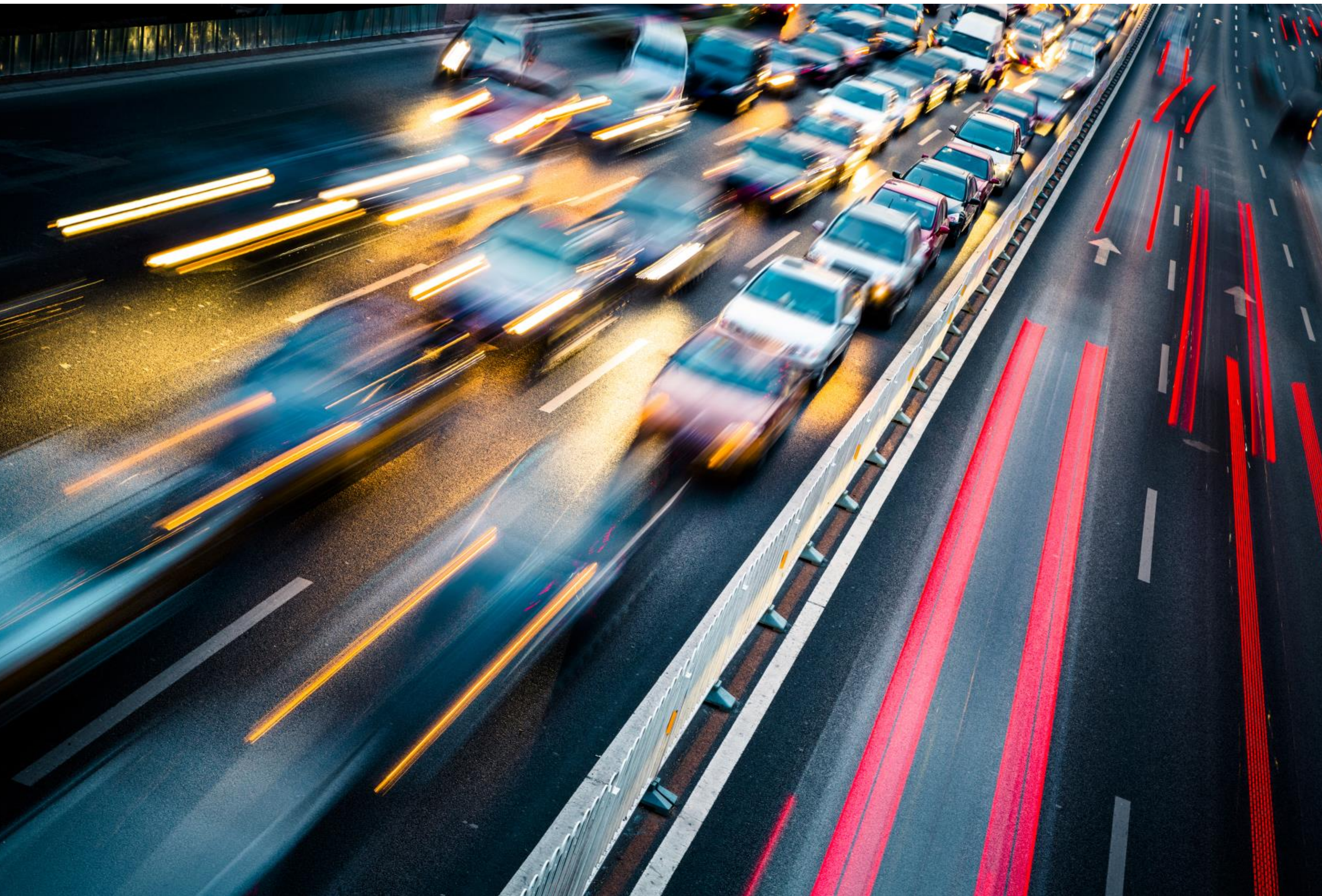
Eionet Report - ETC/CME 2/2020 – November 2020

Greenhouse gas intensities of road transport fuels in the EU in 2018

Monitoring under the Fuel Quality Directive



Authors:
Giorgos Mellios (EMISIA S.A.), Evi Gouliarou (EMISIA S.A.)

ETC/CME consortium partners: *AETHER* Interprofessional Technical Centre for Studies on Air Pollution (*CITEPA*) Czech Hydrometeorological Institute (*CHMI*) Energy and Environmental Studies and Software Development (*EMISIA)* Institute for Applied Ecology (*ÖKO-INSTITUT*) *ÖKO-RECHERCHE* Norwegian Institute for Air Research (*NILU*) Netherlands Environmental Assessment Agency (*PBL*) National Institute for Public Health and the Environment (*RIVM*) Environment Agency Austria (*UBA*) Flemish Institute for Technological Research (*VITO*)

Cover photo ©iStockPhoto, Credits: chinaface, Reference: 175130389

European Topic Centre on Climate
change mitigation and energy
Boeretang 200
B-2400 Mol, Belgium
Tel.: +32 14 33 59 77
Web: www.eionet.europa.eu/etcs/etc-cme
Email: etccme@vito.be

Contents

Acknowledgements

This report was prepared for the European Environment Agency (EEA) by its European Topic Centre on Climate change mitigation and energy (ETC/CME). The authors of the report were Giorgos Mellios and Evi Gouliarou (ETC/CME partner Emisia SA, Greece).

The EEA project manager was Stephanie Schilling. The EEA acknowledges comments received on the draft report from the European Commission's Directorate-General for Climate Action and from the European Environment Information and Observation Network (Eionet).

1 Executive summary

1.1 About this report

This report provides a summary of the information on the greenhouse gas (GHG) emission intensity of road transport fuels in the European Union (EU) in 2018, as reported by 31 December 2019 by EU Member States, Iceland and Norway ([1]) under Art. 7a of Directive 98/70/EC relating to the quality of petrol and diesel fuels (the Fuel Quality Directive, FQD).

Article 7a of the Fuel Quality Directive sets out reporting requirements concerning the volume and type of fuels (including fossil fuels, other non-biofuels and biofuels) supplied for road transport and non-road mobile machinery ([2]) as well as their life cycle greenhouse gas (GHG) emissions (from their extraction, processing and distribution). This includes the emissions resulting from indirect land use change (ILUC) for biofuels. The FQD sets a reduction target for fuel suppliers to reduce the GHG intensity of transport fuels (life cycle GHG emissions per unit of energy from fuel and energy supplied) by a minimum of 6 % by 2020 compared with 2010 levels. Member States must also analyse the share of biofuels in the total amount of fuels consumed.

The EEA supports the European Commission in the compilation, quality checking and dissemination of information reported under Article 7a of the FQD.

1.2 Main findings

Fuel suppliers are not sufficiently reducing the GHG intensity of fuels supplied in the EU

