L.N. 505 of 2021

REGULATOR FOR ENERGY AND WATER SERVICES ACT (CAP. 545)

Biofuels, Bioliquids and Biomass Fuels (Sustainability Criteria) Regulations, 2021

IN EXERCISE of the powers conferred by article 37(1) of the Regulator for Energy and Water Services Act, the Minister for Energy, Enterprise and Sustainable Development, after consultation with the Regulator for Energy and Water Services, has made the following regulations:-

1. (1) The title of these regulations is the Biofuels, Bioliquids and Biomass Fuels (Sustainability Criteria) Regulations, 2021. Citation and scope.

(2) These regulations give effect to Articles 29, 30 and 31 of Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast).

2. (1) Unless otherwise required under these regulations, the definitions prescribed under the Regulator for Energy and Water Services Act, and the Promotion of Energy from Renewable Sources Regulations, 2021 shall apply. Interpretation. Cap. 545. L.N. 503 of 2021.

(2) For the purposes of these regulations and unless the context otherwise requires:

"Act" means the Regulator for Energy and Water Services Act; Cap. 545.

"actual value" means the greenhouse gas emissions saving for some or all of the steps of a specific biofuel, bioliquid or biomass fuel production process, calculated in accordance with the methodology laid down in Part C of the First Schedule or Part B of the Second Schedule;

"agricultural, aquaculture, fisheries and forestry residues" means residues that are directly generated by agriculture, aquaculture, fisheries and forestry and that do not include residues from related industries or processing;

"agricultural biomass" means biomass produced from agriculture;

"biowaste" means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants;

"default value" means a value derived from a typical value by the application of pre-determined factors and that may in circumstances specified in these regulations, be used in place of an actual value;

"Directive" means Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast);

"energy" means all forms of available energy, including electricity, heating, cooling, liquefied petroleum gas, any fuel for heating and cooling, coal and transport fuels;

"energy content" means the lower calorific value of fuel;

"energy consumer" means a natural or legal person who consumes or purchases energy for own use and not for wholesale or retail purposes;

"energy supplier" means an authorised supplier wholesaling or retailing energy or products thereof;

"forest biomass" means biomass produced from forestry;

"forest regeneration" means the re-establishment of a forest stand by natural or artificial means following the removal of the previous stand by felling or as a result of natural causes, including fire or storm;

"Minister" means the minister responsible for energy;

"Regulator" means the Regulator for Energy and Water Services as established by article 3 of the Act;

"sourcing area" means the geographically defined area from which the forest biomass feedstock is sourced, from which reliable and independent information is available and where conditions are sufficiently homogeneous to evaluate the risk of the sustainability and legality characteristics of the forest biomass;

"typical value" means an estimate of the greenhouse gas emissions and greenhouse gas emissions savings saving for a particular biofuel, bioliquid or biomass fuel production pathway which is representative of the Union consumption.

Sustainability and greenhouse gas emissions savings criteria for biofuels, bioliquids and biomass.

3. (1) Energy from biofuels, bioliquids and biomass fuels shall be taken into account for the purposes referred to in paragraphs (a), (b) and (c) of this sub-regulation only if they fulfil the sustainability and the greenhouse gas emissions saving criteria laid down in sub-regulations (6) to (13):

(a) contributing towards the Union target set in Article 3(1) of the Directive and the renewable energy share of Malta as its contribution thereto;

(b) measuring compliance with renewable energy obligations;

(c) eligibility for financial support for the consumption of biofuels, bioliquids and biomass fuels.

(2) Biofuels, bioliquids and biomass fuels which are produced from waste and residues, other than agricultural, aquaculture, fisheries and forestry residues, are required to fulfil only the greenhouse gas emissions saving criteria laid down in sub-regulations (12) and (13) in order to be taken into account for the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1):

Provided that this sub-regulation shall also apply to waste and residues that are first processed into a product before being further processed into biofuels, bioliquids and biomass fuels.

(3) Electricity, heating and cooling produced from municipal solid waste shall not be subject to the greenhouse gas emissions saving criteria laid down in sub-regulations (12) and (13).

