

# ADVANCED BIOFUEL POLICIES IN SELECT EU MEMBER STATES: 2018 UPDATE

## ICCT POLICY UPDATES

SUMMARIZE

REGULATORY

AND OTHER

DEVELOPMENTS

RELATED TO CLEAN

TRANSPORTATION

WORLDWIDE.

This policy update provides details on the latest measures that select European Union (EU) member states, namely Denmark, Germany, Italy, the Netherlands, Sweden, and the United Kingdom, are taking to support advanced alternative fuels.

## EU POLICY BACKGROUND

In 2018, the European Union (EU) set its climate and energy objectives for 2030. They included a greenhouse gas (GHG) reduction of at least 40% and a minimum of a 32% share of renewable energy consumption across all sectors.<sup>1</sup> GHG emissions in the European transportation sector have declined by only 3.8% since 2008, compared to an 18% decrease, or more, in all other sectors, indicating that the decarbonization of transportation should be a priority for the future.<sup>2</sup>

Biofuels are one of the options considered to increase renewable energy and decrease the carbon intensity of the transportation sector. Through the use of directives and national legislation, the EU has incentivized both the adoption of conventional food-based biofuels and advanced biofuels, which are made from non-food feedstocks. Such incentives date to 2009, when the EU Renewable Energy Directive (RED) mandated that by 2020, 10% of energy used in the transportation sector should come from renewable energy sources (RES).<sup>3</sup> In 2015, the RED was

- 1 Jacopo Giuntoli, *Final recast Renewable Energy Directive for 2021-2030 in the European Union*, (ICCT: Washington, DC, 2018), <https://www.theicct.org/publications/final-recast-renewable-energy-directive-2021-2030-european-union>
- 2 EUROSTAT (Greenhouse gas emissions by source sector (env\_air\_gge), accessed November 2018), <https://ec.europa.eu/eurostat>.
- 3 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, Official Journal of the European Union, L 140/16, April 23, 2009, <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32009L0028>.

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Acknowledgements: this work was generously supported by the ClimateWorks Foundation. Thanks to Aaron Berry, David Chiamonti, Tomas Ekbohm, Timo Gerlagh and Lars-Martin Jensen for helpful input and Stephanie Searle and Nic Lutsey for reviews.

amended by the EU Indirect Land Use Change (ILUC) directive<sup>4</sup>, which introduced a 7% cap on the contribution that conventional food and feed-based biofuels could make to the RES-transport target. The ILUC directive introduced a further measure to promote the use of biofuels produced from non-food feedstocks and wastes: a non-binding 0.5% target for advanced biofuels in 2020. Advanced biofuels are defined as biofuels produced from feedstocks listed in Part A of Annex IX of the EU ILUC Directive or from feedstocks recognized as wastes in national legislation. In some countries, advanced biofuels, as well as biofuels made from used cooking oil and animal fats, can be double-counted towards the 10% RES-transportation target.

Targets for advanced biofuels and other alternative fuels for the period up to 2030 are currently being defined and introduced. In June 2018, the EU Commission, Parliament and Council reached an agreement on the recast of the Renewable Energy Directive (REDII)<sup>5</sup>, which introduced a 14% RES-transportation energy target and a 3.5% advanced biofuels sub-target by 2030. Conventional food-based biofuels will be capped at each member state's 2020 level with a maximum of 7%. This implicitly creates a minimum 7% target for advanced, non-food-based alternative fuels. Similarly to the 2020 RED, advanced biofuels, as well as biofuels produced from used cooking oil and animal fats, can double-count towards the 14% RES-transport target. The aviation and maritime sectors will be excluded from the obligation, but if, in the future, they opt in, each unit of biofuel will count at 1.2 times toward the target.

Each EU directive must be implemented through national legislation. Member states may use a variety of policy instruments to support alternative fuels in order to meet the targets in the directives. Here, we focus on the six countries that already have significant measures in place to support advanced alternative fuels: Denmark, Germany, Italy, the Netherlands, Sweden and the United Kingdom. Five of these countries—Germany, Italy, the Netherlands, Sweden and the United Kingdom—are among the top 10 consumers of transportation fuels in the EU and, in 2016, consumed 51.9 million barrels of oil equivalent of liquid biofuels, or 46% of total EU biofuels consumed.<sup>6</sup> In the remainder of this briefing, we review the specific policies these member states have used to meet the targets in the EU directives.

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4 Directive (EU) 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources, Official Journal of the European Union, L 239/1, September 15, 2015, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015L1513&from=EN>

5 Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources - Analysis of the final compromise text with a view to agreement, accessed November 2018. [https://www.consilium.europa.eu/register/en/content/out/?&typ=ENTRY&i=LD&DOC\\_ID=ST-10308-2018-IN17](https://www.consilium.europa.eu/register/en/content/out/?&typ=ENTRY&i=LD&DOC_ID=ST-10308-2018-IN17)

6 EUROSTAT (Supply, transformation and consumption of renewable energies (nrg\_107a), accessed November 2018), <https://ec.europa.eu/eurostat>.

## DENMARK

### BASELINE STATUS

In 2009, Denmark implemented a biofuel mandate for road and rail transportation fuels (Figure 1.) Between 2010 and 2012, the country ramped up biofuel use from 0.55% of transportation energy to 5.75%, which is still the current level of the mandate.<sup>7</sup> Denmark has not yet made a political decision on how to fulfill the 2020 target of 10% biofuels for transportation, as instructed by the RED.

In 2016, Denmark recorded an overall share of 6.8%<sup>8</sup> renewable energy in the transportation sector. Biofuels consumed in Denmark are exclusively conventional biofuels.<sup>9</sup> Biodiesel (fatty acid methyl esters, or FAME) is the main biofuel consumed (80% of all biofuels) followed by ethanol (1.1% of road and rail transport) and a small share of biomethane, which is just starting to appear on the market.

A consortium of Danish industries, including INBICON and Novozymes, are pursuing the Maabjerg Energy Concept,<sup>10</sup> a bioenergy refinery capable of producing 80 million liters of cellulosic ethanol, mainly from straw, and 50 million m<sup>3</sup> of biomethane per year from manure and agricultural waste, as well as generate power and heat from biomass and municipal solid waste. The project was awarded more than €39 million from the EU NER300 program, but as of August 2018, is still on hold due to political uncertainty around the support for advanced biofuels.<sup>11</sup>

### POLICY UPDATES TO SUPPORT ADVANCED FUELS

Figure 1 shows the percentage of transportation fuel that is made up of liquid and gaseous biofuels for Denmark, including historical data through 2016, a continuation of that percentage through 2020 based on the mandate in place, and the 2020 advanced biofuel target. As shown in Figure 1, Denmark's biofuels mandate is still fixed at a level of 5.75%. Denmark transposed the EU ILUC Directive in 2016, introducing a 0.9% mandate for advanced biofuels starting in 2020.<sup>12</sup> It is unclear at the moment how Denmark plans to reach the 10% RED target. No specific provisions are defined for aviation biofuels.<sup>13</sup>

7 Bekendtgørelse af lov om bæredygtige biobrændstoffer og om reduktion af drivhusgasser fra transport (Executive Order of the Act on Sustainable Biofuel and Reduction of Greenhouse Gases from Transport), LBK nr. 674 af 21/06/2011, <https://www.retsinformation.dk/Forms/R0710.aspx?id=137888>.