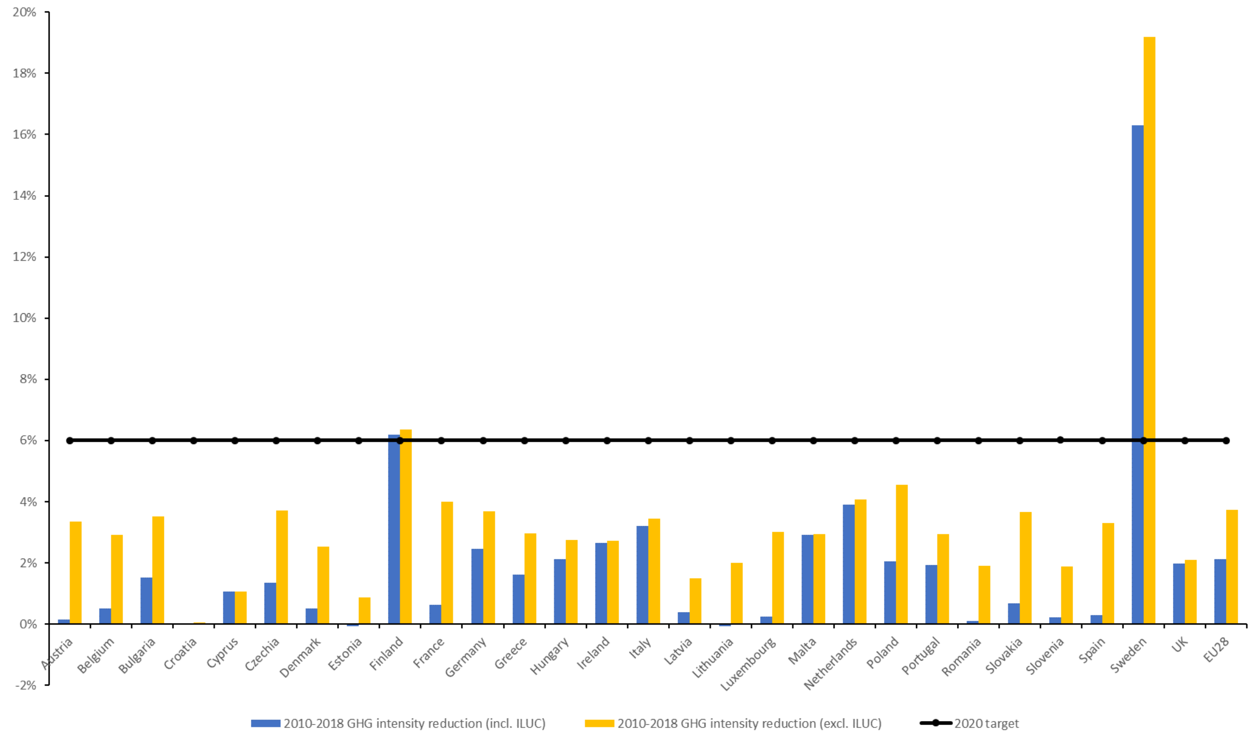
According to the data reported in 2019 by the 28 Member States, the average GHG intensity of the fuels consumed in these countries in 2018 (excluding the ILUC emissions intensity for biofuels) was 90.6 g carbon dioxide equivalent (CO_2e), 3.7 % lower than the 2010 levels. This corresponds to a saving of 51 Mt CO_2e in the year 2018. It represents an additional reduction of 0.3 percentage points compared to 2017 (3.4 % reduction compared to 2010, albeit for only 22 EU-MS). Therefore in 2018, EU fuel suppliers in the 28 reporting Member States were, on average, behind their objective of reducing the GHG intensity of transport fuels by 6 % by 2020 compared with 2010 (see Figure 1.1) ([3]). In order to reach the obligatory 6 %, target, an additional 2.3 % reduction in the GHG intensity of all fossil fuels and biofuels supplied will be needed by 2020.

The progress achieved by fuel suppliers varies greatly across Member States. Sweden and Finland are the only Member States where fuel suppliers already exceeded the 6 % reduction target for 2020 (by 13.2 and 0.4 percentage points respectively). 12 out of 28 Member States reached half of the target (around 3 % reduction) and in 8 Member States, the reductions remain lower than 3%.

ILUC emissions result from the conversion of non-agricultural land, such as forests, into agricultural land to grow biofuels or to displace food production resulting from biofuel production. As biofuels production increased since 2010, taking these ILUC emissions into account results in lower reductions of the GHG intensity of fuels. The average GHG intensity of the fuels consumed in 2018 was only 2.1 % lower than the 2010 levels - this corresponds to a saving of 29 Mt CO_2e in the year 2018.

([1]) Iceland and Norway have no reporting obligation and submit information on a voluntary basis.
([2]) A large number of engine installations in machines used for purposes other than transporting goods or passengers, such as bulldozers, compressors, back loaders or front loaders.
([3]) In 2018 no upstream emission reductions were reported. These are expected to contribute to the 6% reduction target only in the year 2020.

Figure 1.1 **Reductions in GHG intensity of fuels achieved by EU fuel suppliers in Member States, 2010-2018**



Source: EEA
Note: The 2020 target of 6 % refers to GHG intensity reduction excluding ILUC

Diesel and biodiesel dominate fossil fuel and biofuel supply

The total fuel supply of road transport in 2018 for the 28 MS was 14 028 petajoules of which 95 % came from fossil fuels and 5 % from biofuels. The fuel supply was dominated by diesel (59.8 %) and petrol (23.3 %), followed by gas oil (9.7 %), biodiesel (FAME) (3.6 %), bioethanol (0.8 %) and HVO (0.7 %).

Regarding the main feedstock and pathways used to produce biofuels, biodiesel is produced mainly from rapeseed, used cooking oil and palm oil; bioethanol is produced mainly from corn, wheat and sugar beet; and HVO is produced mainly from palm oil, palm fatty acid distillate (PFAD) and waste vegetable or animal oils.

In addition to the reporting on fossil fuels and biofuels, fuel suppliers may also voluntarily report on the quantity of electricity consumed by electric vehicles and motorcycles. In 2018, this quantity accounted for 0.03 % the total energy supply, as reported by ten Member States.

ILUC and effects of substitution by biofuels on GHG intensities

The biofuel feedstock is important when assessing the GHG reduction potential of biofuels, especially when including the ILUC effect. For biodiesel, a substantial part (above 65 %) is produced from oil crops, which have a high GHG intensity compared to other feedstocks. When considering ILUC, this biodiesel is only marginally better than fossil fuel diesel (88.9 vs 95.1 g CO_2e/MJ). In the case of HVO, the majority is produced from other feedstocks (such as waste oils and fats, above 60 %) with a low GHG intensity (with and without ILUC), whereas the quantities produced from oil crops, which have a much higher GHG intensity, are much lower (around 35 %).

Bioethanol is mainly produced from cereals and other starch-rich crops (above 80 %) and sugars (around 14 %) which have a moderate GHG reduction potential compared to other feedstocks. When including ILUC the average GHG intensity of bioethanol increases, however it remains much lower than fossil petrol (35.9 vs 93.3 g CO_2e/MJ).

Substitution of diesel with biodiesel and HVO results in GHG emission reductions around 39 % including ILUC and nearly 74 % excluding ILUC, while substitution of petrol with bioethanol leads to reductions of around 61 % and 74 % respectively.

2 Introduction

The role of fuels and their contribution to decreasing air pollution and GHG emissions has been recognized in EU legislation, which has inter alia stipulated a GHG intensity reduction target for road transport fuels. This reduction target is likely to be achieved with the use of sustainable biofuels, less carbon-intense fossil fuels, renewable fuels of non-biological origin, and a reduction in GHGs emitted during the crude oil production phase.

EU Member States report annually information on the volumes, energy content and life cycle GHG emissions of fuels used in road transport and non-road mobile machinery, in line with their obligations under the Fuel Quality Directive 98/70/EC (FQD) Article 7a.

The reporting on data pursuant to Article 7a occurred for the first time in 2018 in relation to the year 2017, following the application and transposition of Council Directive (EU) 2015/652.

Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action amended the FQD and the Council Directive by removing the reporting requirement on the origin of crude oil and the place of purchase for refined fossil fuels. This reporting is no longer obligatory.

The key documents that lay out the official requirements for the quality and GHG intensity of fuel sold in the EU, as well as it's monitoring and reporting for Article 7a, are the following:

- Directive 98/70/EC of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC;
- Directive 2015/652 of 20 April 2015 laying down calculation methods and reporting requirements pursuant to Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels;
- Directive 2009/30/EC of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC; the Directive introduces Article 7a on GHG emission reductions;
- Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources (Renewable Energy Directive RED) defines, like the FQD, the sustainability criteria for biofuels (Article 17); in addition, it defines the lower calorific values to be used for biofuels (Annex III) and the default GHG emissions for biofuels not fulfilling the sustainability criteria (Annex V D).

This report summarises the information reported by the EU Member States and subsequently collected, checked and compiled by the EEA on the volume, energy consumption, and GHG intensity of fossil fuels and biofuels.