(4) Biomass fuels shall fulfil the sustainability and greenhouse gas emissions saving criteria laid down in sub-regulations (6) to (13) if used in installations producing electricity, heating and cooling or fuels with a total rated thermal input equal to or exceeding twenty megawatts (20MW) in the case of solid biomass fuels, and with a total rated thermal input equal to or exceeding two megawatts (2MW) in the case of gaseous biomass fuels:

Provided that the Minister may require that the sustainability and greenhouse gas emissions saving criteria be applicable to installations with lower total rated thermal input.

(5) The sustainability and the greenhouse gas emissions saving criteria laid down in sub-regulations (6) to (13) shall apply irrespective of the geographical origin of the biomass.

(6) Biofuels, bioliquids and biomass fuels produced from

waste and residues derived not from forestry but from agricultural land shall not be taken into account for the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1) unless either the operators or the national authorities of the country in which they are produced have monitoring or management plans in place in order to address the impacts on soil quality and soil carbon, and the information about how those impacts are monitored and managed is being reported pursuant to Article 30(3) of the Directive.

(7) Biofuels, bioliquids and biomass fuels produced from agricultural biomass taken into account for the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1) shall not be made from raw material obtained from land with a high biodiversity value, namely land that had one of the following statuses in or after January 2008, whether or not the land continues to have that status:

(a) primary forest and other wooded land, namely forest and other wooded land of native species, where there is no clearly visible indication of human activity and the ecological processes are not significantly disturbed; or

(b) highly biodiverse forest and other wooded land which is species-rich and not degraded, or has been identified as being highly biodiverse by the relevant competent authority, unless evidence is provided that the production of that raw material did not interfere with those nature protection purposes; or

(c) areas designated:

(i) by law or by the relevant competent authority for nature protection purposes; or

(ii) for the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or included in lists drawn up by intergovernmental organisations or the International Union for the Conservation of Nature, subject to their recognition in accordance with the first sub-paragraph of Article 30(4) of the Directive;

unless evidence is provided that the production of that raw material did not interfere with those nature protection purposes;

or

(d) highly biodiverse grassland spanning more than one hectare that is:

(i) natural, namely grassland that would remain grassland in the absence of human intervention and that maintains the natural species composition and ecological characteristics and processes; or

(ii) non-natural, namely grassland that would cease to be grassland in the absence of human intervention and that is species-rich and not degraded and has been identified as being highly biodiverse by the relevant competent authority, unless evidence is provided that the harvesting of the raw material is necessary to preserve its status as highly biodiverse grassland.

(8) Biofuels, bioliquids and biomass fuels produced from agricultural biomass taken into account for the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1) shall not be made from raw material obtained from land with high-carbon stock, namely land that had one of the following statuses in January 2008 and no longer has that status:

(a) wetlands, namely land that is covered with or saturated by water permanently or for a significant part of the year;or

(b) continuously forested areas, namely land spanning more than one hectare with trees higher than five metres and a canopy cover of more than thirty per cent (30%), or trees able to reach those thresholds *in situ*; or

(c) land spanning more than one hectare with trees higher than five (5) metres and a canopy cover of between ten and thirty per cent (10% - 30%), or trees able to reach those thresholds *in situ*, unless evidence is provided that the carbon stock of the area before and after conversion is such that, when the methodology laid down in Part C of the First Schedule is applied, the conditions laid down in sub-regulations (12) and (13) would be fulfilled:

Provided that this sub-regulation shall not apply if, at the time the raw material was obtained, the land had the same status as it had in January 2008.

(9) Biofuels, bioliquids and biomass fuels produced from agricultural biomass taken into account for the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1) shall not be made from

raw material obtained from land that was peatland in January 2008, unless evidence is provided that the cultivation and harvesting of that raw material does not involve drainage of previously undrained soil.

