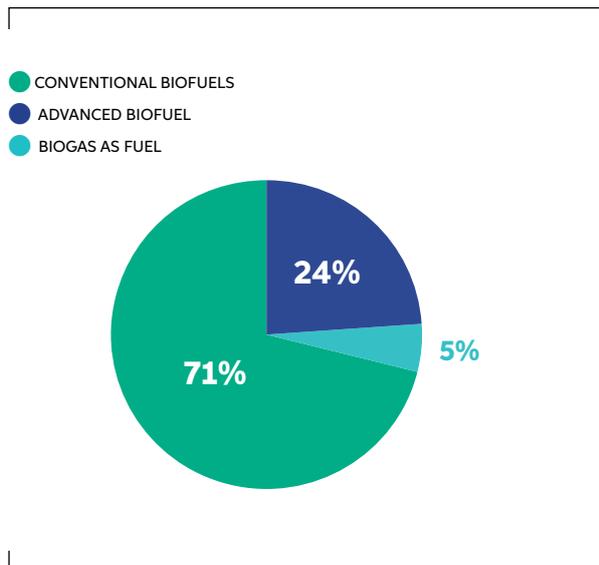
³ All the facts and numbers are referenced from Eurostat SHARES 2017 and EurObserv'ER 2017; ICCT report Advanced Biofuel Policies in Select EU Member State, 2018 Update http://www.gesetze-im-internet.de/bimschg/_37a.html, Last Visited on [22/03/2019]



Barriers to uptake advanced biofuel:

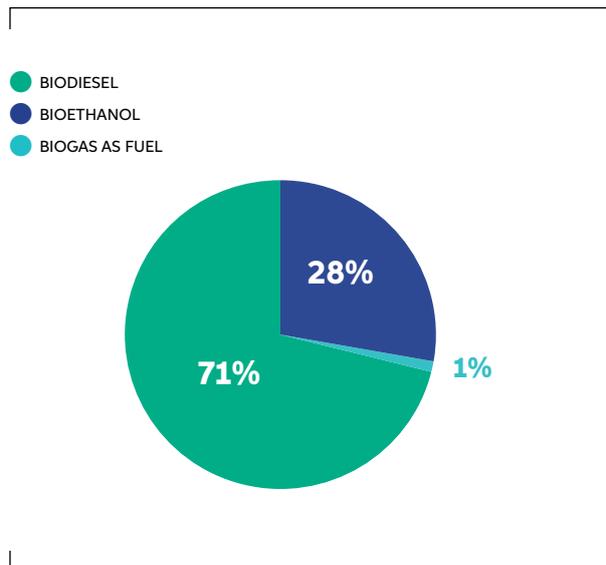
- GHG savings mandate has forced the biofuel producers to improve their industrial processes to enhance GHG efficiency, which reduces the biofuel incorporation by volume for fuel suppliers.

FIGURE 19. COMPLIANT BIOFUELS CONSUMPTION FOR TRANSPORT IN 2017 GERMANY (2561 KTOE TOTAL)



Source : SHARES Renewable 2017, Eurostat

FIGURE 20. BIOFUEL CONSUMPTION FOR TRANSPORT IN 2017 FOR GERMANY



Source : EurObserv'ER 2017

Enabling policy instruments in place for 2030:

- Double counting mandate expired in 2014 and introduced GHG savings mandate of 6% by 2025 which created a competitive environment for advanced biofuels like HVO and UCO compared to conventional biofuels, although the most performing biofuels are incentivised since all fall under the GHG quota. There is no double counting towards the mandate.
- German national cap on first generation biofuel is 6.5% and this was set under the ILUC Directive and new RED II which set a limit of 7% blending of conventional biofuels and this gave an advanced biofuel an opportunity to contribute towards to overall RES-T target of 14% by 2030
- Penalty for fuel suppliers failing to meet the biofuel mandate were subjected to penalties of €0.7 per litre of diesel equivalent for biodiesel and €1.55 per litre of diesel equivalent for ethanol. Beginning in 2015, the penalty switched to €470 per ton of CO₂e of GHG savings not achieved.
- Germany has national mandate of 0.05 % share of advanced starting from 2020 and slowly move up to 0.5% by 2025
- For biodiesel and bio gasoline used in transport Germany has quota obligation with Tradable Green certificates and tax regulation mechanisms II (BioKraftQuG)
- Under the Federal Emission Control Act, starting from 2017 Germany increased their GHG savings mandate from 3.5% (2015) to 4%, which will go up to 6% from 2020 onwards.