8 Calculated from data from EUROSTAT (SHARES tool, accessed November 2018), <https://ec.europa.eu/eurostat/web/energy/data/shares>. Applying the following multipliers: 2x for advanced and double-counted biofuels, 2.5x multiplier for renewable electricity utilized in rail transportation and 5x for renewable electricity in road transportation.

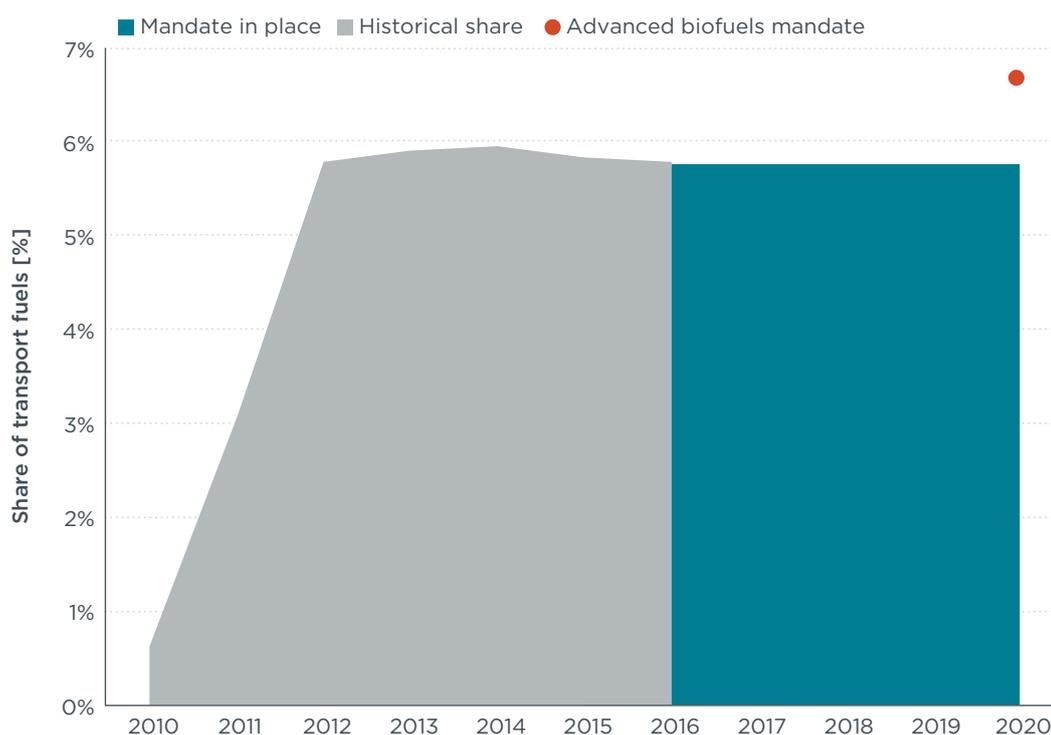
9 Danish Energy Agency, "Annual and monthly statistics" (2016), <https://ens.dk/en/our-services/statistics-data-key-figures-and-energy-maps/annual-and-monthly-statistics>.

10 Official website of the Maabjerg Energy Center, Facts about MEC: About the Concept, accessed September 14, 2018, <https://www.maabjergenergycenter.com/facts-about-mec/about-the-concept>.

11 European Commission, "MET NER300 Factsheet" (2016), [https://setis.ec.europa.eu/system/files/bio\\_met\\_-\\_dk\\_-\\_2016\\_factsheet.pdf](https://setis.ec.europa.eu/system/files/bio_met_-_dk_-_2016_factsheet.pdf).

12 Bekendtgørelse om biobrændstoffers bæredygtighed m.v. (Order on the sustainability of biofuels, etc.), BEK nr. 1044 af 07/09/2017, <https://www.retsinformation.dk/Forms/R0710.aspx?id=192647>.

13 "Biofuels", Danish Energy Agency, accessed November 8, 2018, <https://ens.dk/ansvarsomraader/transport/biobraendstoffer>.



**Figure 1.** Liquid and gaseous biofuels as a share of total energy used in road and rail transportation in Denmark.

The mechanisms for Denmark's support for biofuels are tax exemptions and direct subsidies. Since 1992, Denmark has imposed a carbon tax on fossil GHG emissions. The value of the carbon tax in 2018 was equal to 173 DKK per ton CO<sub>2</sub>e (ca. €23.2 per ton CO<sub>2</sub>e).<sup>14</sup> Liquid biofuels are exempted from this carbon tax as well as other energy taxes. Since 2012, biomethane has received an additional direct premium tariff, which is updated annually. In 2018, the tariff was equal to €0.6 per liter of diesel equivalent when injected into the natural gas grid or to €0.4 per liter of diesel equivalent when sold directly as a transportation fuel.<sup>15</sup>

## LONG-TERM STRATEGY

A new energy agreement signed by the Danish government in June 2018 included a 55% renewable energy target and a net-zero carbon emissions ambition with a fully decarbonized energy system by 2050. It allocated more than €530 million for biogas expansion for the entire period up to 2030 and about €67 million for sustainable transportation development between 2020 and 2024. This plan focuses on widespread electrification for road transport, aiming at a long-term strategy where biofuels will be used mainly in heavy-duty vehicles and in aviation.<sup>16</sup>

<sup>14</sup> "Carbon Pricing Dashboard", The World Bank, accessed November 8, 2018, [https://carbonpricingdashboard.worldbank.org/map\\_data](https://carbonpricingdashboard.worldbank.org/map_data).

<sup>15</sup> Danish Energy Agency, "The Danish subsidy scheme for the use of biogas" (2018), [https://ens.dk/sites/ens.dk/files/Bioenergi/the\\_danish\\_subsidy\\_scheme\\_for\\_the\\_use\\_of\\_biogas\\_and\\_current\\_subsidy\\_levels.pdf](https://ens.dk/sites/ens.dk/files/Bioenergi/the_danish_subsidy_scheme_for_the_use_of_biogas_and_current_subsidy_levels.pdf).

<sup>16</sup> "New Danish energy agreement secured: 50 percent of Denmark's energy needs to be met by renewable energy in 2030," State of Green, accessed November 8, 2018, <https://stateofgreen.com/en/partners/state-of-green/news/new-danish-energy-agreement-a-green-focus-towards-2030/>.