(10) Biofuels, bioliquids and biomass fuels produced from forest biomass taken into account for the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1) shall meet the following criteria to minimise the risk of using forest biomass derived from unsustainable production:

(a) the country in which forest biomass was harvested has national or sub-national laws applicable in the area of harvest as well as monitoring and enforcement systems in place ensuring:

(i) the legality of harvesting operations;

(ii) forest regeneration of harvested areas;

(iii) that areas designated by international or national law or by the relevant competent authority for nature protection purposes, including in wetlands and peatlands, are protected;

(iv) that harvesting is carried out considering maintenance of soil quality and biodiversity with the aim of minimising negative impacts; and

(v) that harvesting maintains or improves the long-term production capacity of the forest; and

(b) when the evidence referred to in paragraph (a) of this sub-regulation is not available, the biofuels, bioliquids and biomass fuels produced from forest biomass shall be taken into account for the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1) if management systems are in place at forest sourcing area level ensuring:

(i) the legality of harvesting operations;

(ii) forest regeneration of harvested areas;

(iii) that areas designated by international or national law or by the relevant competent authority for nature protection purposes, including in wetlands and peatlands, are protected unless evidence is provided that the harvesting of that raw material does not interfere with those nature protection purposes;

(iv) that harvesting is carried out considering the maintenance of soil quality and biodiversity with the aim of minimising negative impacts; and

(v) that harvesting maintains or improves the long-term production capacity of the forest.

(11) Biofuels, bioliquids and biomass fuels produced from forest biomass taken into account for the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1) shall meet the following land-use, land-use change and forestry (LULUCF) criteria:

(a) the country or regional economic integration organisation of origin of the forest biomass is a Party to the Paris Agreement and

(i) it has submitted a nationally determined contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC), covering emissions and removals from agriculture, forestry and land use which ensures that changes in carbon stock associated with biomass harvest are accounted towards the country's commitment to reduce or limit greenhouse gas emissions as specified in the nationally determined contribution; or

(ii) it has national or sub-national laws in place, in accordance with Article 5 of the Paris Agreement, applicable in the area of harvest, to conserve and enhance carbon stocks and sinks, and providing evidence that reported LULUCF-sector emissions do not exceed removals;

(b) where the evidence referred to in paragraph (a) of this sub-regulation is not available, the biofuels, bioliquids and biomass fuels produced from forest biomass shall be taken into account for the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1) if management systems are in place at forest sourcing area level to ensure that carbon stocks and sinks levels in the forest are maintained, or strengthened over the long term.

(12) The greenhouse gas emission savings from the use of biofuels, bioliquids and biomass fuels taken into account for the purposes referred to in sub-regulation (1) shall be:

(a) at least fifty per cent (50%) for biofuels, biogas consumed in the transport sector, and bioliquids produced in installations in operation on or before 5th October 2015;

(b) at least sixty per cent (60%) for biofuels, biogas consumed in the transport sector, and bioliquids produced in installations starting operation from 6 October 2015 until 31st December 2020;

(c) at least sixty-five per cent (65%) for biofuels, biogas consumed in the transport sector, and bioliquids produced in installations starting operation from 1st January 2021;

(d) at least seventy per cent (70%) for electricity, heating and cooling production from biomass fuels used in installations starting operation from 1st January 2021 until 31st December 2025, and eighty per cent (80%) for installations starting operation from 1st January 2026:

Provided that an installation shall be considered to be in operation once the physical production of biofuels, biogas consumed in the transport sector and bioliquids, and the physical production of heating and cooling and electricity from biomass fuels has started.

(13) The greenhouse gas emission savings from the use of biofuels, biogas consumed in the transport sector, bioliquids and biomass fuels used in installations producing heating, cooling and electricity shall be calculated in accordance with sub-regulation (1) of regulation 5.

(14) Electricity from biomass fuels shall be taken into account for the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1) only if it meets one or more of the following requirements:

(a) it is produced in installations with a total rated thermal input below fifty megawatts (50MW);

(b) for installations with a total rated thermal input from fifty to one hundred megawatts (50 to 100MW), it is produced applying high-efficiency cogeneration technology, or, for electricity-only installations, meeting an energy efficiency level associated with the best available techniques (BAT-AEELs) as defined in Commission Implementing Decision (EU) 2017/1442;

(c) for installations with a total rated thermal input above one hundred megawatts (100MW), it is produced applying high-efficiency cogeneration technology, or, for electricity-only installations, achieving a net-electrical efficiency of at least thirty-six per cent (36%);

(d) it is produced applying Biomass CO_2 Capture and Storage:

Provided that for the purposes of paragraphs (a), (b) and (c) of sub-regulation (1), electricity-only-installations shall be taken into account only if they do not use fossil fuels as a main fuel and only if there is no cost-effective potential for the application of high-efficiency cogeneration technology according to the assessment carried out in accordance with the Energy Efficiency Regulations. S.L. 545.33.