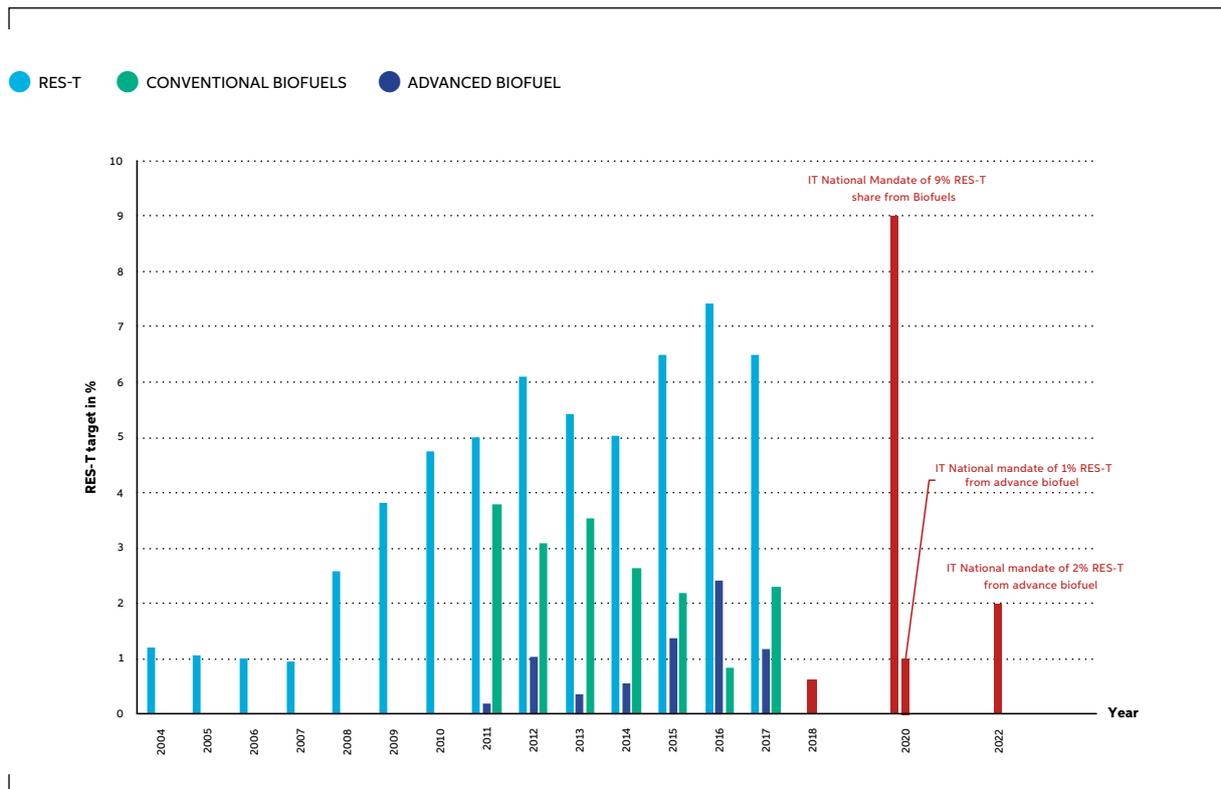
Italy (IT)

Current State of Art ⁴:

Italy has achieved their overall EU renewable and GHG emission reduction targets for 2020. They were the first member state to mandate the use of advanced biofuels. The Ministerial Decree of October 10th, 2014 encourage the use of advanced biofuels that comes from waste and non-food origin and the new regulations encourages its adoption with gradual increase over the years². In 2014 they had the mandate of at least 1.2% advanced biofuels, which is now increased to 2% by 2022. 66% of the total share of compliant biofuels comes from conventional biofuel sources and rest 34% comes from advanced biofuel. Italy’s biofuel share is dominated by biodiesel 97%. They have increased the overall consumption of biofuel but reduced the share of conventional biofuel and increased the share of advanced biofuels.

Overall RES share for 2017: 18.26% Overall RES-T share for 2017: 6.48% RES target for 2020: 17%

FIGURE 21. EVOLUTION OF RES-T TARGET FOR ITALY



Source : SHARES Renewable 2017, Eurostat

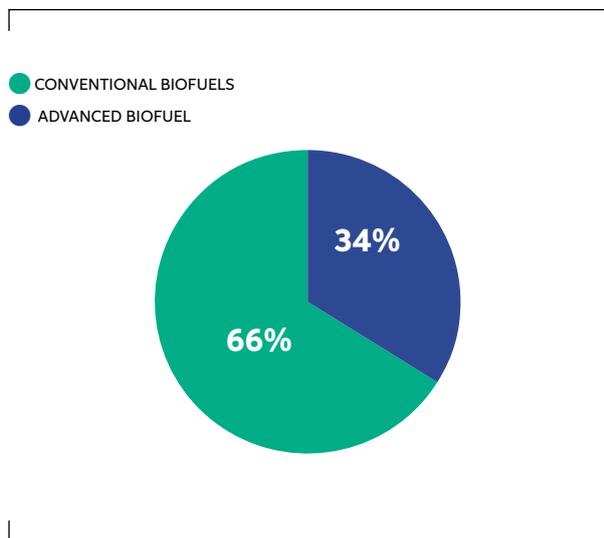
⁴ All the number and facts in these factsheets are from Eurostat, SHARES, 2017; Italy’s NREAP Report; ICCT report Advanced Biofuel Policies in Select EU Member State: 2018 Update and Biofuels Mandates in the EU-Report 2018



Barriers to uptake advance biofuel:

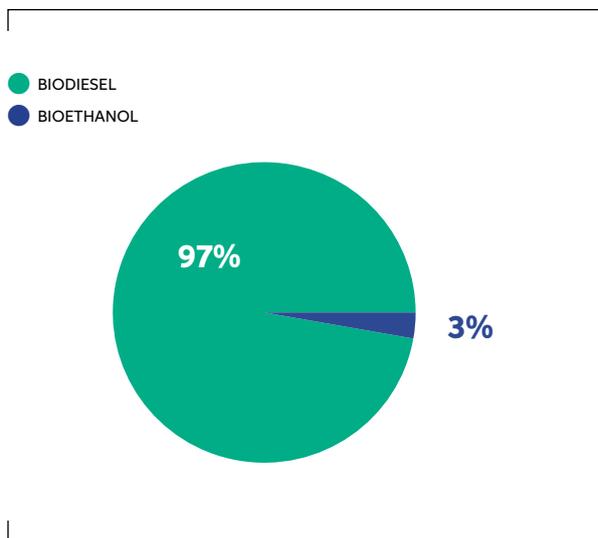
- Transport sector in Italy consumes the highest share of final energy consumption (FEC), therefore the highest savings are expected from this sector. Excepted FEC saving in 2020 is 5.50 mtoe/yr.
- Italy had differentiated rates of excise duty on the fuel blend but post 2010 excise duty break on bioethanol was discontinued. Thus biofuels including advance biofuels follows the similar taxation to the fossil fuel.