## GERMANY

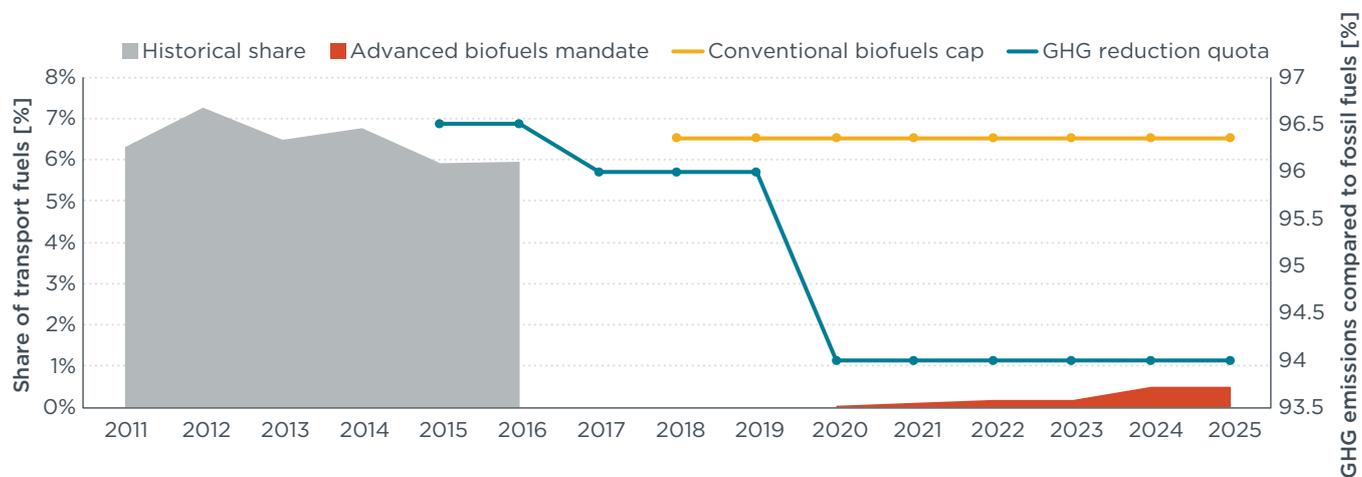
### BASELINE STATUS

Germany has had a biofuel mandate in place since 2009 with a 6.25% target for biofuels in road and rail transport.<sup>17</sup> In 2016, renewable energy and biofuels accounted for 6.9%, with double-counting, and 4.7%, respectively, of the energy consumed in the transportation sector.<sup>18,19</sup> Biodiesel constituted 59% of all biofuels, followed by ethanol (35%). Sales of pure biofuels in Germany have decreased to basically zero.

In 2012, the German company Clariant established a demonstration plant in Bayern that produces 1,000 tons per year of cellulosic ethanol from agricultural residues. In 2017, Clariant announced plans to build a new plant in Romania using €23 million funding from the EU research program FP7.<sup>20,21</sup> The plant will produce 50,000 tons of cellulosic ethanol per year.

### POLICY UPDATES TO SUPPORT ADVANCED FUELS

Figure 2 shows the historical share of transportation fuels in Germany that were biofuels through 2016. The advanced biofuel mandate is shown for 2020-2025. Starting in 2015, Germany moved from an energy mandate to a GHG reduction quota with the goal of achieving a 6% GHG reduction in the transportation fuel mix by 2025. There is no double-counting towards the mandate. Furthermore, biofuels produced from animal oils and fats cannot be counted towards the biofuel GHG reduction.



**Figure 2.** Historical share of biofuels, advanced biofuels mandate and conventional biofuels cap (left axis) and GHG emission reduction mandate (right axis) in Germany.

17 Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnliche Vorgänge (Bundes-Immissionsschutzgesetz - BImSchG) - 37a. (Law for the protection against harmful environmental effects caused by air pollution, noise, vibrations and similar processes (Federal Pollution Control Act) - Section 37a), Bundesministerium der Justiz und für Verbraucherschutz, <https://www.gesetze-im-internet.de/bimschg/>.

18 See footnote 9.

19 Fachagentur Nachwachsende Rohstoffe e. V., "Facts and Figures: Bioenergy in Germany. Biofuels" (2017), <https://international.fnr.de/basisdaten/bioenergie/biofuels.html>.

20 "Clariant to build flagship sunliquid cellulosic ethanol plant in Romania," Clariant, accessed September 14, 2018, <https://www.clariant.com/en/Corporate/News/2017/10/Clariant-to-build-flagship-sunliquid-cellulosic-ethanol-plant-in-Romania>.

21 Website of Sunliquid research project, accessed September 14, 2018, <https://www.sunliquid-project-fp7.eu/funding/>.

In 2017 the EU ILUC directive was transposed into German legislation, introducing two new categories of biofuels:<sup>22</sup>

- » Conventional biofuels. Biofuels made from cereal and high-starch crops (irrespective if only grains or the whole plant is used), sugar crops, oil crops and energy crops on agricultural land.
- » Advanced fuels. These are biofuels made from a specific list of raw materials (similar to feedstocks in Annex IX EU ILUC Directive); Renewable Fuels of Non-Biological Origin, or RFONBOs; fuels produced by CO<sub>2</sub> capture and use, provided the energy is from renewable sources; and fuels produced from bacteria.

The 2017 legislation introduced a sub-target for advanced biofuels, increasing it from 0.05% of energy used in road and rail transportation (for companies supplying more than 20 PJ of fuels), up to 0.5% for all suppliers by 2025. Conventional biofuels are capped at 6.5% of the energy used in transportation, as shown in Figure 2.

Until 2014, fuel suppliers failing to meet the mandate were subjected to penalties of €0.7 per liter of diesel equivalent for biodiesel and €1.55 per liter of diesel equivalent for ethanol. Beginning in 2015, the penalty switched to €470 per ton of CO<sub>2</sub>e of GHG savings not achieved.

## ITALY

### BASELINE STATUS

Italy has had a transportation biofuel obligation in place since 2006. In 2011, it began to transpose the RED, setting a minimum mandate of 5% blending by energy by 2014.<sup>23</sup> Italy then decreed on October 10, 2014<sup>24</sup> that they would extend the biofuel mandate to achieve 10% blending by 2022 and introduced a specific mandate for advanced biofuels.

In 2016, Italy recorded an overall share of 7.2%<sup>25</sup> renewable energy in the transportation sector, including double-counting some biofuels. The country's biofuel sector is almost completely dominated by diesel substitutes (97%), mostly biodiesel (FAME) as well as a small share of hydrotreated vegetable oil (HVO) produced from palm oil. Bio-ethyl tert-butyl ether (ETBE), an oxygenate gasoline additive, is the next most common type of biofuel followed by a negligible fraction of ethanol. Italy has been consuming less palm-based biofuel over time and has increased consumption of biofuels produced from wastes and residues that can be double-counted towards the RED target, while decreasing the physical amount of biofuels consumed.

22 Achtunddreißigste Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung zur Festlegung weiterer Bestimmungen zur Treibhausgasreduzierung bei Kraftstoffen - 38. BImSchV). (Thirty-eighth Ordinance on the Implementation of the Federal Pollution Control Act (Ordinance laying down further provisions on the reduction of greenhouse gases in the case of fuels - 38th BImSchV), Bundesministerium der Justiz und für Verbraucherschutz, December 8, 2017, [https://www.gesetze-im-internet.de/bimschv\\_38\\_2017/BJNR389200017.html](https://www.gesetze-im-internet.de/bimschv_38_2017/BJNR389200017.html).

23 Decreto Legislativo 3 marzo 2011, n. 28. Attuazione della direttiva 2009/28/CE sulla promozione dell'uso dell'energia da fonti rinnovabili, recante modifica e successiva abrogazione delle direttive 2001/77/CE e 2003/30/CE. (Implementation of Directive 2009/28 / EC on the promotion of the use of energy from renewable sources, amending and subsequently repealing Directives 2001/77 / EC and 2003/30 / EC), Gazzetta Ufficiale Serie Generale n.71 del 28-03-2011 - Suppl. Ordinario n. 81, <http://www.gazzettaufficiale.it/eli/id/2011/03/28/011G0067/sg>.