(15) Sub-regulation (14) shall:

(a) apply only to installations starting operation or converted to the use of biomass fuels after 25th December 2021 for the purposes of paragraphs (a) and (b) of sub-regulation (1);

(b) be without prejudice to support granted under support schemes in accordance with regulation 4 of the Promotion of Energy from Renewable Sources Regulations, 2021 approved by 25 December 2021 for the purposes of paragraph (c) of sub-regulation (1); L.N. 503 of 2021.

(c) not apply to electricity from installations which are the object of a specific notification to the Commission based on the duly substantiated existence of risks for the security of supply of electricity:

Provided that the Minister may apply higher energy efficiency requirements to installations with lower rated thermal input.

(16) For the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1), and without prejudice to regulations 27 and 28 of the Promotion of Energy from Renewable Sources Regulations, 2021, the Regulator shall not refuse to take into account, on other sustainability grounds, biofuels and bioliquids obtained in compliance with this regulation, provided that this sub-regulation shall be without prejudice to public support granted under support schemes approved before 24th December 2018. L.N. 503 of 2021.

(17) For the purposes referred to in paragraphs (a), (b) and (c) of sub-regulation (1), the Minister may establish additional sustainability criteria for biomass fuels.

Verification of compliance with the sustainability and greenhouse gas emissions saving criteria.

4. (1) Where biofuels, bioliquids and biomass fuels, or other fuels that are eligible for counting towards the amount of energy from renewable sources consumed in the transport sector for the purposes of calculating the share of renewable energy within the final consumption of energy in the transport sector are to be taken into account for the purposes of calculating the share of renewable energy in heating and cooling and for the purpose of calculating the share of renewable energy in the transport sector, and for the purpose referred to in paragraphs (a), (b) and (c) of sub-regulation (1) of regulation 3, economic operators are required to show that the sustainability and greenhouse gas emissions saving criteria laid down in sub-regulations (6) to (13) of regulation 3 have been fulfilled, and for this purpose economic operators are required to use a mass balance system which:

(a) allows consignments of raw material or fuels with differing sustainability and greenhouse gas emissions saving characteristics to be mixed for instance in a container, processing or logistical facility, transmission and distribution infrastructure or site;

(b) allows consignments of raw material with differing energy content to be mixed for the purposes of further processing, provided that the size of consignments is adjusted according to their energy content;

(c) requires information about the sustainability and greenhouse gas emissions saving characteristics and sizes of the consignments referred to in paragraph (a) to remain assigned to the mixture; and

(d) provides for the sum of all consignments withdrawn from the mixture to be described as having the same sustainability characteristics, in the same quantities, as the sum of all consignments added to the mixture and requires that this balance be achieved over an appropriate period of time.

(2) The mass balance system referred to in sub-regulation (1) shall ensure that each consignment is counted only once when calculating the gross final consumption of electricity from renewable sources, the gross final consumption of energy from renewable sources in the heating and cooling sector and the final consumption of energy from renewable sources in the transport sector for the purposes of calculating the gross final consumption of energy from renewable sources, and shall include information on whether support has been provided for the production of that consignment, and if so, on the type of support scheme.

(3) Where a consignment is processed, information on the sustainability and greenhouse gas emissions saving characteristics of the consignment shall be adjusted and assigned to the output in accordance with the following rules:

(a) when the processing of a consignment of raw material yields only one output that is intended for the production of biofuels, bioliquids or biomass fuels, renewable liquid and gaseous transport fuels of non-biological origin, or recycled carbon fuels, the size of the consignment and the related quantities of sustainability and greenhouse gas emissions saving characteristics shall be adjusted applying a conversion factor representing the ratio between the mass of the output that is intended for such production and the mass of the raw material entering the process;

(b) when the processing of a consignment of raw material yields more than one output that is intended for the production of biofuels, bioliquids or biomass fuels, renewable liquid and gaseous transport fuels of non-biological origin, or recycled carbon fuels, for each output a separate conversion factor shall be applied and a separate mass balance shall be used.