FIGURE 22. COMPLIANT BIOFUELS CONSUMPTION FOR TRANSPORT IN 2017 ITALY (1069 KTOE TOTAL)



Source : SHARES Renewable 2017, Eurostat

FIGURE 23. BIOFUEL CONSUMPTION FOR TRANSPORT IN 2017 FOR ITALY



Source : EurObserv'ER 2017

Enabling policy instruments in place for 2030:

- The main incentive for renewable energy use in transport is a quota system. These quota obligations that are issued annually without the tradable green certificates. The quota is to gradually increase from 5% in 2014 to 10% by 2020.
- In 2018 a new decree was published which included an obligation for advanced biofuels starting at 0.6% in 2018, 1% in 2020 increasing to 1.85% in 2022.
- There is cap set for conventional biofuels under EU ILUC Directive.
- The decree has introduced an emission certificates (CIC) for producers of biofuels. 1 CIC is assigned for 10 Gcal of conventional biofuels but for just 5 Gcal of advanced biofuels. The decree also has fixed subsidy for each advanced CIC.
- There is increase in subsidy for plants which produces biomethane for transport instead of electricity.





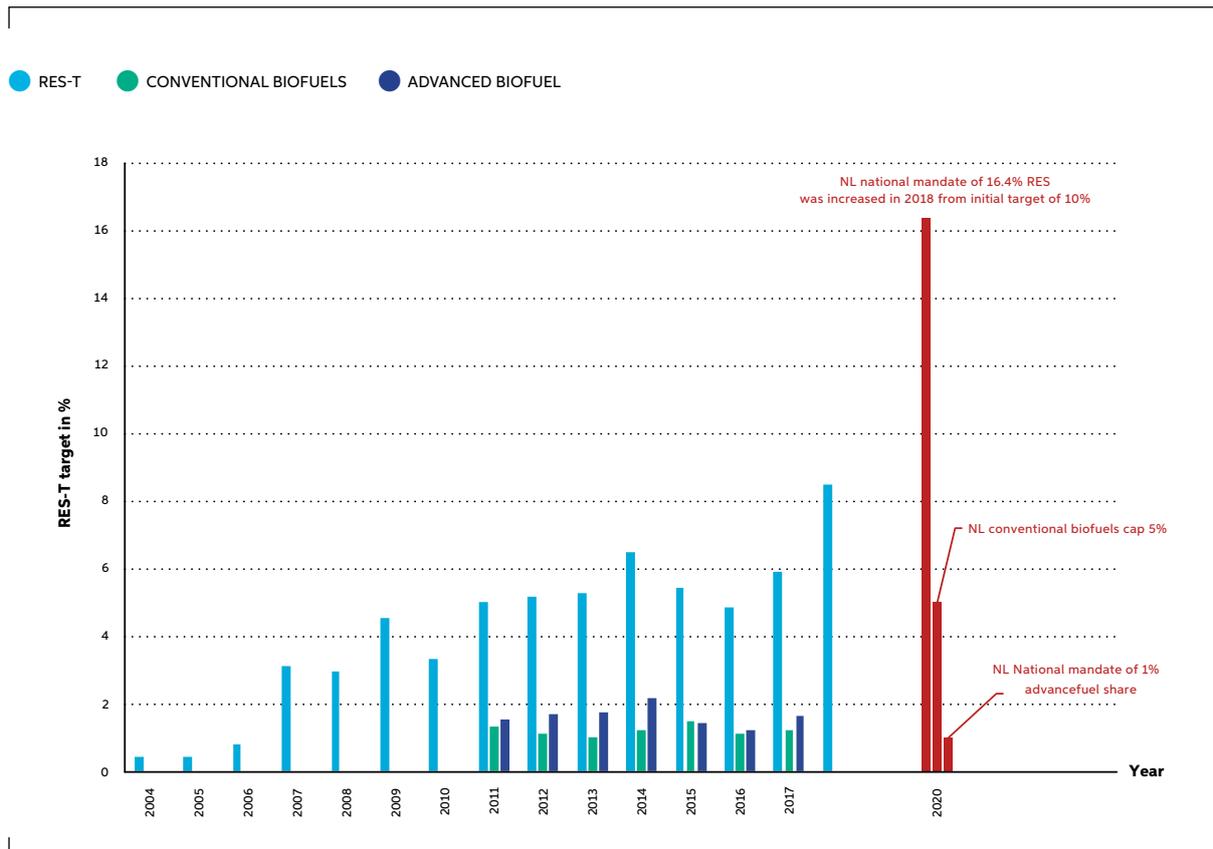
The Netherlands (NL)

Current State of Art⁵:

Netherlands is on right path to achieve their national mandates as well as EU mandates for both renewable energy and GHG emission reduction targets for 2020 and 2030. In 2018 they increased their RES-T share from biofuels mandate to 16.4%. Their advanced biofuel mandate was also increased from 0.6% in 2018 to 1% in 2020. The physical volume of biofuel blended is not as large because of double counting. If we look at the consumption trend of conventional as well as the advanced biofuels we can see that share of advanced biofuels is higher until 2017 and is on track to meet the target set for 2020.