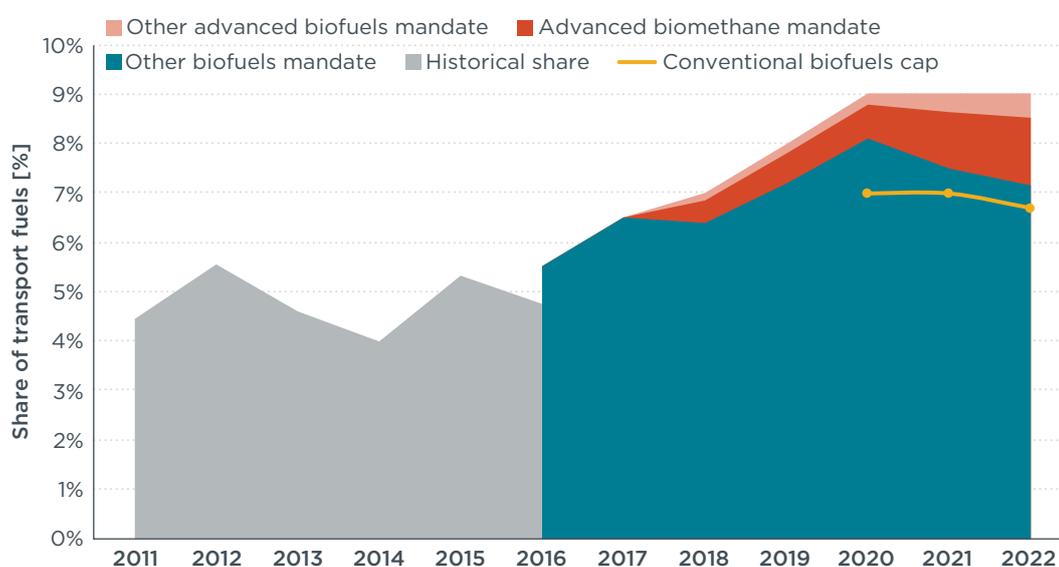
24 Decreto 10 Ottobre 2014, Aggiornamento delle condizioni, dei criteri e delle modalità di attuazione dell'obbligo di immissione in consumo di biocarburanti compresi quelli avanzati (14A08212). (Updating the conditions, criteria and implementation modalities of the obligation to release biofuels, including advanced ones, for consumption), Gazzetta Ufficiale Serie Generale n.250 del 27-10-2014, [http://www.gazzettaufficiale.it/atto/serie\\_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2014-10-27&atto.codiceRedazionale=14A08212&isAnonimo=false&normativi=false&tipoVigenza=originario&tipoSerie=serie\\_generale&currentPage=1](http://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2014-10-27&atto.codiceRedazionale=14A08212&isAnonimo=false&normativi=false&tipoVigenza=originario&tipoSerie=serie_generale&currentPage=1).

25 See footnote 9

Italy hosted Europe's first commercial-scale cellulosic biofuel plant, which opened in 2013 and was operated by CHEMTEX until 2017, when its parent company filed for bankruptcy. The plant aimed at producing 51 million liters of ethanol per year from cereal straw and giant reed (*Arundo donax*).<sup>26</sup> The biofuel plant received a large amount of public EU funding and the Italian government had negotiated to support it with an offtake agreement, along with the development of other cellulosic ethanol plants operated by the same company.<sup>27</sup>

## POLICY UPDATES TO SUPPORT ADVANCED FUELS

Figure 3 shows the historical share of biofuels in transportation fuels in Italy through 2016 and the 2022 biofuels target, including a sub-target for advanced biofuels and advanced biomethane. The white line represents the cap set for conventional biofuels.



**Figure 3.** Historical biofuels share in transportation gasoline and diesel and future biofuel mandate in Italy

The Italian government continues to support the penetration of advanced biofuels. Italy redefined and operationalized its 2014 commitment with a new decree published on March 2, 2018,<sup>28</sup> amending the biofuel mandate from 10% to 9% by 2020 (Figure 3). The 2018 mandate includes an obligation for advanced biofuels starting at 0.6% in 2018 and rising to 1.85% in 2022. As the chart shows, the advanced biofuel target is further sub-divided: 75% must be met with advanced biomethane and 25% by other advanced biofuels. The chart also shows the capped share of food-based biofuels in transportation for Italy, following the EU ILUC directive. Producers of biofuels are assigned Immission Certificates ('Certificati di immissione in consumo' or CIC) which can be traded and sold to suppliers, and can

26 European Commission, "Best NER300 Factsheet" (2016), [https://setis.ec.europa.eu/system/files/bio\\_best\\_it\\_2016\\_factsheet.pdf](https://setis.ec.europa.eu/system/files/bio_best_it_2016_factsheet.pdf)

27 "Biodiesel 2, con 720 milioni di fondi pubblici e soci privati al via tre nuove raffinerie (*Biodiesel 2, with 720 million of public funds and private shareholders at the start of three new refineries*)", *La Repubblica*, December 8, 2014, [http://www.repubblica.it/economia/affari-e-finanza/2014/12/08/news/biodiesel\\_2\\_con\\_720\\_milioni\\_di\\_fondi\\_pubblici\\_e\\_soci\\_privati\\_al\\_via\\_tre\\_nuove\\_raffinerie-102378554/](http://www.repubblica.it/economia/affari-e-finanza/2014/12/08/news/biodiesel_2_con_720_milioni_di_fondi_pubblici_e_soci_privati_al_via_tre_nuove_raffinerie-102378554/)

28 Decreto 2 Marzo 2018, Promozione dell'uso del biometano e degli altri biocarburanti avanzati nel settore dei trasporti (18A01821). (Promotion of the use of biomethane and other advanced biofuels in the transport sector), *Gazzetta Ufficiale Serie Generale* n.65 del 19-03-2018, [http://www.gazzettaufficiale.it/atto/serie\\_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2018-03-19&atto.codiceRedazionale=18A01821&isAnonimo=false&normativi=false&tipoVigenza=originario&tipoSerie=serie\\_generale&currentPage=1](http://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2018-03-19&atto.codiceRedazionale=18A01821&isAnonimo=false&normativi=false&tipoVigenza=originario&tipoSerie=serie_generale&currentPage=1)

be used by authorities to verify compliance with the obligation. One CIC is assigned for each 10 Gigacalorie (Gcal) of conventional biofuels supplied and for each 5 Gcal of advanced biofuels. There is a penalty of €750 per missing certificate for suppliers that do not comply with the mandate; this is equivalent to €2.7 per liter of diesel equivalent for conventional biofuels and €5.4 per liter of diesel equivalent for advanced biofuels. This penalty can be reduced if supply on the market is less than 20% of the mandated quantity. Currently, aviation biofuels cannot opt into the mandate and are not eligible to receive CICs.

Additionally, the decree establishes a fixed subsidy of €375 for each advanced-CIC.<sup>29</sup> Advanced biomethane plants that build new connections to the natural gas distribution grid and those building new biomethane liquefaction plants are eligible to a 20% increase on the subsidy. These incentives are valid for 10 years and the infrastructure and liquefaction incentives are capped at €600,000 and €1.2 million, respectively. Advanced biofuel producers also have the option to sell their fuel directly to the National Energy Authority (GSE) for 95% of the average market price. These incentives also apply to biogas plants that are converted from producing electricity to producing upgraded biomethane for transport. This is particularly relevant as Italy has almost 2,000 existing biogas plants generating electricity.<sup>30</sup>

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29 Gestore Servizi Energetici, "Procedure Applicative DM 2 marzo 2018 (Application procedures DM march 2 2018)" (2018), [https://www.gse.it/documenti\\_site/Documenti%20GSE/Servizi%20per%20te/BIOMETANO/Procedure%20Applicative%20DM%202%20marzo%202018\\_18062018.pdf](https://www.gse.it/documenti_site/Documenti%20GSE/Servizi%20per%20te/BIOMETANO/Procedure%20Applicative%20DM%202%20marzo%202018_18062018.pdf).