(4) Economic operators shall submit reliable information to the Regulator regarding the compliance with the greenhouse gas emissions savings thresholds from the use of renewable liquid and gaseous transport fuels of non-biological origin of at least seventy per cent (70%) from the 1st of January 2021 and with the sustainability and greenhouse gas emissions saving criteria laid down in sub-regulations (6) to (13) of regulation 3, and said economic operators shall make available to the Regulator when so requested, and to any competent authority within any relevant Member State, as the case may be, upon request, the data that were used to develop the information.

(5) Economic operators shall arrange for an adequate standard of independent auditing of the information submitted, and shall provide to the Regulator evidence that this has been done. In order to comply with paragraph (a) of sub-regulation (10) of regulation 3, and paragraph (a) of sub-regulation (11) of regulation 3, the first or second party auditing may be used up to the first gathering point of the forest biomass.

(6) The auditing referred to in sub-regulation (5) shall verify that the systems used by economic operators are accurate, reliable and protected against fraud, including verification ensuring that materials are not intentionally modified or discarded so that the consignment or part thereof could become a waste or residue. It shall evaluate the

frequency and methodology of sampling and the robustness of the data.

(7) The auditing referred to in sub-regulation (5) is to be complied with as follows:

(a) Economic operators who are producers of biofuels, bioliquids or biomass fuels, renewable liquid and gaseous transport fuels of non-biological origin, or recycled carbon fuels shall ensure that auditing and verification is to be compiled:

(i) under voluntary national or international schemes approved by the Commission; or

(ii) under national schemes which the Minister may choose to set up pursuant to sub- regulation (10); and

(b) Economic operators importing biofuels, bioliquids or biomass fuels, renewable liquid and gaseous transport fuels of non-biological origin, or recycled carbon fuels shall ensure that such auditing and verification is to be compiled:

(i) under voluntary national or international schemes approved by the Commission; or

(ii) under national schemes approved by Member States of the European Union which comply with the sustainability criteria contained in the Directive.

(8) The obligations laid down in sub-regulations (4) to (7) shall apply regardless of whether the biofuels, bioliquids, biomass fuels, renewable liquid and gaseous transport fuels of non-biological origin, or recycled carbon fuels are produced within the Union or are imported. Information about the geographic origin and feedstock type of biofuels, bioliquids and biomass fuels per fuel supplier shall be made available to consumers on the websites of operators, suppliers or the relevant competent authorities and shall be updated on an annual basis.

(9) The Regulator shall submit to the Minister, in aggregated form, the information referred to in sub-regulation (4), and such information shall be published in summary form preserving the confidentiality of commercially sensitive information. The Minister shall submit to the Commission, in aggregated form, the information referred to in sub-regulation (4).

(10) The Minister may set up national schemes where compliance with the following is verified, through the involvement of

competent national authorities, throughout the entire chain of custody:

(a) the sustainability and greenhouse gas emissions saving criteria laid down in sub-regulations (6) to (13) of regulation 3; and

(b) the greenhouse gas emissions savings thresholds for renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels of at least seventy per cent (70%) from the 1st of January 2021:

Provided that the Minister may furthermore notify such national schemes to the Commission.

(11) Where an economic operator provides evidence or data obtained in accordance with a voluntary, national or international scheme that has been the subject of a decision of the Commission, to the extent covered by that decision, the Regulator shall not require the supplier to provide further evidence of compliance with the sustainability and greenhouse gas emissions saving criteria laid down in sub-regulations (6) to (13) of regulation 3.

Calculation of the greenhouse gas impact of biofuels, bioliquids and biomass fuels.