Overall RES share for 2017: 6.60% **Overall RES-T share for 2017: 5.91%** **RES target for 2020: 14%**

FIGURE 24. EVOLUTION OF RES-T TARGET FOR THE NETHERLANDS



Source : SHARES Renewable 2017, Eurostat

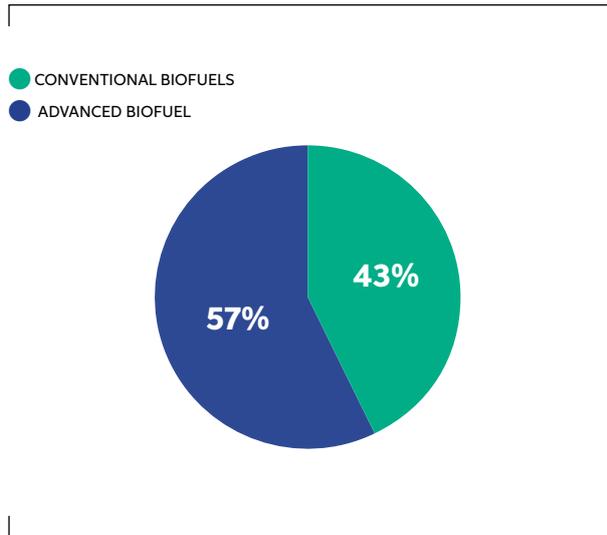
⁵ All the number and facts in these factsheets are from Eurostat, SHARE tool, 2017; Netherland's NREAP Report; ICCT report Advanced Biofuel Policies in Select EU Member State: 2018 Update



Barriers to uptake advanced biofuel:

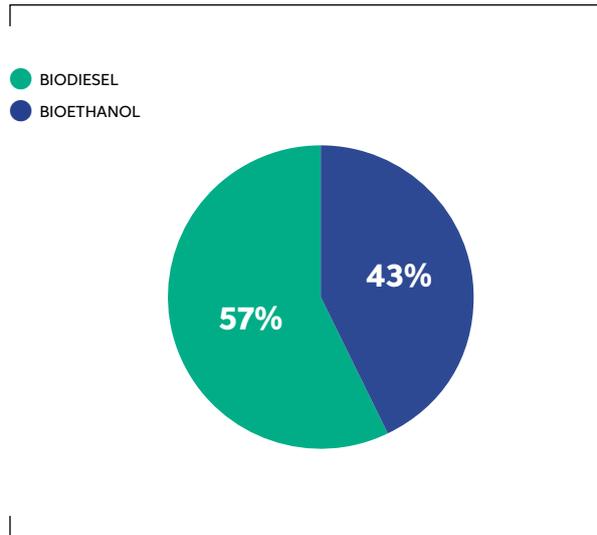
- There is no legislation in place to implement the Climate Agreement even though it was signed in 2017.

FIGURE 25. **COMPLIANT BIOFUELS CONSUMPTION FOR TRANSPORT IN 2017 THE NETHERLANDS (1069 KTOE TOTAL)**



Source : SHARES Renewable 2017, Eurostat

FIGURE 26. **BIOFUEL CONSUMPTION FOR TRANSPORT IN 2017 FOR THE NETHERLANDS**



Source : EurObserv'ER 2017

Enabling policy instruments in place for 2030:

- Biofuel quota obligation with tradable Green certificates. Biofuel traders of transport fuels need to adopt an obligation scheme which should result in a 10% RES share of energy consumption in the transport sector.
- Tax credits exist for biofuel and hydrogen related RES-T investments.
- GHG emission reduction goal of 7.3 million tons by 2030 under Climate Agreement signed in 2017.
- Under the Climate Agreement NL agreed to prioritize the use of sustainable biomass for fuels in heavy road transportation, aviation and shipping. Aviation biofuels are eligible to obtain green certificates.
- IBB subsidy programme: This subsidy programme supports market players that improve or renew the process for supplying innovative biofuels to the transport.
- TAB (Tankstations Alternatieve Brandstoffen) subsidy filling stations for alternative fuels. Under the voluntary scheme, sellers of the transport fuels can apply for subsidy to install a filling stations for an alternative fuel such as E85 (bioethanol) and B30 (biodiesel).
- Additionally, the Netherlands Enterprise Agency facilitates market parties and specific organizations to establish training and certification facilities for RES installers and installations. Innovation in energy is supported through innovation contracts between private companies, universities, R&D institutes.
- Clean and Efficient Strategy in place to support the new innovative technologies and policy instruments in place.
- Priority to energy produced from renewable source in network connection RED Directive 2009 Article 16(2)