Chapter 3 describes the reporting requirements and the summary format for each Member State's submission under FQD Article 7a.
Chapter 4 provides an overview of the Article 7a reported information aggregated at EU level.
Chapter 5 summarises the progress to 2020 targets under the Fuel Quality Directive, whereas Chapter 6 discusses the effects of ILUC on GHG intensities.
Chapter 7 compares the information provided under Article 7a and Article 8 of the FQD. The latter is solely relating to the quality of fuel, but provides also annual sales for petrol and diesel like Art. 7a.

3 Reporting by European Union Member States

3.1 Reporting requirements

The information provided by the Member States under Article 7a comprises the following aspects:

1. fossil fuels and other non-biofuels information: data provided by fewer than three suppliers (confidential), fuel or energy type, raw material source and process, fuel quantity supplied, energy quantity supplied and greenhouse gas (GHG) intensity;
2. biofuels information: data provided by fewer than three suppliers (confidential), biofuel or energy type, sustainability of biofuel, feedstock used, biofuel production pathway, biofuel quantity supplied, energy quantity supplied, GHG intensity and indirect land use change (ILUC) feedstock category and emissions intensity;
3. on a voluntary basis, information on electricity consumed by electric vehicles and motorcycles: energy quantity, including and excluding the powertrain efficiency and the GHG intensity.

3.2 Quality of Member States' reporting in 2018

The EEA is responsible for the collection, quality assurance/quality control (QA/QC) and compilation of the data submitted at EU level and is assisted in these tasks by the European Topic Centre on Climate change mitigation and energy (ETC/CME) ([4]).

An Excel template is used by EU Member States for their reporting obligations under Article 7a of the FQD[5]. Its purpose is to provide the necessary information and guidance for the preparation of national reports and to ensure that all the required information has been provided.

In 2019, in relation to year 2018, 28 EU Member States plus Iceland and Norway submitted their fuel quality reports in accordance with the requirements of the FQD. During the QA/QC procedure, the ETC/CME reviewers posed clarifying questions to the reporting countries, relating to the completeness and consistency of their submitted data sets. The most common findings communicated to the countries following the quality checks performed on the information reported were:

- data reported not corresponding to the data lists provided in the template;
- missing information, mainly on feedstock or pathway;
- data reported in aggregated form.

Most of these issues could be solved directly with the Member States in the communication process, by completing missing information, correcting erroneous values or providing the necessary clarifications. Following the QA/QC procedure, 19 Member States submitted revised data sets.

([4]) The ETC/CME is a consortium of 11 European organizations contracted by the EEA to carry out specific tasks identified in the EEA strategy in the area of climate change mitigation and energy.

([5]) http://cdr.eionet.europa.eu/help/fqd

4 Supplied quantities of road transport fuels in 2018

4.1 Fossil fuel and biofuel quantities supplied

Fuel suppliers must report annually to the authority designated by the Member State on the greenhouse gas (GHG) intensity of fuel and energy supplied within each Member State by providing as a minimum the total volume or quantity of each type of fuel or energy supplied and the life cycle GHG emissions per unit of energy.

The total energy quantities supplied by suppliers are presented in Table 4.1 for the different fossil fuels and biofuels marketed in the 28 Member States that have provided relevant data.

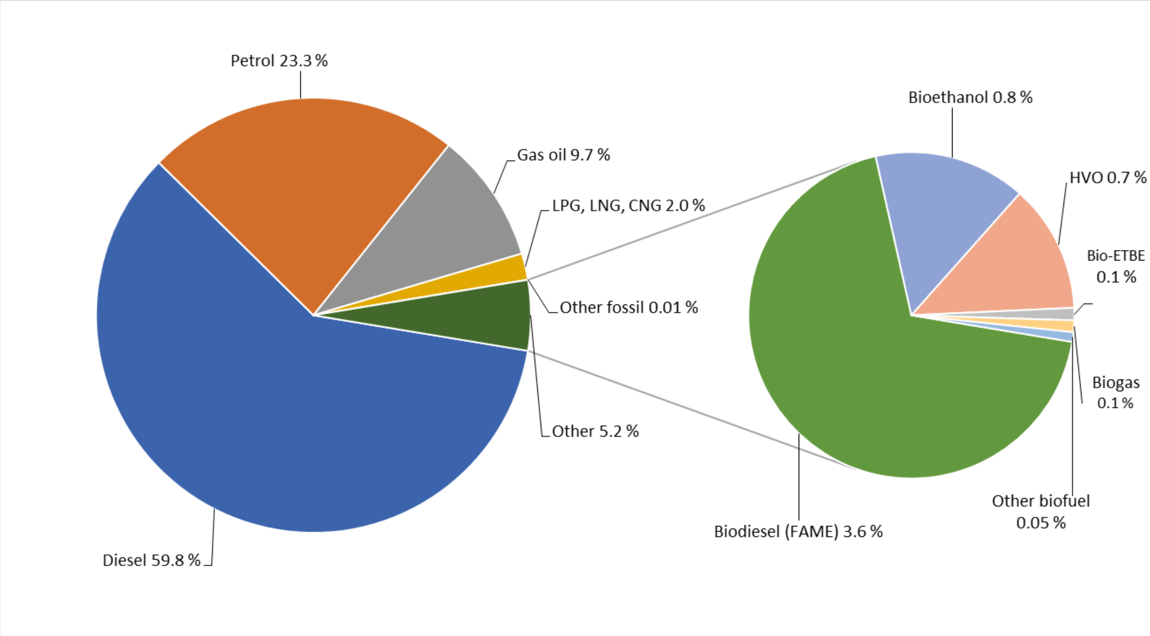
Table 4.1 Total quantities of fossil fuels and biofuels

	Total quantity (PJ)
Fossil fuels	13 296
Petrol	3 271
Diesel	8 386
Liquid petroleum gas (LPG)	236
Compressed natural gas (CNG)	36
Gas oil	1 363
Liquefied natural gas (LNG)	4
Other	1
Biofuels	732
Biodiesel	504
Bioethanol	111
Hydrotreated vegetable oil (HVO)	93
Bio-ETBE	9
Biogas	8
Other	7

Total fuel supply reported was 14 028 petajoules (PJ), of which 94.8 % was from fossil fuels, and 5.2 % was from biofuels (Figure 4.1). No renewable fuels of non-biological origin were reported in 2018. Based on data from national inventory submissions to United Nations Framework Convention on Climate Change (UNFCCC) ([6]), most of this fuel is used in passenger transport (passenger cars, buses and two-wheelers), followed by freight transport (light duty and heavy-duty trucks) and non-road mobile machinery.

([6]) https://unfccc.int/ghg-inventories-annex-i-parties/2020.

Figure 4.1 Fuel energy supply shares per fuel type in 2018



Notes: In category "other biofuel" the following types are included: bio-TAEE, Fischer-Tropsch diesel, bioethanol diesel, biofuel oil, diesel (origin bio), liquid biogas, methanol (non-bio, renewable), naphtha and pure vegetable oil. ETBE, ethyl tert butyl ether; TAEE, tert amyl ethyl ether.

The fossil fuel supply in 2018 was dominated by diesel (59.8 %; 8 386 PJ ([7])), followed by petrol (23.3 %; 3 271 PJ) and gas oil (9.7 %; 1 363 PJ). Liquified petroleum gas, liquified natural gas and compressed natural gas had a total share of 2 % (275 PJ).

The biofuels energy consumption in the 28 EU Member States is dominated by biodiesel (Fatty acid methyl esters (FAME)) (3.6 %; 504 PJ), followed by bioethanol (0.8 %; 111 PJ) and hydrotreated vegetable oil (HVO; 0.7 %; 93 PJ). Bio-ethyl tert-butyl ether (bio-ETBE) and biogas account for 0.1 % (18 PJ). All other biofuels used in road transport and non-road mobile applications in 2018 present a much smaller share (about 0.05 %) (Figure 4.1).

4.2 Biofuel production pathways and feedstocks used

Member States must report on the feedstock and the biofuel production pathway used for each of the biofuels consumed in their territories. Feedstock is relevant for estimating the potential indirect land use change (ILUC), whereas the biofuel production pathways are relevant for calculating the GHG intensity of the produced fuels and the potential emissions savings from their use.