5. (1) For the purposes of sub-regulations (12) and (13) of regulation 3, the greenhouse gas emissions saving from the use of biofuel, bioliquids and biomass fuels shall be calculated in one of the following ways:

(a) where a default value for greenhouse gas emissions saving for the production pathway is laid down in Part A or B of the First Schedule for biofuels and bioliquids and in Part A of the Second Schedule for biomass fuels where the el value for those biofuels or bioliquids calculated in accordance with item 7 of Part C of the First Schedule and for those biomass fuels calculated in accordance with item 7 of Part B of the Second Schedule is equal to or less than zero, by using that default value;

(b) by using an actual value calculated in accordance with the methodology laid down in Part C of the First Schedule for biofuels and bioliquids and in Part B of the Second Schedule for biomass fuels;

(c) by using a value calculated as the sum of the factors of the formulas referred to in item 1 of Part C of the First Schedule, where disaggregated default values in Part D or E of the First Schedule may be used for some factors, and actual values, calculated in accordance with the methodology laid down in Part C of the First Schedule, are used for all other factors;

(d) by using a value calculated as the sum of the factors of the formulas referred to in item 1 of Part B of the Second Schedule, where disaggregated default values in Part C of the Second Schedule may be used for some factors, and actual values, calculated in accordance with the methodology laid down in Part B of the Second Schedule, are used for all other factors.

(2) The Minister may submit to the Commission reports including information on the typical greenhouse gas emissions from the cultivation of agricultural raw materials of the areas classified as level 2 in the nomenclature of territorial units for statistics (NUTS) or as a more disaggregated NUTS level in accordance with Regulation (EC) No 1059/2003 of the European Parliament and of the Council. Those reports shall be accompanied by a description of the method and data sources used to calculate the level of emissions. That method shall take into account soil characteristics, climate and expected raw material yields.

Administrative penalties.

6. (1) The Regulator may impose an administrative penalty upon any person who infringes any provision of these regulations or who fails to comply with any directive or decision given by the Regulator in ensuring compliance with these regulations.

(2) An administrative penalty imposed under sub-regulation (1) shall not exceed one hundred thousand euro (€100,000).

Repeal.

7. The Biofuels (Sustainability Criteria) Regulations are hereby repealed.

FIRST SCHEDULE
(regulations 2, 3 and 5)

Rules for calculating the greenhouse gas impacts of biofuels, other bioliquids and their fossil fuel comparators

Part A
TYPICAL AND DEFAULT VALUES FOR BIOFUELS IF PRODUCED WITH NO NET CARBON EMISSIONS FROM LAND-USE CHANGE

Biofuel production pathway	**Greenhouse gas emissions saving – typical value**	**Greenhouse gas emissions saving – default value**
sugar beet ethanol (no biogas from slop, natural gas as process fuel in conventional boiler)	67%	59%
sugar beet ethanol (with biogas from slop, natural gas as process fuel in conventional boiler)	77%	73%
sugar beet ethanol (no biogas from slop, natural gas as process fuel in CHP plant (*))	73%	68%
sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*))	79%	76%
sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*))	58%	47%
sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*))	71%	64%
corn (maize) ethanol (natural gas as process fuel in conventional boiler)	48%	40%
corn (maize) ethanol, (natural gas as process fuel in CHP plant (*))	55%	48%
corn (maize) ethanol (lignite as process fuel in CHP plant (*))	40%	28%
corn (maize) ethanol (forest residues as process fuel in CHP plant (*))	69%	68%
other cereals excluding maize ethanol (natural gas as process fuel in conventional boiler)	47%	38%
other cereals excluding maize ethanol (natural gas as process fuel in CHP plant (*))	53%	46%
other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*))	37%	24%