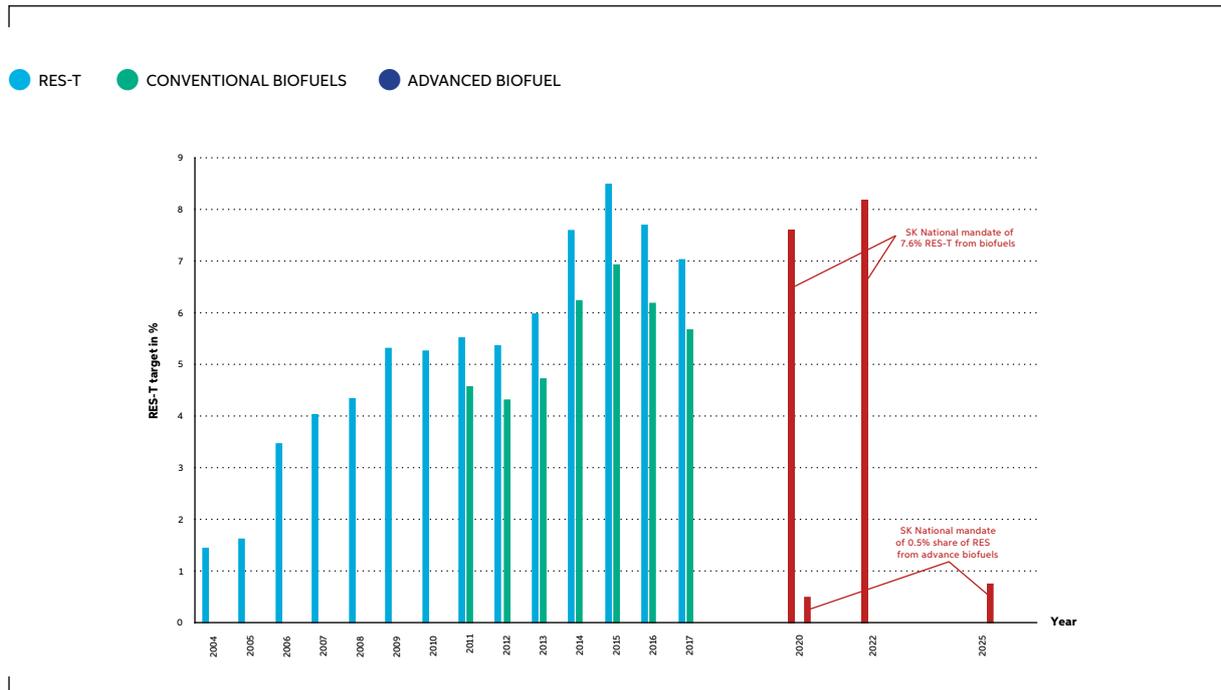
Slovakia (SK)

Current State of Art⁶:

Slovakia’s National Energy Action Plan (NREAP) states that the overall national mandate for renewable energy share in transport sector to be 7.6% by 2020 and 0.5% of the total share to come from the advanced biofuels. When you look at the consumption trend of biofuels (Eurostat SHARES 2017) we can see that there is no account of advanced biofuels but conventional biofuels is quiet high. However, Slovakia’s NREAP⁷ estimated that in 2018, their share of advanced fuel is expected to grow up to 14 ktoe in 2018 and up to 60 ktoe by 2020. Slovakia amended its Act no. 309/2009 on Support of Renewable Energy Sources and it updated the overall blending percentage and introduced mandates for advanced biofuels, as well as targets for 2020 which is 0.5% and increases to 0.75% by 2025. The contribution from the advanced biofuels will be double counted.

Overall RES share for 2017: 11.49% Overall RES-T share for 2017: 7.03% RES target for 2020: 14%

FIGURE 27. EVOLUTION OF RES-T TARGET FOR SLOVAKIA



Source : SHARES Renewable 2017, Eurostat

6 All the number and facts in these factsheets are from Eurostat, SHARE tool, 2017; Slovakia’s NREAP Report; ICCT report Advanced Biofuel Policies in Select EU Member State: 2018 Update

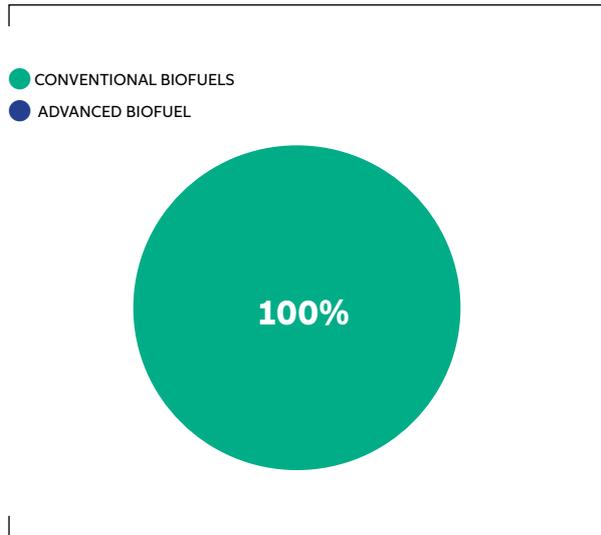
7 Table 4b in NREAP Slovakia report



Barriers to uptake advanced biofuel:

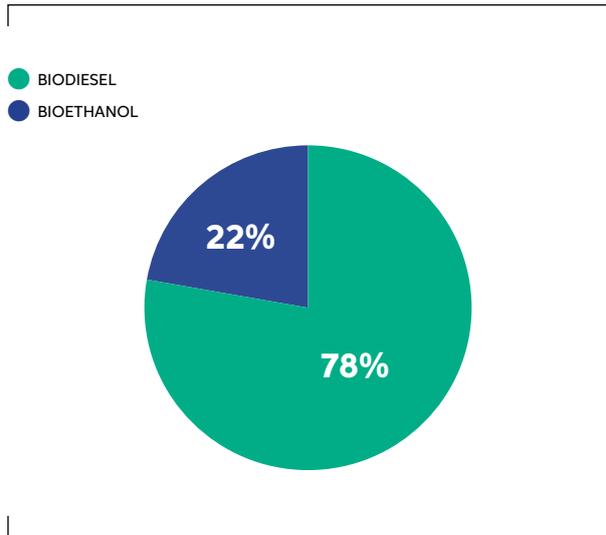
- There were no dedicated policy instruments to support advanced biofuels until now.