30 Gestore Servizi Energetici, "Rapporto Statistico. Energia da fonti rinnovabili in Italia. Anno 2016. (Statistical Report. Energy from Renewable sources in Italy. 2016)" (2018), [https://www.gse.it/documenti\\_site/Documenti%20GSE/Rapporti%20statistici/Rapporto%20statistico%20GSE%20-%202016.pdf](https://www.gse.it/documenti_site/Documenti%20GSE/Rapporti%20statistici/Rapporto%20statistico%20GSE%20-%202016.pdf).

## THE NETHERLANDS

### BASELINE STATUS

The Netherlands first placed renewable energy obligations on fuel suppliers in 2007, with the goal of achieving a share of 4% by 2010.<sup>31</sup> The mandate was then updated in 2011 to grow from 4.25% to 10% in 2020, in line with the RED target.<sup>32</sup> In 2017, biofuels accounted for 7.75% of the energy consumed in road and rail transportation in the Netherlands with double counting; the physical energy share was 4.6%. The main biofuels consumed were double-counted FAME (82% of all biofuels) produced from used cooking oil imported from Asia and animal fats, followed by conventional ethanol. Crop-based biodiesel disappeared from the Dutch fuel mix by 2017. Advanced biofuels accounted for 0.1% of the transportation energy in 2017 and 1.6% of all biofuels delivered. Biomethane for transportation accounted for only 0.1% of total transportation energy, but biomethane produced from municipal organic waste and sewage sludge constituted 74% of advanced biofuels consumed in the Netherlands.<sup>33</sup>

### POLICY UPDATES TO SUPPORT ADVANCED FUELS

Figure 4 shows the historical share of transportation fuels constituted by conventional and advanced biofuels in the Netherlands through 2017. The figure also shows the historical share of waste-based biofuels produced using first-generation technologies, such as used cooking oil biodiesel, which are double-counted towards the RED in all EU countries. In addition, Figure 4 shows the 2020 mandate in place for advanced and other biofuels and the cap set for conventional biofuels. In 2018, the Dutch government raised the biofuel mandate to 16.4% by 2020, including double-counting.<sup>34</sup> The country increased the advanced biofuels mandate from 0.6% in 2018 to 1% by 2020. The remaining quota of the mandate is expected to be filled by double-counted biofuels. Aviation biofuels are not subject to the mandate, but bio-kerosene and bio-naphtha producers can opt in and be eligible to obtain renewable certificates.<sup>35</sup>

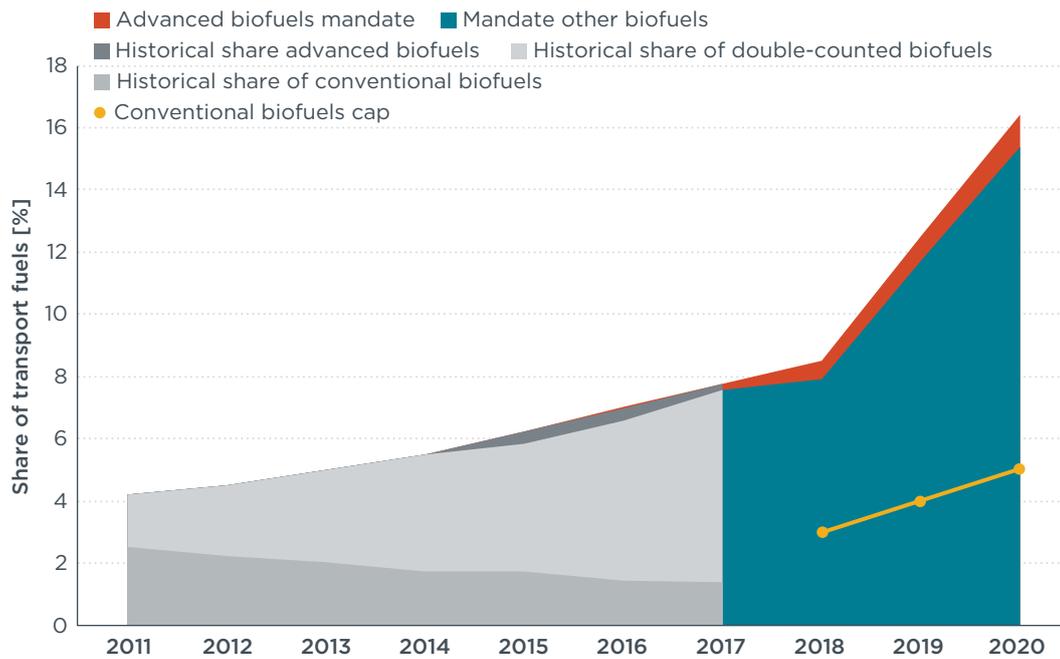
31 Kristine Bitnere and Stephanie Searle, *Effective policy design for promoting investment in advanced alternative fuels*, (ICCT: Washington, DC, 2017), [https://www.theicct.org/sites/default/files/publications/Advanced-alternative-fuels\\_ICCT-white-paper\\_21092017\\_vF.pdf](https://www.theicct.org/sites/default/files/publications/Advanced-alternative-fuels_ICCT-white-paper_21092017_vF.pdf).

32 Besluit van 18 april 2011, houdende regels omtrent de inzet van energie uit hernieuwbare bronnen ten behoeve van bepaalde vormen van vervoer (Besluit hernieuwbare energie vervoer). (Decree on renewable energy in transport of April 11 2011), Staatsblad, Nr. 197, 3 mei, 2011, <https://zoek.officielebekendmakingen.nl/stb-2011-197.html>.

33 Dutch Emissions Authority, "Rapportage Energie voor Vervoer in Nederland 2017. (Report on energy in transport in the Netherlands 2017)" (2017), <https://www.rijksoverheid.nl/documenten/rapporten/2018/07/03/bijlage-1-rapportage-energie-voor-vervoer-in-nederland-2017>.

34 Besluit van 3 mei 2018, houdende regels met betrekking tot de jaarverplichting hernieuwbare energie vervoer en de rapportage- en reductieverplichting vervoersemissies, ter implementatie van Richtlijn (EU) 2015/1513 van het Europees Parlement en de Raad van 9 september 2015 tot wijziging van Richtlijn 98/70/EG betreffende de kwaliteit van benzine en dieselbrandstof en tot wijziging van Richtlijn 2009/28/EG ter bevordering van het gebruik van energie uit hernieuwbare bronnen alsmede in verband met de operationalisering van de reductieverplichting uit Richtlijn 98/70/EG betreffende de kwaliteit van benzine en dieselbrandstof, en tot intrekking en wijziging van enkele andere besluiten (Besluit energie vervoer). (Decision of 3 May 2018, containing rules relating to the annual obligation for renewable energy transport and the reporting and reduction obligation for transport emissions, for the implementation of Directive (EU) 2015/1513 [...]), Staatsblad, Nr. 134, 17 mei 2018, <http://wetten.overheid.nl/BWBR0041050/2018-07-01>

35 Dutch Emissions Authority, "Brandstoffen in het REV - Augustus 2018). (Fuels in the register for transport energy - August 2018)" (2018), <https://www.emissieautoriteit.nl/onderwerpen/register-energie-voor-vervoer/documenten/publicatie/2018/08/14/brandstoffen-in-het-rev---augustus-2018>.