Feedstocks used for biofuel production may be derived from plants grown directly for the purpose of energy production, or from plant parts, processing wastes, residues and materials from human and animal activities. In relation to the feedstock used, different production pathways may be followed to develop the final biofuels that are available in the market. Hence, feedstocks refer to the origin and to the raw material source of the biofuel while production pathways refer to the different processes used for the production of the biofuel always relevant to the respective feedstock.

([7]) A petajoule (PJ) is equal to one thousand terajoules (TJ) or one million gigajoules (GJ) or one billion megajoules (MJ).

The main feedstocks and production pathways for the three main biofuels are summarised in Table 4.2 below. The share of undefined production pathways (N/A) largely explains the differences in the shares of the different feedstocks and pathways. Any remaining differences are due to the shares reported as "Other" by the Member States.

Table 4.2 Summary of main feedstock and production pathways by biofuel

Biodiesel	**Feedstock**	**Pathway**
Rapeseed	41.3 %	36.3 %
Used cooking oil / waste vegetable oil or animal fat	20.5 %	18.9 %
Palm oil	12.7 %	9.3 %
Other	25.3 %	18.3 %
N/A	0.2 %	17.2 %
Bioethanol	**Feedstock**	**Pathway**
Corn (maize)	49.1 %	29.7 %
Wheat	22.9 %	16.1 %
Sugar beet	12.2 %	11.1 %
Other	15.8 %	13.5 %
N/A	0 %	29.6 %
Hydrotreated vegetable oil	**Feedstock**	**Pathway**
Palm oil	34.8 %	32.1 %
Palm fatty acid distillate (PFAD)	27.3 %	26.8 %
Waste vegetable or animal oils	18.8 %	21.2 %
Other	19.1 %	18.7 %
N/A	0 %	1.2 %

Feedstocks

- The main types of feedstock used to produce **biodiesel** are rapeseed (41.3 %), used cooking oil (20.5 %) and palm oil (12.7 %). These three feedstocks account for about 74.5 % of the total biodiesel quantities supplied to the 28 Member States.
- **Bioethanol** is mainly produced from maize (49.1 %), wheat (22.9 %) and sugar beet (12.2 %). These three feedstocks account for about 84.2 % of the total bioethanol quantities supplied to the 28 Member States.
- For **HVO** production, palm oil accounts for 34.8 %, palm fatty acid distillate (PFAD) for 27.3 % and waste vegetable or animal oils for 18.8 %. These three feedstocks account for about 80.9 % of the total HVO quantities supplied to the 28 Member States.

Production pathways

- **Biodiesel** is derived mainly from four production pathways: rapeseed biodiesel (36.3 %), waste vegetable oil or animal fat biodiesel (18.9 %), palm oil biodiesel (9.3 %) and soybean biodiesel (9.1 %). These four production pathways account for about 73.5 % of the total biodiesel quantities supplied to the 28 Member States. There is also a substantial share of 17 % for which the production pathway of biodiesel has not been defined by the reporting Member States. This incomplete reporting also explains the lower shares of the different production pathways compared to the respective values for the feedstocks indicated above.
- For the production of **bioethanol**, corn ethanol (29.7 %, of which 7.5 % is with natural gas as process fuel in combined heat and power plants) is the most common pathway, followed by wheat (16.1 % of which 2.5 % is with natural gas as process fuel in combined heat and power plants (CHP), and sugar

beet (11.1 %). These three pathways account for the production of about 56.9 % of the total bioethanol quantities supplied to the 28 Member States. There is also a substantial share of 29.6 % for which the production pathway of bioethanol has not been defined by the reporting Member States. Similar to biodiesel, this share explains the differences between feedstocks used and production pathways.
- **HVO** originates mainly from palm oil (32.1 %), PFAD (26.8 %) and waste vegetable oil or animal fat biodiesel (21.2 %). For HVO there is a very good agreement of these values with the respective feedstock shares, due to the very low share (1.2 %) of unknown pathways.

4.3 Electricity consumption

The reporting of the quantity of electricity consumed by electric vehicles and motorcycles by fuel suppliers is voluntary although it is considered for the 6 % reduction target by 2020. Only ten Member States reported the electricity consumed by electric vehicles and motorcycles while one of them, Slovenia, did not report the GHG intensities of the electricity consumed and the information on the GHG intensities of Bulgaria was inconsistent and not included. In Table 4.3 the energy quantities consumed by electric vehicles, excluding and including powertrain efficiency, are summarized for the ten Member States.

Actual electricity consumption in the different Member states may be larger. GHG intensities reported by Member States under Article 7a are compared with data provided by the Joint Research Centre (JRC) of the European Commission ([8]) on the average carbon intensity of the electricity consumed at low voltage in the EU in 2015 and are presented in the same table.

Table 4.3 Electricity consumed by electric vehicles and motorcycles in 2018 as a reported contribution by fuel suppliers to their GHG reduction target

Member State	Quantity of energy		GHG intensity		
	excluding powertrain efficiency (GJ)	including powertrain efficiency (GJ)	reported by Member State (g CO_2e/MJ)	reported by Member State (g CO_2e/kWh)	JRC data (g CO_2e/kWh)
Bulgaria	189 652	75 861	-	-	637
France	1 122 448	448 979	20.4	73	80
Germany	774 000	309 600	153	551	541
Italy	1 444 681	577 872	110.3	397	426
Netherlands	236 081	94 432	165	594	594
Portugal	19 224	7 690	74.7	269	483
Slovakia	1 407	563	46.4	167	421
Slovenia	318	127	-	-	361
Sweden	52	21	169.2	609	24
United Kingdom	867 996	347 198	85.3	307	487

Note: Member States data are for 2018 whereas JRC data refer to 2015.

The above data on GHG intensity are not directly comparable as individual Member States may have used a calculation methodology different from that used by the JRC. For example, electricity consumed versus electricity generated and/or applied corrections for the effect of cross-border electricity trade may have an impact on the calculated intensities. In addition, JRC data refer to the year 2015 whereas Member States data are for 2018.

([8]) Improved calculation of carbon intensity of electricity consumed in the EU Member States in 2015 including upstream emissions and trade, Ispra, 7 February 2018.

5 Progress to 2020 targets under the Fuel Quality Directive

5.1 Average GHG emissions intensity of transport fuels in 2018

The Fuel Quality Directive (FQD) requires a reduction in the GHG intensity of transport fuels by a minimum of 6 % by 2020 compared with 2010 levels via the suppliers' monitoring mechanism ([9]) and by an additional optional 4 % via reduction technologies and the Clean Development Mechanism of the Kyoto Protocol. The baseline for this reduction is the average GHG intensity of the EU's fuel mix in 2010, which was 94.1 g CO_2/MJ ([10]). The fuel baseline standard is calculated based on EU average fossil fuel consumption of petrol, diesel, (non-road) gasoil, LPG and CNG.

For each Member State Table 5.1 shows the GHG emissions from the consumption of all fuels (fossil fuels and biofuels) and electricity used in road transport. The average GHG intensity has been calculated for each Member State as well as the relative reduction over the 2010 default baseline value is also shown in the same table.

The average GHG intensity of the fuels supplied in the 28 EU Member States (excluding the ILUC for biofuels) was 90.6 g carbon dioxide equivalent (CO_2e) in 2018. Thus, a reduction of 3.7 % was achieved in 2018 compared to 2010. This corresponds to a saving of 51 Mt CO_2e compared to the 2010 level in the year 2018. It also corresponds to an additional reduction of 0.3 percentage points, compared to 2017 (3.4 % reduction compared to 2010, albeit for only 22 EU-MS). In order to reach the obligatory 6 % target, an additional reduction of 2.3 percentage points in the GHG intensity of all fossil fuels and biofuels supplied will be needed over 2019 and 2020, on average in the EU ([11]). Consequently, extra efforts from fuel suppliers are necessary to meet the 6 % target by 2020. In 2018 no upstream emission reductions were reported (see details in the chapter 5.2).