FIGURE 28. **COMPLIANT BIOFUELS CONSUMPTION FOR TRANSPORT IN 2017 SLOVAKIA (149 KTOE TOTAL)**



Source : SHARES Renewable 2017, Eurostat

FIGURE 29. **BIOFUEL CONSUMPTION FOR TRANSPORT IN 2017 FOR SLOVAKIA**



Source : EurObserv'ER 2017

Enabling policy instruments in place for 2030:

- Biofuel quota scheme: SK has compulsory blending obligations of biofuels in place since 2006.
- SK has national mandate for share of advanced biofuels starting from 2020 at 0.5% to 0.75% by 2025.
- SK has tax credit mechanisms II which are fiscal incentives the biofuel producers can apply for. Biofuels are fully exempted and blended transport fuels are also partially exempted which is proportionate to their blend percentage.
- SK has legislative and regulatory measures in place to promote the production of woody raw materials to increase the supply of biomass from both agricultural as well as forestry holdings since 2011.
- Biofuels sustainability certification scheme in place in accordance with Article 15 of Directive 2009/28/EC.



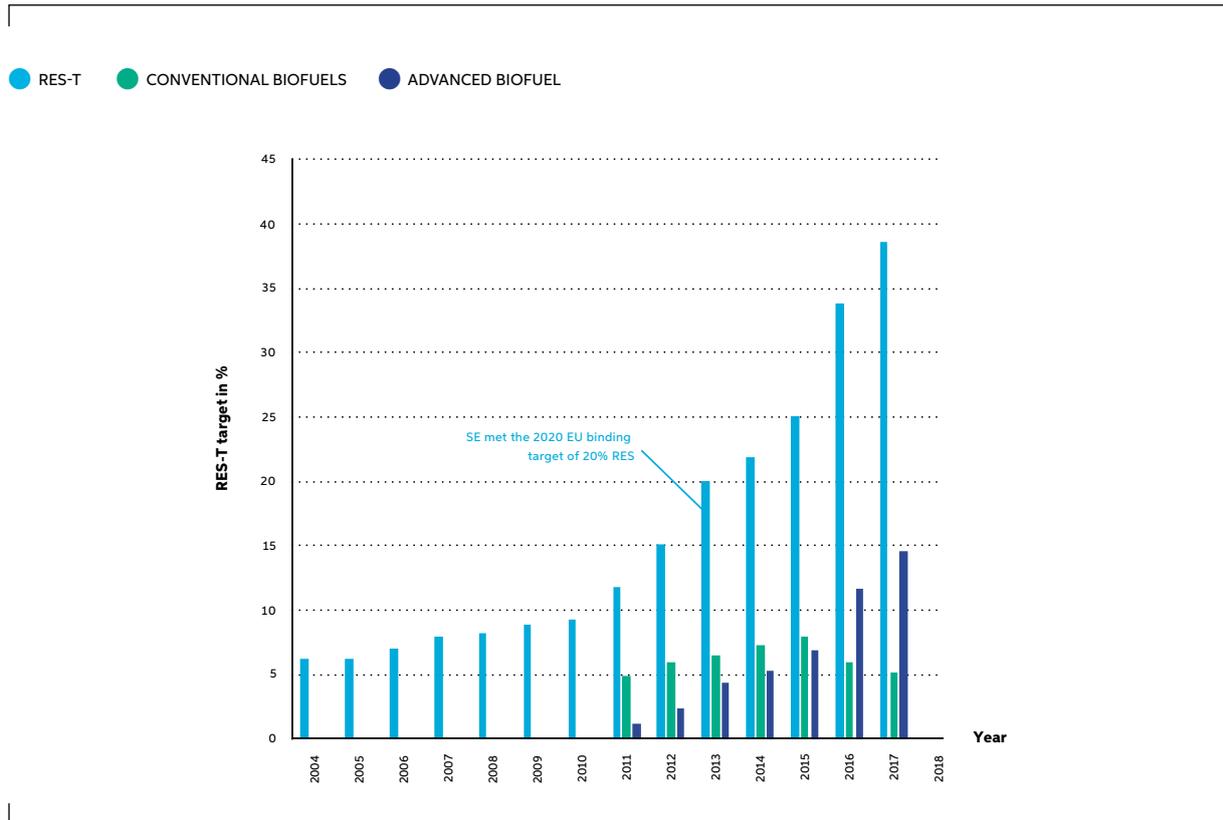
Sweden (SE)

Current State of Art ⁸:

Sweden has been on a good track record for biofuel consumption. The total share of advanced biofuel is 74% which is 1669 ktoe in 2017 (Eurostat, SHARES 2017). In 2017 they set a new record and this rise is attributed to the HVO biodiesel, according to the Swedish Bioenergy Association. If we look at the percentage of biofuel consumed in 2017, biodiesel makes up 87% of the total share. Sweden has no national mandate set for advanced biofuel but they have already surpassed the EU28 mandate. SE has national target of 70% GHG emission reduction from transportation sector by 2030 compared to 2010 level. It is expected that 50% of passenger vehicles could be fuelled by biofuels and 20% by electricity to achieve this reduction target.

Overall RES share for 2017: 54.5% Overall RES-T share for 2017: 38.63% RES target for 2020: 49%

FIGURE 30. EVOLUTION OF RES-T TARGET FOR SWEDEN



Source : SHARES Renewable 2017, Eurostat

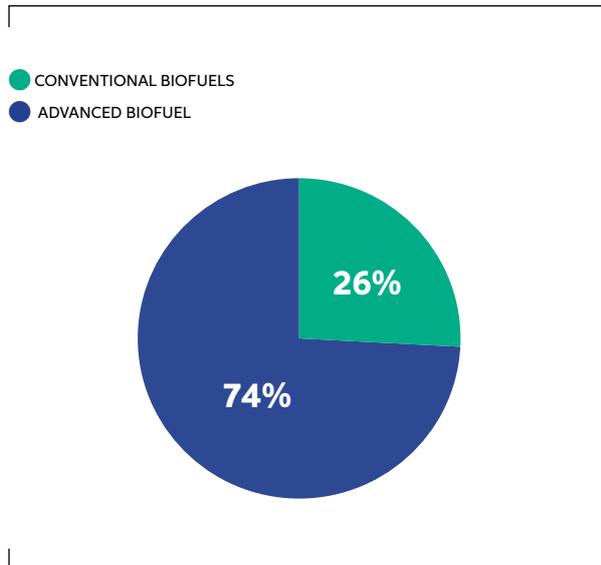
⁸ All the number and facts in these factsheets are from Eurostat, SHARE tool, 2017; ICCT report Ad-vanced Biofuel Policies in Select EU Member State: 2018 Update