**Figure 4.** Historical share of biofuels as a fraction of total energy used in transportation and future mandate in the Netherlands.

## LONG-TERM STRATEGY

The Dutch government signed the country’s Climate Agreement in 2017 with the goal of reducing transportation CO<sub>2</sub> emissions by 7.3 million tons by 2030 compared to 1990.<sup>36</sup> It includes a priority to use sustainable biomass for fuels in heavy road transportation, aviation and shipping, while favoring electrification and hydrogen for other transportation modes. Legislation to implement the Climate Agreement is still being discussed.

<sup>36</sup> Official website of the Dutch climate agreement, accessed November 8, 2018, <https://www.klimaatkoord.nl/>.

## SWEDEN

### BASELINE STATUS

Sweden did not have a biofuels mandate or target until 2018. Its main support mechanism for biofuels has been exemptions from its energy and carbon taxes, which apply to fossil fuels.<sup>37</sup> In 2018, the carbon tax was 1150 SEK per ton CO<sub>2</sub> (€109 per ton CO<sub>2</sub>).<sup>38</sup>

Almost 21% of the energy used for road vehicles in 2017 came from biofuels.<sup>39</sup> In the last three years, Sweden has doubled the share of biofuels sold.<sup>40</sup> Importantly, the consumption of HVO has expanded in recent years, both as a blend with fossil diesel (FAME and HVO together make up 21% of diesel sold in 2016 by volume) and as a pure fuel (HVO100).<sup>41</sup> Currently, almost all the HVO consumed in Sweden is imported.<sup>42</sup> The small quantity (4% in volume) produced domestically is derived from tall oil. Around 23% of HVO consumed in Sweden is produced from palm fatty acid distillate (PFAD). Biomethane accounted for 87% of vehicle gas consumed in Sweden in 2017, and the total consumption of biomethane in transportation was on par with ethanol consumption.<sup>43</sup>

New investments in Sweden focus on HVO production capacity, expanding HVO products to include HVO-gasoline and producing raw HVO material from tall oil.<sup>44</sup>

### POLICY UPDATES TO SUPPORT ADVANCED FUELS

Figure 5 shows the current GHG reduction quota for diesel and gasoline in Sweden as well as the baseline GHG values. On the right axis, the historical share of biofuels in transportation fuels in Sweden is shown. In July 2018, Sweden introduced a new mandate on fuel distributors to reduce GHG emissions of the fuel mix supplied.<sup>45</sup> As shown in Figure 5, this policy requires fuel distributors to decrease GHG emissions by 19.3% in the diesel supply and 2.6% in the gasoline supply by 2018.<sup>46</sup> The reduction targets increase to 21% and 4.2% for diesel and gasoline, respectively, by 2020. Sweden has a longer term target for a fuel mix that would achieve a GHG reduction of about 40% by 2030 corresponding to around 50% of biofuels blending.

37 Susanne Åkerfeldt, "How to design a cost-effective carbon tax on motor fuels and be in line with EU state aid rules," (Ministry of Finance of Sweden, 2017), <https://www.government.se/492fd9/contentassets/18e-d243e60ca4b7fa05b36804ec64beb/170925-aakerfeldt-carbon-tax-on-motor-fuels-gcet-tucson.pdf>.

38 "Carbon Pricing Dashboard", The World Bank, accessed November 8, 2018, [https://carbonpricingdashboard.worldbank.org/map\\_data](https://carbonpricingdashboard.worldbank.org/map_data).

39 See footnote 9

40 "2017 another record year for biofuels in Sweden", Bioenergy International, accessed September 14, 2018, <https://bioenergyinternational.com/markets-finance/2017-another-record-year-biofuels-sweden>.

41 "HVO100 is third largest transportation fuel type in Sweden", Bioenergy International, accessed September 14, 2018, <https://bioenergyinternational.com/markets-finance/hvo100-third-largest-transportation-fuel-type-sweden>.

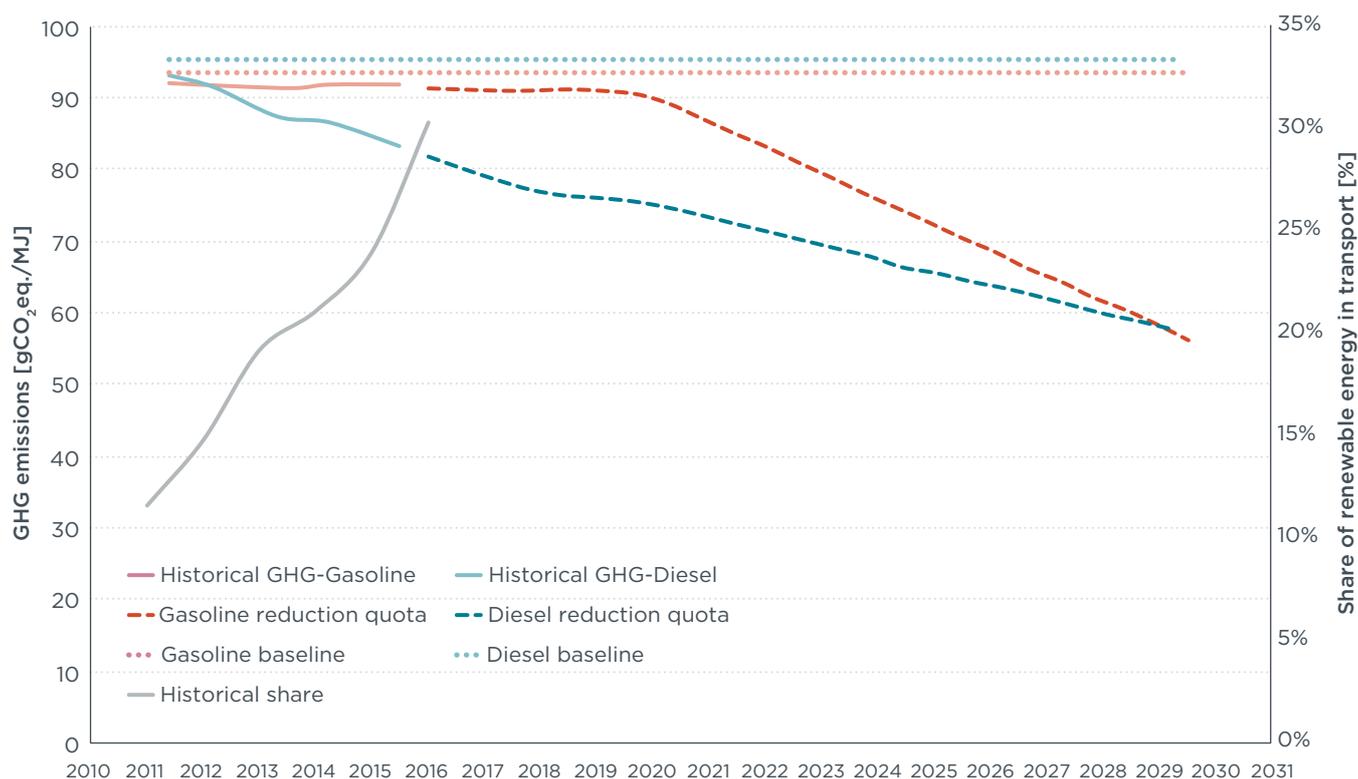
42 Swedish Energy Agency, "Energy in Sweden – Facts and Figures 2018" (2018), <http://www.energimyndigheten.se/en/news/2018/energy-in-sweden---facts-and-figures-2018-availabl%C3%A9-now/>.