The average GHG intensity and hence also the relative distance to target depends on the share and type of fossil fuels and biofuels in the total fuel mix. Diesel and gas oil have the highest GHG intensity (95.1 g CO_2e/MJ) of all fuels whereas substitution with HVO (15.6 g CO_2e/MJ, excluding ILUC) and biodiesel (26.4 g CO_2e/MJ, excluding ILUC) reduces significantly the GHG intensity.

The distance to target varies from 5.9 % (for Croatia) to 1.4 % (for Poland) across Member States. The two Member States with the lowest achievements in reducing their GHG intensities over the 2010 – 2018 period (lower than 1 %) are Croatia (0.1 %) and Estonia (0.9 %). The main reasons for these low performances are low biofuels share (0.2 % in Croatia and 2.0 % in Estonia) and the high GHG intensity of biofuels in Estonia (35.1 g CO_2eq/MJ).

On the other hand, Finland and Sweden have achieved the highest reductions in the average GHG intensity of their fuels with 6.4 % and 19.2 % respectively (excluding ILUC). These two are the only Member States having exceeded the target. Finland has a biofuel share of 8 % (of which 63 % is HVO and 20 % is bioethanol) while diesel, petrol and gas oil represent 49 %, 28 % and 15 % of the mix respectively. Sweden has the highest biofuel share among all Member States amounting to 23 % (of which 66 % is HVO and 19 % is biodiesel).

([9]) For the purposes of Article 7a of the FQD, Member States shall ensure that suppliers use the calculation method set out in Annex I of Directive 2015/652 to determine the GHG intensity of the fuels they supply.
([10]) Baseline value for 2010, according to Annex II of the Council Directive (EU) 2015/652.
([11]) Determined across the 28 Member States that reported data.

Table 5.1 Average GHG emissions intensity reported by fuel suppliers by Member State in 2018 and reductions compared with 2010

Member State	Fossil fuels		Biofuels		Electricity		Average fuel GHG intensity (g CO_2e/MJ) (excl. ILUC)	2010-2018 GHG intensity reduction (excl. ILUC) (%)	Average fuel GHG intensity (g CO_2e/MJ) (incl. ILUC)	2010-2018 GHG intensity reduction (incl. ILUC) (%)
	Energy consumption (TJ)	GHG emissions (kt)	Energy consumption (TJ)	GHG emissions (kt)	Energy consumption (TJ)	GHG emissions (kt)				
Austria	324 245	30 712	21 977	779	-	-	91.0	3.3	94.0	0.1
Belgium	384 072	36 332	20 902	668	-	-	91.4	2.9	93.6	0.5
Bulgaria	118 619	10 996	5 070	234	-	-	91.6	2.6	93.5	0.6
Croatia	94 923	8 941	193	4	-	-	94.0	0.1	94.1	0.0
Cyprus	28 326	2 667	378	5	-	-	93.1	1.1	93.1	1.1
Czechia	250 266	23 517	13 196	357	-	-	90.6	3.7	92.8	1.3
Denmark	184 645	17 458	9 210	319	-	-	91.7	2.5	93.6	0.5
Estonia	35 113	3 318	731	26	-	-	93.3	0.9	94.2	-0.1
Finland	181 809	17 186	15 711	217	-	-	88.1	6.4	88.3	6.2
France	1 773 826	168 000	131 788	4 218	1 122	23	90.3	4.0	93.5	0.6
Germany	2 391 479	225 724	120 069	1 840	774	118	90.6	3.7	91.8	2.5
Greece	208 202	19 425	6 868	212	-	-	91.3	3.0	92.6	1.6
Hungary	213 235	20 087	7 973	158	-	-	91.5	2.7	92.1	2.1
Ireland	157 125	14 882	6 497	94	-	-	91.5	2.7	91.6	2.7
Italy	1 506 744	140 818	53 333	882	1 445	159	90.8	3.5	91.1	3.2
Latvia	53 030	4 980	1 173	45	-	-	92.7	1.5	93.7	0.4
Lithuania	75 094	7 083	3 034	121	-	-	92.2	2.0	94.2	-0.1
Luxembourg	85 440	8 100	5 072	161	-	-	91.3	3.0	93.9	0.2
Malta	9 019	851	394	9	-	-	91.3	2.9	91.4	2.9
Netherlands	450 429	42 337	23 504	426	236	39	90.3	4.1	90.4	3.9
Poland	980 892	90 761	50 588	1 874	-	-	89.8	4.6	92.2	2.0
Portugal	234 330	22 169	10 926	233	19	1.44	91.3	2.9	92.3	1.9
Romania	230 419	21 815	9 104	294	-	-	92.4	1.9	94.0	0.1
Slovakia	104 116	9 816	6 430	206	1.41	0.07	90.7	3.7	93.5	0.7
Slovenia	58 543	5 536	2 120	65	-	-	92.3	1.9	93.9	0.2
Spain	1 147 139	108 562	73 677	2 518	-	-	91.0	3.3	93.8	0.3
Sweden	251 614	23 756	75 125	1 088	0.05	0.01	76.0	19.2	78.8	16.3
United Kingdom	1 763 464	166 677	56 319	961	868	74	92.1	2.1	92.2	2.0
EU (28 Member States)	**13 296 158**	**1 252 507**	**731 363**	**18 014**	**4 466**	**415**	**90.6**	**3.7**	**92.1**	**2.1**

5.2 Upstream emission reductions

Upstream emissions refer to the GHG emissions produced during the extraction, processing, handling and transport of fuels from their original state to the refinery or processing plant where the fuel was produced. Upstream emission reductions (UER) are the reductions that can occur prior to the crude oil entering the refinery, including reductions in flaring and venting emissions. The UER claimed by a supplier have to be quantified and reported in accordance with the requirements set out in Council Directive (EU) 2015/652. There are several options for suppliers to reduce the GHG intensity of fuels and energy towards the 2020 reduction target. However, there is no obligation to use UER as a compliance option.

None of the 28 Member States that have submitted data under Article 7a has claimed any UER, hence the total reported UER (in g CO_2e) was zero in 2018.

6 Effects of indirect land use change on GHG intensities

6.1 Greenhouse gas emission intensities of crop types

According to Article 7a paragraph 7 of the FQD, fuel suppliers have to report the life cycle greenhouse gas emissions per unit of energy, including the provisional mean ([12]) values of the estimated ILUC emissions from biofuels to the Member States. ILUC emissions may significantly reduce the GHG benefits from the use of the different biofuels. Depending on the land types converted to cropland because of biofuels production, these GHG savings may be completely cancelled out. Hence, in an encompassing life cycle analysis, the ILUC-related GHG emissions intensity should be added to the GHG intensity directly attributed to the production and transport of biofuels. For the reporting of ILUC emissions, the mean values included in Annex V of the FQD are used. ILUC emissions are not taken into account for assessing compliance with the obligatory 6 % reduction target.

Table 6.1 provides an overview of the energy supplied by the different crops from which biofuels are produced. The default GHG intensities for each crop type are also included.
ILUC emissions related to biofuel consumed were close to 22 Mt CO2e in 2018, an amount equivalent to the annual total emissions (excluding ILUC) of Romania. Oil crops were responsible for 93% of these ILUC emissions.

Table 6.1 ILUC summary table

Feedstock category	Cereals and other starch-rich crops	Sugars	Oil crops	Other
Quantity of energy supplied (TJ)	99 631	16 697	366 632	244 007
Default ILUC intensity provisional mean ([13]) values of the estimated ILUC emissions (g CO_2e/MJ)	12	13	55	0
Total ILUC GHG emissions (kt CO_2e)	**1 196**	**217**	**20 165**	

Based on the provisional mean values of the estimated indirect land-use change emissions in the FQD (see Annex VIII, Directive 2018/2001), an average value of 1.5 g CO_2e/MJ has been calculated for the additional GHG intensity of ILUC based on the total energy consumption of all fossil fuels and biofuels. Adding this value to the average GHG intensity of 90.6 g CO_2e/MJ (without ILUC) of the fuels consumed in the 28 EU Member States as calculated above (Table 6.1), this results in a total value of 92.1 g CO_2e/MJ (with ILUC). If ILUC was included in the calculation of the GHG intensity, the relevant reduction from the baseline (in the year 2010) would be 2.1 % as opposed to the 3.7 % reduction when excluding ILUC, see Table 5.1. The GHG intensity including ILUC even increased in 2018 in comparison to 2017 (91.9 g CO_2e/MJ in 2017) due to the higher use of oil crops that have the highest GHG intensity.