Barriers to uptake advance biofuel:

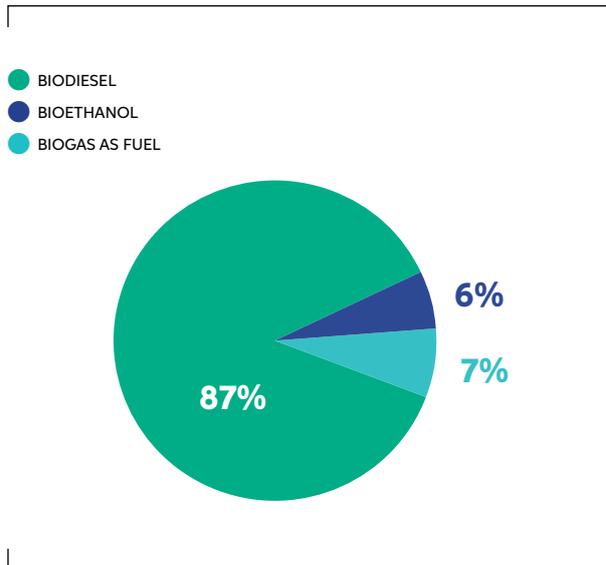
- There is no specific barrier as their uptake started since 2011 has been increasing consistently until 2017.

FIGURE 31. COMPLIANT BIOFUELS CONSUMPTION FOR TRANSPORT IN 2017 SWEDEN (1669 KTOE TOTAL)



Source : SHARES Renewable 2017, Eurostat

FIGURE 32. BIOFUEL CONSUMPTION FOR TRANSPORT IN 2017 FOR SWEDEN



Source : EurObserv'ER 2017

Enabling policy instruments in place for 2030:

- Energy and Carbon tax exemptions are the main incentives in place to promote the biofuels for transport. In 2018, the carbon tax was 1150 SEK per ton CO₂ (€109 per ton CO₂).
- In 2018 a new mandate was introduced in SE for fuel distributors to reduce GHG emissions of fuel supplied. The mandate is 19.3% reduction in diesel and 2.6% in gasoline by 2018. These targets increase to 21% and 4.2% by 2020 and up to 40% by 2030.
- SE Government has long term strategy to reduction 70% of GHG emission from transportation sector compared to 2010 level.
- Biofuel blending target is set for 50% by 2030.





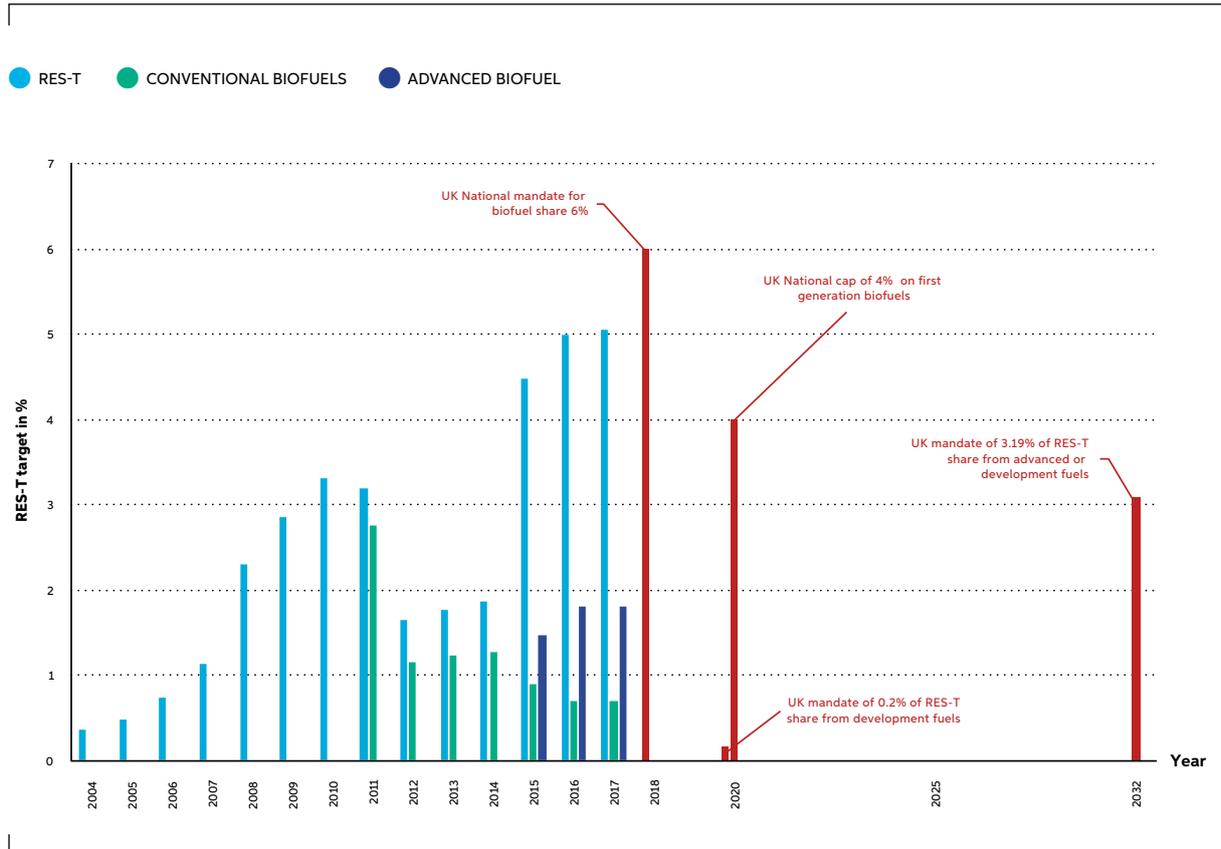
The United Kingdom (UK)