43 "Biofuels for transport", Svebio, accessed November 8, 2018, <https://www.svebio.se/en/about-bioenergy/biodrivmedel/>.

44 Sören Eriksson, "At least 3 Mm3 drop in fuels from forest residues in 2030," (Preem AB, 2017), [https://www.svebio.se/app/uploads/2017/05/Eriksson\\_-\\_So%CC%88ren\\_ABC17.pdf](https://www.svebio.se/app/uploads/2017/05/Eriksson_-_So%CC%88ren_ABC17.pdf).

45 Förordning (2018:195) om reduktion av växthusgasutsläpp genom inblandning av biodrivmedel i bensin och dieselbränslen. (Regulation (2018: 195) on the reduction of greenhouse gas emissions through the inclusion of biofuels in petrol and diesel fuels), Miljö- och energidepartementet, April 5, 2018, [https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/forordning-2018195-om-reduktion-av\\_sfs-2018-195](https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/forordning-2018195-om-reduktion-av_sfs-2018-195).

46 "Reduktionsplikt. (Reduction duty)", Swedish Energy Agency, accessed November 8, 2018, <http://www.energimyndigheten.se/fornybart/hallbarhetskriterier/reduktionsplikt/>.



**Figure 5.** GHG reduction targets for the gasoline and diesel mix in Sweden up to 2030, and GHG baseline values for diesel and gasoline (left axis) and historical biofuels share (right axis).

In 2019, the classification of PFAD will be changed from a residue to a co-product: a share of GHG emissions from the cultivation of palm oil will then be allocated to PFAD, reducing its calculated GHG savings and thus losing its comparative advantage towards the GHG reduction mandate. This change was made based on evidence that PFAD has productive, non-energy uses, in which it is likely to be replaced by virgin palm oil.<sup>47</sup>

The tax exemptions for biofuels were removed with the introduction of the new GHG targets. High-blended and pure biofuels, such as E85, HVO100 and biomethane, are not allowed within the reduction duty, but are still exempted from the carbon tax.

The penalty for not complying with the reduction quota is 5 SEK/kg CO<sub>2</sub>e. (€476 per ton CO<sub>2</sub>e) for petrol and 4 SEK/kg CO<sub>2</sub>e (€380 per ton CO<sub>2</sub>e) for diesel. Sweden will consider specific measures for aviation biofuels in the spring of 2019.

## LONG-TERM STRATEGY

The Swedish government has longer-term targets for a fossil-independent vehicle fleet and a reduction of 70% in GHG emissions in the transportation sector (excluding aviation) by 2030 compared to 2010.<sup>48</sup> Within this vision, Sweden forecasts that by 2030, 50% of passenger vehicles could be fueled by biofuels and 20% by electricity.

47 Chris Malins, *Waste not want not. Understanding the greenhouse gas implications of diverting waste and residual materials to biofuel production*, (ICCT: Washington, DC, 2017), [https://www.theicct.org/sites/default/files/publications/Waste-not-want-not\\_Cerulogy-Consultant-Report\\_August2017\\_vF.pdf](https://www.theicct.org/sites/default/files/publications/Waste-not-want-not_Cerulogy-Consultant-Report_August2017_vF.pdf).

48 Government Offices of Sweden, "The Swedish Government's climate initiatives - three years into the electoral period" (2017), <https://www.government.se/articles/2017/10/the-swedish-governments-climate-initiatives--three-years-into-the-electoral-period/>.

## UNITED KINGDOM (UK)

### BASELINE STATUS

The UK introduced the Renewable Transportation Fuel Obligation (RTFO)<sup>49</sup> in 2008, setting a biofuel mandate that started at 2.6% by volume in 2009 and increased up to 6% in 2018. The share of renewable energy in transportation was 4.9% in 2016, with double-counting.<sup>50</sup> Of the volume of biofuels consumed in the UK 48% are biodiesel (mostly UCO) and 47% ethanol (mostly wheat). In the period 2016-2017, double-counted biofuels accounted for 66% of all renewable fuels by volume. Of this share, 41% was produced from UCO, 12% from starch slurry and 3% from tallow oil.

### POLICY UPDATES TO SUPPORT ADVANCED FUELS

UK amended the RTFO in the spring of 2018 to transpose requirements from the EU ILUC directive. The mandate has now been extended to 2032 and the ambition has significantly increased, aiming for a doubling of renewable fuels in road and non-road mobile machinery transportation from 6% in 2017 to 12.4% in 2032 (Figure 6).

The RTFO has a market-based credit trading system. One Renewable Transport Fuel Certificate (RTFC) is allocated for each liter of liquid renewable fuel produced. Renewable fuels produced from specific wastes and other feedstocks listed by the UK government are counted double and awarded two RTFCs for each liter of fuel.<sup>51</sup> With the 2018 amendment, the certificates are now differentiated into three categories of renewable fuels: relevant crop, development fuel, and general RTFCs. Each of these categories have specific prescriptions in the mandate, as shown in Figure 6. “Relevant crop fuels” refer to crop-based fuels; these are subject to a cap starting at 4% by volume in 2018, decreasing to 2% in 2032. “Development fuels” are advanced fuels with a sub-mandate and each liter is double-counted. The definition of “development fuel” is double-tiered, as it<sup>52</sup> needs to satisfy a feedstock requirement and must be produced:

- » from an eligible waste on the government list, excluding segregated oil and fat feedstocks, such as UCO and tallow, or
- » is a Renewable Fuel of Non-Biological Origin.

Furthermore, development fuels need to be one of the following fuel types:

- » hydrogen
- » aviation fuel (both kerosene-type and gasoline-type fuels)
- » substitute natural gas by gasification or pyrolysis
- » Fuel that’s blended to have more than 25% of renewable component in the final fuel and still comply with diesel and gasoline fuel qualities (i.e. drop-in fuels).