The GHG intensity reduction including ILUC is below 1 % for half of the Member States. Estonia and Lithuania even increased their GHG intensity including ILUC (negative reduction of -0.06 % for both) between 2010 and 2018. This is due to the extensive use of oil crops (72 % in Estonia and 89 % in Lithuania) as the main feedstock to produce biofuels, and in particular biodiesel, as the GHG intensity of oil crops is only marginally better than fossil fuel diesel when ILUC is included (88.9 vs 95.1 g CO2e/MJ).

([12]) For the purposes of Article 7a of the FQD, Member States shall ensure that suppliers use the calculation method set out in Annex I of Directive 2015/652 to determine the GHG intensity of the fuels they supply.
([13]) The mean values included here represent a weighted average of the individually modelled feedstock values (Annex VIII, Directive 2018/2001).

6.2 Greenhouse gas emission savings by substituting fossil fuels with biofuels

In order to estimate the decarbonisation potential of biofuels, i.e. the GHG savings from the substitution of their fossil fuel counterparts, data on the actual biofuel use and the respective GHG intensities, as reported by the different EU Member States, are used.

To this aim, GHG emissions from the use of biofuels differentiated for the biofuel feedstock have been calculated with and without ILUC, by using the reported GHG intensities. These emissions are then compared with the calculated GHG emissions from the use of equal quantities — in terms of energy content — of conventional fuels.

The most relevant biofuels for this analysis are biodiesel, bioethanol and HVO, which account for 97 % of the total biofuel energy consumption in the 28 EU Member States. The relevant data for this comparison is summarised in Table 6.2. The average GHG intensity and corresponding GHG emissions with and without ILUC are presented for the different feedstocks for each of the selected biofuels.

Table 6.2 GHG emissions from the use of biofuels and different feedstocks

	Energy quantity (TJ)		Average GHG intensity ($g\ CO_2e/MJ$)				GHG emissions ($kt\ CO_2e$)			
			Excluding ILUC emissions		Including ILUC emissions		Excluding ILUC emissions		Including ILUC emissions	
Year	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
Biodiesel	**267 270**	**504 122**	**26.51**	**26.44**	**56.56**	**62.64**	**7 086**	**13 328**	**15 118**	**31 577**
Cereals and other starch-rich crops	88	1	21.02	15.33	33.02	27.33	2	0	3	0
Sugars	-	-	-	-	-	-	-	-	-	-
Oil crops	146 025	331 808	35.58	33.92	90.58	88.92	5 196	11 256	13 227	29 506
Other	118 678	167 404	13.98	11.61	13.98	11.61	1 659	1 943	1 660	1 943
HVO	**71 004**	**92 899**	**16.75**	**15.60**	**25.52**	**34.05**	**1 189**	**1 449**	**1 812**	**3 164**
Cereals and other starch-rich crops	322	1 898	13.62	10.94	25.62	22.94	4	21	8	44
Sugars	-	-	-	-	-	-	-	-	-	-
Oil crops	11 248	30 761	34.23	30.24	89.23	85.24	385	930	1 004	2 622
Other	40 067	60 240	13.27	8.27	13.27	8.27	532	498	532	498
Bioethanol	**75 179**	**110 523**	**30.83**	**24.27**	**41.48**	**35.83**	**2 318**	**2 682**	**3 118**	**3 960**
Cereals and other starch-rich crops	56 377	89 742	30.71	23.63	42.71	35.63	1 732	2 120	2 408	3 197
Sugars	8 473	15 439	28.67	31.91	41.67	44.91	243	493	352	693
Oil crops	13	1	25.57	34.18	80.57	89.18	0	0	1	0
Other	2 179	5 296	16.21	12.74	16.21	12.74	35	67	35	67

Note: ILUC emissions correspond to provisional mean values of the estimated ILUC emissions

The above table shows that the biofuel feedstock is important when assessing the GHG reduction potential of biofuels, especially when including the ILUC effect.
For biodiesel, a substantial part (above 65 %) is produced from oil crops, which have a high GHG intensity compared to other feedstocks. When considering ILUC, this biodiesel is only marginally better than fossil fuel diesel (88.9 vs 95.1 g $CO2e$/MJ).

In the case of HVO, the majority is produced from other feedstocks (such as waste oils and fats, above 60 %) with a low GHG intensity (with and without ILUC), whereas the quantities produced from oil crops, which have a much higher GHG intensity, are much lower (around 35 %).

Bioethanol is mainly produced from cereals and other starch-rich crops (above 80 %) and sugars (around 14 %) which have a moderate GHG reduction potential compared to other feedstocks. When including ILUC the average GHG intensity of bioethanol increases, however it remains much lower than fossil petrol (35.6 vs 93.3 g CO_2e/MJ).

Table 6.3 shows the calculated GHG emissions saved by replacing fossil fuels with corresponding biofuels. Substitution of diesel by biodiesel and HVO results in GHG emission reductions in the order of 75 % when ILUC is excluded, whereas these reductions are in the order of 40 % when including ILUC. The respective reductions for petrol and bioethanol are somewhat lower but in the same order of magnitude. The percentage reductions are higher for natural gas, but the overall effect is rather small due to the small quantities of CNG supplied.

Table 6.3 GHG emissions savings from the use of biofuels

Fossil fuel	Substituting biofuel	Excluding /including provisional mean values of the estimated ILUC emissions	GHG emissions from fossil fuels (kt CO_2e)	Emissions savings (kt CO_2e)	GHG emission reduction from substitution (%)
Diesel	Biodiesel + HVO	Excluding	56 777	42 000	74.0
		Including	56 777	22 036	38.8
Petrol	Bioethanol + ETBE	Excluding	11 154	8 206	73.6
		Including	11 154	6 819	61.1
CNG	Biogas	Excluding	587	476	81.1
		Including	587	452	76.9

7 Consistency between fuel volumes reported under Article 7a and Article 8

To ensure consistency, the reported fuel volumes under Article 7a are compared with those reported under Article 8 of the Fuel Quality Directive (FQD). The comparison is carried out for petrol and diesel only, as no other fuels are reported under Article 8.

The total volumes of petrol and diesel reported under Article 8 already contain biofuels, i.e. mainly bioethanol in petrol and biodiesel (and HVO) in diesel. To enable the comparison, all volumes of bioethanol, bio-ETBE and other petrol substitutes were added to the petrol volumes as reported by Member States under Article 7a. Similarly, all volumes of biodiesel, HVO and other diesel substitutes were added to the diesel volumes. Table 7.1 shows the results of the comparison for the 28 Member States that have reported under both Articles 7a and 8.