Current State of Art⁹:

UK has set a very high national mandate of 10.63% share of advanced biofuel in total RES-T consumption by 2020. Their overall RES-T share for UK in 2017 is accounted as 5.05% whereas the EU mandate for RES-T share by 2030 is 14% which is quite a big gap to fill. If you look at the consumption trend of conventional biofuels for the UK from 2011 to 2017 we can see a declining trend. UK has also set a national cap of 4% share from conventional biofuels by 2020 which will be reduced to 2.33% by 2030. Therefore, there is an opportunity for advanced biofuels to fill that gap.

Overall RES share for 2017: 10.21% **Overall RES-T share for 2017: 5.05%** **RES target for 2020: 15%**

FIGURE 33. EVOLUTION OF RES-T TARGET FOR THE UNITED KINGDOM



Source : SHARES Renewable 2017, Eurostat

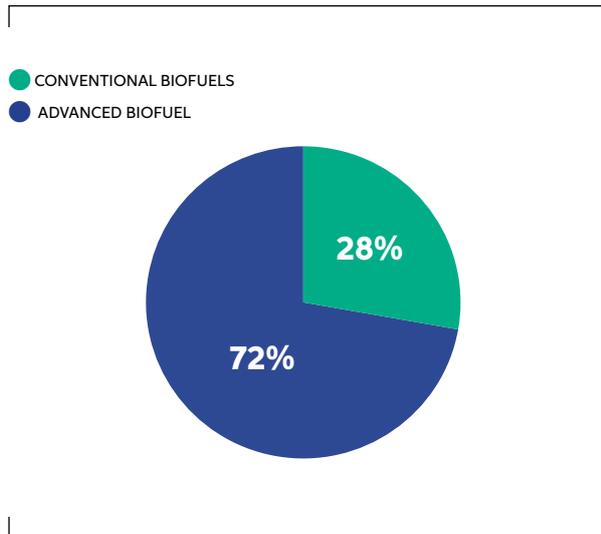
⁹ All the number and facts in these factsheets are from Eurostat, SHARE tool, 2017; UKs NREAP Report; ICCT report Advanced Biofuel Policies in Select EU Member State: 2018 Update



Barriers to uptake of advanced biofuels:

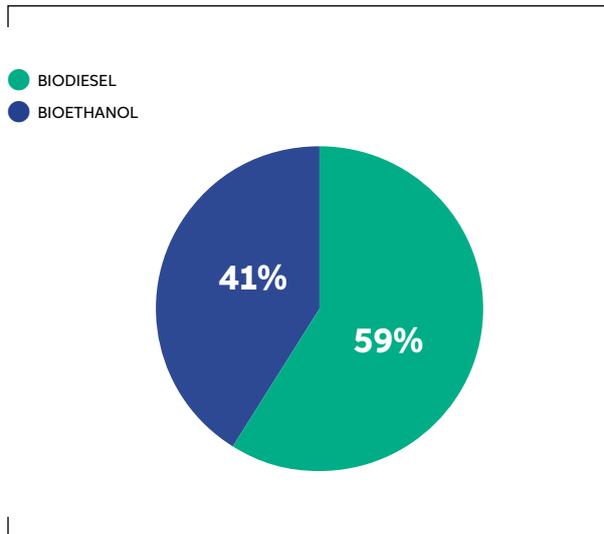
- UK has long-term mandates for advanced biofuels not the challenge is to mobilize technologically and commercially available innovations to achieve this mandate.

FIGURE 34. **COMPLIANT BIOFUELS CONSUMPTION FOR TRANSPORT IN 2017 UK (1016 KTOE TOTAL)**



Source : SHARES Renewable 2017, Eurostat

FIGURE 35. **BIOFUEL CONSUMPTION FOR TRANSPORT IN 2017 FOR THE UNITED KINGDOM**



Source : EurObserv'ER 2017

Enabling policy instruments in place for 2030:

- The UK introduced RTFO (Renewable Transport Fuel Obligation) in 2008 and RTFC (Renewable Transport Fuel Certification) allocated for advanced biofuels. 2 RTFCs are awarded for each litre of fuel.
- Aviation fuel qualifies for development fuel RTFCs
- There is a cap set on the maximum amount of RES-T share from first generation biofuels. This will be a maximum of 4 percent by volume in the period 2018 to 2020, and then must reduce incrementally to reach 2 percent in 2032.
- UK has cap on conventional biofuels starting from 2020 at 4% up to 2% in 2032.
- Advanced biofuels are categorised as 'Development fuel' and a mandate started from 2019. It is double counted. The aim is to double the use of renewable fuels in the transport sector in the next 15 years. A development fuel must also be one of the following fuel types: hydrogen, aviation fuel, substitute natural gas (i.e. renewable methane) or a fuel that can be blended to give 25 percent or more renewable fraction in the final blend while still meeting fuel technical and quality standards. (From the Renewable Transport Fuels and Greenhouse Gas Emissions Regulations 2018)