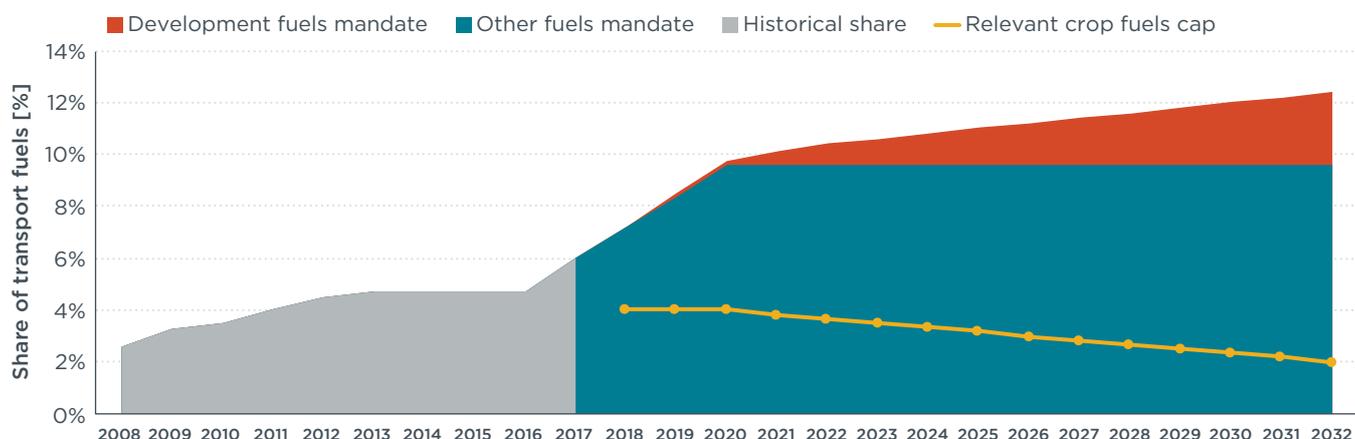
49 Department for Transport, “Renewable Transport Fuel Obligation (RTFO) order [Collection 2018]” (2018), <https://www.gov.uk/government/collections/renewable-transport-fuels-obligation-rtfo-orders>.

50 See footnote 9

51 Department for transport, “RTFO Guidance – Feedstocks including wastes and residues” (2018), [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/731027/rtfo-guidance-feedstocks-including-wastes-and-residues-year-11.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/731027/rtfo-guidance-feedstocks-including-wastes-and-residues-year-11.pdf).

52 Department for Transport, “Renewable Transport Fuel Obligation Guidance Part One – Process Guidance Year 11: 15/4/18 to 31/12/18” (2018), [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/694277/rtfo-guidance-part-1-process-guidance-year-11.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/694277/rtfo-guidance-part-1-process-guidance-year-11.pdf).

Figure 6 shows the historical share of biofuels in transportation fuels in the UK through 2017 as well as the future mandate in place for development and other biofuels.



**Figure 6.** Historical share of biofuels in the volume of all road and non-road mobile machinery fuels consumed in UK and RTFO-2018 mandate.

Fuel suppliers can carry over up to 25% of RTFCs from the year before. Fuel suppliers that still fail to achieve their target have the option to buy out the missing quota by paying a fixed amount equal to 0.3 GBP for each RTFC (around €0.33 per liter) and 0.8 GBP for each development RTFC (around €1.8 per liter).<sup>53</sup> Fossil aviation fuels are not obligated under the RTFO, but renewable fuels used in aviation in the UK are eligible to opt into the program. In addition, aviation fuels are one of the fuel types that qualifies to receive development fuel RTFCs.

## PROGRESS AND OBSTACLES TOWARDS THE REDII

Table 1 summarizes the key comparable aspects and provisions related to the transportation biofuel policies in place in the six European countries assessed in this policy update. Across these countries, between 4.8% and 31% of their transportation fuels are derived from biomass. Four of the member states have in place mandates based on energy content, while Sweden and Germany have recently switched to GHG reduction quotas. All countries except Denmark and Sweden have placed a cap on conventional or food-based biofuels for 2020, with caps ranging from 4 to 6.7%. All countries except for Sweden have defined mandates for advanced biofuels by 2020, although the ambition varies widely from 0.05% in Germany to 1% in the Netherlands. The UK has the longest-term mandate, with an increasing subtarget for advanced biofuels reaching 2.8% in 2032. The prices for noncompliance range from €9 per gigajoule (GJ) for conventional biofuels in the UK up to €150 per GJ for advanced biofuels in Italy.

<sup>53</sup> Department for Transport, “Cost Benefit Analysis Amendments to the Renewable Transport Fuel Obligations Order” (2017), [http://www.legislation.gov.uk/ukxi/2018/374/pdfs/ukxi0d\\_20180374\\_en.pdf](http://www.legislation.gov.uk/ukxi/2018/374/pdfs/ukxi0d_20180374_en.pdf).

**Table 1:** summary table for the six select EU member states analyzed

	Biofuel share in transportation fuel <sup>54</sup>	Overall biofuels mandate	Mandate for advanced biofuels (target year)	GHG Reduction quota (target year)	Cap on conventional biofuels (target year)	Price for non-compliance
<b>Denmark</b>	5.75%	(5.75%)	0.9% (2020)	n.a.	n.d.	n.d.
<b>Germany</b>	5.9%	n.a.	0.05% (2020) 0.5% (2025)	-6% (2025)	6.5% (2018)	€470 per tCO <sub>2e</sub>
<b>Italy</b>	4.8%	7.15%	0.9% (2020) 1.85% (2022)	n.a.	6.7% (2022)	€75 per GJ €150 per GJ (advanced biofuels)
<b>The Netherlands</b>	7.75%	15.4%	1.0% (2020)	n.a.	5.0% (2020)	n.d.
<b>Sweden</b>	31.2%	n.a.	n.a.	-21% diesel (2020) -4.2% gasoline (2020) -40% both (2030)	n.d.	€380 per tCO <sub>2e</sub> (gasoline) €476 per tCO <sub>2e</sub> (diesel)
<b>United Kingdom</b>	6.0%	9.6%	0.2% (2020) 2.8% (2032)	n.a.	4.0% (2020) 2.0% (2032)	€9.5 – 11 per GJ €51 – 57 per GJ (development fuels)

n.a. = not applicable  
n.d. = not defined

We conclude that the six member states reviewed are actively implementing the EU ILUC directive provisions and are increasing their support for advanced biofuels, either through mandates or significant financial incentives. All of the countries except Denmark have already defined short-term mandates to 2020, both for conventional and for advanced biofuels, but only the UK has a mandate through 2032.

From the data analyzed, it is clear that these short-term mandates for advanced biofuels are, or are expected to be, fulfilled by technologically ready and commercially available products. For instance, we noticed a significant focus on biomethane produced from biowaste and slurries. However, we point out that achieving a significant penetration of biomethane in the long term would require large-scale changes in vehicle fleets and infrastructure. In addition, the combination of double-counting applied to waste-derived biofuels and the widespread caps placed on conventional biofuels has already led to a significant shift from conventional biofuels towards waste-based biofuels, such as biodiesel and HVO from UCO and tallow. However, the extent to which these waste-based HVO fuels could contribute to long-term targets is limited by the availability of residual oil feedstocks.

The REDII requires a minimum share of advanced biofuels of 3.5% in 2030. Given the limitations above, we conclude that the longer-term goals of the REDII will require member states to step up their ambition and to stimulate long-term investment in new capacity for advanced technologies. This is especially necessary for cellulosic ethanol and thermochemical pathways, which have a much greater

<sup>54</sup> All shares are calculated from EUROSTAT (SHARES tool) for the year 2016, except for the Netherlands and UK where values are from national statistics and refer to 2017. For EUROSTAT values, the numerator considers double-counting for all biofuels in Annex IX, the denominator considers all liquid and gaseous fuels in transportation, but excludes renewable electricity used in road and rail transport.

potential to deliver significant volumes to the EU vehicle fleet than biomethane or waste-based biodiesel and HVO. Given the long lead time needed for planning, constructing and ramping up production at cellulosic biofuel facilities, introducing robust support measures for advanced technologies should be an urgent priority for these Member States over the next few years.