Table 7.1 Total quantities of fossil fuels and biofuels (million litres)

Member State	Petrol		Diesel		Difference (%)	
	Article 7a	Article 8	Article 7a	Article 8	Petrol	Diesel
Austria	2 209	2 213	7 742	8 331	-0.2%	-7.1%
Belgium	2 599	2 311	8 517	8 039	12.5%	5.9%
Bulgaria	707	687	2 295	2 605	2.9%	-11.9%
Croatia	668	667	1 990	2 027	0.1%	-1.8%
Cyprus	461	460	387	387	0.2%	0.0%
Czechia	1 930	2 135	5 451	5 917	-9.6%	-7.9%
Denmark	1 790	1 789	3 294	3 315	0.0%	-0.6%
Estonia	268	257	754	805	4.1%	-6.3%
Finland	1 874	1 907	3 131	3 124	-1.7%	0.2%
France	10 100	10 749	44 317	40 036	-6.0%	10.7%
Germany	25 508	24 043	47 308	44 647	6.1%	6.0%
Greece	3 066	3 067	3 005	3 143	0.0%	-4.4%
Hungary	1 909	1 960	3 265	4 354	-2.6%	-25.0%
Ireland	1 095	1 418	3 605	3 649	-22.8%	-1.2%
Italy	9 848	8 101	5 805	31 495	21.6%	-81.6%
Latvia	238	240	1 236	1 211	-0.7%	2.1%
Lithuania	313	314	1 853	2 038	-0.3%	-9.1%
Luxembourg	451	424	2 134	1 892	6.3%	12.8%
Malta	107	106	166	170	0.7%	-2.2%
Netherlands	5 841	5 648	7 858	7 948	3.4%	-1.1%
Poland	6 106	5 970	20 569	20 568	2.3%	0.0%
Portugal	1 358	1 376	5 552	5 351	-1.3%	3.8%
Romania	1 599	949	5 289	2 641	68.5%	100.3%
Slovakia	739	740	2 386	2 388	-0.1%	-0.1%
Slovenia	387	689	1 338	2 018	-43.9%	-33.7%
Spain	6 443	6 765	25 446	27 779	-4.8%	-8.4%
Sweden	3 084	3 009	6 349	5 757	2.5%	10.3%
United Kingdom	16 695	15 865	30 625	29 384	5.2%	4.2%
EU (28 Member States)	107 392	103 859	251 667	271 019	3.4%	-7.1%

For many Member States, the differences for both petrol and diesel are very small, within ± 5 %. However, there are also many Member States for which larger differences are observed, where total volumes reported under Article 7a are lower or higher than those reported under Article 8. The main reasons include fuel quantities purchased and sold in different years, or incomplete reporting by Member States. It is not possible to distinguish to what extent the differences can be attributed to each of these reasons. In some cases, there are indications of incomplete reporting as in the case of Italy where the diesel quantities reported under Article 7a are much lower than those reported under Article 8 and also much lower compared to other Member States of similar size. Another case of incomplete reporting is Romania which has only reported summer grade petrol under Article 8 and hence the much higher quantities reported under Article 7a.

Abbreviations, symbols and units

CHP	Combined heat and power
CO_2	Carbon dioxide
CO2e	Carbon dioxide equivalent
EEA	European Environment Agency
Eionet	European Environment Information and Observation Network
ETBE	Ethyl tert-butyl ether
ETC/ACM	European Topic Centre for Air Pollution and Climate Change Mitigation
EU	European Union
FAME	Fatty acid methyl esters
FQD	Fuel Quality Directive
GHG	Greenhouse gas
GJ	Gigajoule
HVO	Hydrotreated vegetable oil
ILUC	Indirect land use change
JRC	Joint Research Centre
LPG	Liquid petroleum gas
MJ	Megajoule
MTBE	Methyl tert-butyl ether
PJ	Petajoule
PFAD	Palm fatty acid distillate (PFAD)
QA/QC	Quality assurance/quality control
TAEE	Tert-amyl ethyl ether
TJ	Terajoule
UER	Upstream emission reductions

Annex

Table A1.1 Greenhouse gas (GHG) intensity per fossil fuel type

Fuel or energy type	GHG intensity ($g\ CO_2e/MJ$)
Liquified petroleum gas	73.6
Compressed natural gas	69.3
Diesel	95.1
Petrol	93.3
Gas oil	95.1
Liquified natural gas	74.5
Other	N/A

Table A1.2 Average reported greenhouse gas (GHG) intensity per biofuel type (excluding ILUC)

Fuel or energy type	GHG intensity ($g\ CO_2e/MJ$)
Biodiesel	26.44
Bio-ETBE	25.78
Bioethanol	24.27
Biofuel oil	8.73
Biogas	15.60
Biomethanol	37.58
Bio-petrol	9.67
Bio-TAEE	19.78
Fischer-Tropsch diesel	8.30
Hydrotreated vegetable oil (HVO)	15.60
Other (Bioethanol diesel)	9.30
Other (bio-naphtha)	20.43
Other (bio-LPG)	23.47
Other (Diesel (origin Bio))	8.10
Other (Liquid Biogas)	10.05
Other (Methanol (non bio, renewable))	13.00
Other (Naphta)	20.65
Pure vegetable oil	32.01

Table A1.3 Feedstocks used for biofuels

- Acid oil from used cooking oil
- Animal fats classified as categories 1 and 2
- Animal manure and sewage sludge
- Barley
- Biomass fraction of industrial waste
- Biomass fraction of mixed municipal waste
- Biomass fraction of wastes and residues from forestry and forest-based industries
- Bio-waste
- Brown grease
- Cobs cleaned of kernels of corn
- Corn (maize)
- Crude glycerine
- Farmed wood
- Grape marcs and wine lees
- Husks
- N/A
- Other
- Other (Acetic acid)
- Other (Alcohol from ethanol production)
- Other (Alcohol)
- Other (Crude tall oil)
- Other (Fatty Acids)
- Other (Fish oil)
- Other (Food industry waste and process residues)
- Other (Forage)
- Other (Garden waste)
- Other (Geothermal energy)
- Other (Glycerol waters)
- Other (Landfill gas)
- Other (Manure and waste)
- Other (Oil emulsion)
- Other (Palm seeds)
- Other (PFAD)
- Other (Poultry feather acid oil)
- Other (Regenerated vegetable oils and fats extracted from bleaching earths)
- Other (Road side grass)
- Other (RUCO)
- Other (Sawdust)
- Other (Sewage sludge, municipal biowaste and industrial biowaste)
- Other (Shea Olein)
- Other (Sugar beet tops, tails, chips & process waters)
- Other (Technical corn oil)
- Other (TER)
- Other (Triticale)
- Other (Vegetable lubricating oils from fatty acids)
- Other (Wetland grass)
- Other (Whey Permeate)
- Other cereals
- Other oil crops
- Other sugar crops
- Palm oil
- Palm oil mill effluent
- Palm oil mill effluent and empty palm fruit bunches
- Rapeseed
- Soapstock acid oil contaminated with sulphur
- Soybeans
- Spent bleached earth
- Starch slurry
- Straw
- Sugar beet
- Sugar cane
- Sunflower seed
- Tall oil pitch
- Tallow - category 3 or unknown
- Used cooking oil
- Waste pressings from production of vegetable oils
- Waste vegetable or animal oils
- Waste wood
- Wheat

Table A1.4 Biofuel production pathways

- Biogas from dry manure as compressed natural gas
- Biogas from municipal organic waste as compressed natural gas
- Biogas from wet manure as compressed natural gas
- Farmed wood ethanol
- Farmed wood methanol
- Hydrotreated vegetable oil from palm oil
- Hydrotreated vegetable oil from palm oil (process not specified)
- Hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)
- Hydrotreated vegetable oil from rape seed
- Hydrotreated vegetable oil from sunflower
- Hydrotreated vegetable oil from Used cooking oil
- N/A
- Other
- Other (Animal fat)
- Other (Biodiesel from Biomass fraction of industrial waste)
- Other (Biodiesel from Brown grease)
- Other (Biodiesel from Crude glycerine)
- Other (Biodiesel from Empty palm fruit bunches)
- Other (Biodiesel from Esterification of Palm oil mill effluent and empty palm fruit bunches)
- Other (Biodiesel from Fatty Acids)
- Other (Biodiesel from Food waste)
- Other (Biodiesel from Industrial waste)
- Other (Biodiesel from oil crops)
- Other (Biodiesel from olive oil)
- Other (Biodiesel from Palm seed)
- Other (Biodiesel from PFAD)
- Other (Biodiesel from pomace (process not specified))
- Other (Biodiesel from Poultry feather acid oil)
- Other (Biodiesel from Rape oil)
- Other (Biodiesel from Sewage system FOG)
- Other (Biodiesel from sludge (entirely of veg. Origin))
- Other (Biodiesel from Soapstock acid oil contaminated with sulphur)
- Other (Biodiesel from Soy seed)
- Other (Biodiesel from spent bleached earth)
- Other (Biodiesel from Tall oil pitch)
- Other (Biodiesel from TER)
- Other (Biodiesel from used cooking oil (entirely of veg. Origin))
- Other (Biodiesel from used cooking oil)
- Other (Biodiesel from Wheat oil)
- Other (Bio-ETBE from barley)
- Other (Bio-ETBE from corn)
- Other (Bio-ETBE from other cereals)
- Other (Bio-ETBE from sugar beet)
- Other (Bio-ETBE from sugar cane)
- Other (Bio-ETBE from triticale)
- Other (Bio-ETBE from Wheat oil)
- Other (Bio-ETBE from wheat)
- Other (Bioethanol diesel renewable component)
- Other (Bioethanol from Barley)
- Other (Bioethanol from burned bagasse)
- Other (Bioethanol from cereals)
- Other (Bioethanol from Corn, EC)
- Other (Bioethanol from Corn, non-EC)
- Other (Bioethanol from Food waste)
- Other (Bioethanol from Starch slurry (low grade))
- Other (Bioethanol from Starch slurry (regular))
- Other (Bioethanol from Starch slurry (waste))
- Other (Biofuel oil from oil from waste vegetable oil or animal fat)
- Other (Biofuel oil from PFAD)
- Other (Biofuel oil from POME)
- Other (Biofuel oil from technical corn oil)
- Other (Biogas from acetic acid)
- Other (Biogas from biomass fraction of mixed municipal waste)
- Other (Biogas from biowaste)
- Other (Biogas from corn)
- Other (Biogas from ethanol)
- Other (Biogas from forage)
- Other (Biogas from green waste as compressed biomethane)
- Other (Biogas from manure and agricultural waste)
- Other (Biogas from methanisation)
- Other (Biogas from oil emulsion)
- Other (Biogas from pellet fuel)
- Other (Biogas from sewage sludge, municipal biowaste and industrial biowaste)
- Other (Biogas from solid waste from the food industry)
- Other (Biogas from sugar beets)
- Other (Biogas from waste from ethanol production)
- Other (Biogas from waste vegetable oils or animal fats)
- Other (Biogas from wet manure as compressed biomethane)
- Other (Biogas from wheat)
- Other (Bio-LPG from Hydrogenation of Fatty Acids)
- Other (Bio-LPG from Hydrogenation of Shea Olein)
- Other (Bio-LPG from Hydrogenation of Used Cooking Oil)
- Other (Bio-LPG from Hydrogenation of vegetable oils)
- Other (Biomass ethanol (process fuel not specified))
- Other (Biomethane from Husks)
- Other (Biomethane from Road Side Grass)
- Other (Biomethane from Sugar beet tops, tails, chips & process water)
- Other (Biomethanol from Crude glycerin)
- Other (Biomethanol from Dry manure)
- Other (Biomethanol from Food waste)
- Other (Biomethanol from Municipal organic waste)
- Other (Biomethanol from Road, Side Grass)
- Other (Biomethanol from Sewage sludge)
- Other (Biomethanol from Straw)
- Other (Biomethanol from Sugar beet tops, tails, chips & process water)
- Other (Biomethanol from Tallow - category 1)
- Other (Biomethanol from Waste pressings from production of vegetable oils)
- Other (Biomethanol from Wet manure)
- Other (Bio-Naphtha from forestry and forest-based industries)
- Other (Bio-Naphtha from Used Cooking Oil)
- Other (Biopetrol from palm oil)
- Other (Biopetrol from PFAD)
- Other (Biopetrol from Used Cooking Oil)

- Other (Biopetrol from Waste vegetable oil or animal fat)
- Other (Biopropane from Palm fatty acid distillate)
- Other (Biopropane from Palm)
- Other (Biopropane from Used Cooking Oil)
- Other (Corn biodiesel)
- Other (Corn bioethanol (destillation))
- Other (Corn ethanol (biomass as process fuel in biomass plant))
- Other (Corn ethanol (natural gas as process fuel in CHP plant))
- Other (Corn ethanol (natural gas as process fuel in conventional plant))
- Other (Corn ethanol (process fuel not specified))
- Other (Cottonseed biodiesel)
- Other (Crude tall oil biodiesel)
- Other (Diesel (origin Bio) from Used cooking oil)
- Other (Draff/Brewers' spent grain)
- Other (ETBE renewable component)
- Other (ETBE, bio part corn ethanol, produced in the community (natural gaz as process fuel in CHP plant))
- Other (ETBE, bio part wheat ethanol (process fuel not specified))
- Other (Ethanol from barley)
- Other (Ethanol from biomass fraction of industrial waste)
- Other (Ethanol from liquid waste in the food industry)
- Other (Ethanol from other cereals)
- Other (Ethanol from rapeseed)
- Other (Ethanol from rye)
- Other (Ethanol from Sawdust)
- Other (Ethanol from solid waste in the food industry)
- Other (Ethanol from the food industry waste and process residues)
- Other (Ethanol from the pulp industry process residues)
- Other (Ethanol from triticale)
- Other (Ethanol)
- Other (Hydrotreated vegetable oil from Fatty Acids)
- Other (Hydrotreated Vegetable Oil from grape marcs and wine lees)
- Other (Hydrotreated vegetable oil from Palm oil mill effluent)
- Other (Hydrotreated vegetable oil from PFAD)
- Other (Hydrotreated vegetable oil from residues from forestry and forest, based industries)
- Other (Hydrotreated vegetable oil from residues from palm oil mill effluent and empty palm fruit bunches)
- Other (Hydrotreated Vegetable Oil from Shea butter (process not specified))
- Other (Hydrotreated vegetable oil from Shea Olein)
- Other (Hydrotreated vegetable oil from tall oil)
- Other (Hydrotreated Vegetable Oil from Technical Corn Oil (process not specified))
- Other (Hydrotreated vegetable oil from Used Cooking Oil)
- Other (Hydrotreated vegetable oil from waste vegetable oil or animal fat)
- Other (Liquid waste from the food industry)
- Other (MTBE renewable component)
- Other (Methanol (non-bio, renewable) from Geothermal energy)
- Other (Molasses ethanol)
- Other (Naphta from PFAD)
- Other (Naphta from sugar beet)
- Other (Rapeseed biodiesel from transesterification)
- Other (Starch Slurry Ethanol)
- Other (Sugar beet (natural gas as process fuel in CHP plant))
- Other (TAEE renewable component)
- Other (TAEE, triticale ethanol (rejected heat as process fuel))
- Other (Tall oil biopetrol)
- Other (Waste animal fats from slaughterhouses)
- Other (Waste classified wetland grass)
- Other (Waste from animal feed production)
- Other (Waste from biodiesel production)
- Other (Waste from ethanol and liquor production from agricultural products)
- Other (Waste from the cereal industry)
- Other (Waste residue, Vegetable origin)
- Other (Waste vegetable oil from ethanol production)
- Other (Waste vegetable oil from the pulp and paper industry)
- Other (Wheat ethanol (bran as process fuel in CHP plant))
- Palm oil biodiesel
- Palm oil biodiesel (process not specified)
- Palm oil biodiesel (process with methane capture at oil mill)
- Rapeseed biodiesel
- Rye ethanol
- Soybean biodiesel
- Sugar beet ethanol
- Sugar cane ethanol
- Sunflower biodiesel
- Waste vegetable oil or animal fat biodiesel
- Waste wood ethanol
- Waste wood methanol
- Wheat bio-ETBE (lignite as process fuel in CHP plant)
- Wheat ethanol (lignite as process fuel in CHP plant)
- Wheat ethanol (natural gas as process fuel in CHP plant)
- Wheat ethanol (natural gas as process fuel in conventional boiler)
- Wheat ethanol (process fuel not specified)
- Wheat straw ethanol

European Topic Centre on Climate change
mitigation and energy
Boeretang 200
B-2400 Mol, Belgium
Tel.: +32 14 33 59 77
Web: www.eionet.europa.eu/etcs/etc-cme
Email: etccme@vito.be

The European Topic Centre on Climate change mitigation and energy (ETC/CME) is a consortium of European institutes under contract of the European Environment Agency.

European Environment Agency
European Topic Centre on Climate change
mitigation and energy