other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*))	67%	67%
sugar cane ethanol	70%	70%
the part from renewable sources of ethyl-tertio-butyl-ether (ETBE)	Equal to that of the ethanol production pathway used	
the part from renewable sources of tertiary-amyl-ethyl-ether (TAEE)	Equal to that of the ethanol production pathway used	
rape seed biodiesel	52%	47%
sunflower biodiesel	57%	52%
soybean biodiesel	55%	50%
palm oil biodiesel (open effluent pond)	33%	20%
palm oil biodiesel (process with methane capture at oil mill)	51%	45%
waste cooking oil biodiesel	88%	84%
animal fats from rendering biodiesel (**)	84%	78%
hydrotreated vegetable oil from rape seed	51%	47%
hydrotreated vegetable oil from sunflower	58%	54%
hydrotreated vegetable oil from soybean	55%	51%
hydrotreated vegetable oil from palm oil (open effluent pond)	34%	22%
hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	53%	49%
hydrotreated oil from waste cooking oil	87%	83%
hydrotreated oil from animal fats from rendering (**)	83%	77%
pure vegetable oil from rape seed	59%	57%
pure vegetable oil from sunflower	65%	64%
pure vegetable oil from soybean	63%	61%
pure vegetable oil from palm oil (open effluent pond)	40%	30%
pure vegetable oil from palm oil (process with methane capture at oil mill)	59%	57%
pure oil from waste cooking oil	98%	98%

(*) Default values for processes using CHP are valid only if all the process heat is supplied by CHP.

(**) Applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009 of the European Parliament and of the Council ([1]), for which emissions related to hygenisation as part of the rendering are not considered.

([1])
Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation) (OJ L 300, 14.11.2009, p.1).

Part B

ESTIMATED TYPICAL AND DEFAULT VALUES FOR FUTURE BIOFUELS THAT WERE NOT ON THE MARKET OR WERE ON THE MARKET ONLY IN NEGLIGIBLE QUANTITIES IN 2016, IF PRODUCED WITH NO NET CARBON EMISSIONS FROM LAND-USE CHANGE

Biofuel production pathway	**Greenhouse gas emissions saving - typical value**	**Greenhouse gas emissions saving - default value**
wheat straw ethanol	85%	83%
waste wood Fischer-Tropsch diesel in free-standing plant	83%	83%
farmed wood Fischer-Tropsch diesel in free-standing plant	82%	82%
waste wood Fischer-Tropsch petrol in free-standing plant	83%	83%
farmed wood Fischer-Tropsch petrol in free-standing plant	82%	82%
waste wood dimethylether (DME) in free-standing plant	84%	84%
farmed wood dimethylether (DME) in free-standing plant	83%	83%
waste wood methanol in free-standing plant	84%	84%
farmed wood methanol in free-standing plant	83%	83%
Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill	89%	89%
Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill	89%	89%
dimethylether (DME) from black-liquor gasification integrated with pulp mill	89%	89%
Methanol from black-liquor gasification integrated with pulp mill	89%	89%
the part from renewable sources of methyl-tertio-butyl-ether (MTBE)	Equal to that of the methanol production pathway used	

Part C
METHODOLOGY

1. Greenhouse gas emissions from the production and use of transport fuels, biofuels and bioliquids shall be calculated as follows:

(a) greenhouse gas emissions from the production and use of biofuels shall be calculated as:

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr},$$

where

E = total emissions from the use of the fuel;

e_{ec} = emissions from the extraction or cultivation of raw materials;

e_l = annualised emissions from carbon stock changes caused by land-use change;

e_p = emissions from processing;

e_{td} = emissions from transport and distribution;

e_u = emissions from the fuel in use;

e_{sca} = emission savings from soil carbon accumulation via improved agricultural management;

e_{ccs} = emission savings from CO_2 capture and geological storage; and

e_{ccr} = emission savings from CO_2 capture and replacement.

Emissions from the manufacture of machinery and equipment shall not be taken into account.

(b) Greenhouse gas emissions from the production and use of bioliquids shall be calculated as for biofuels (E), but with the extension necessary for including the energy conversion to electricity and, or heat and cooling produced, as follows:

(i) For energy installations delivering only heat:

$$EC_h = \frac{E}{\eta_h}$$

(ii) For energy installations delivering only electricity:

$$EC_{el} = \frac{E}{\eta_{el}}$$

Where

$EC_{h,el}$ = Total greenhouse gas emissions from the final energy commodity.

E = Total greenhouse gas emissions of the bioliquid before end-conversion

η_{el} = The electrical efficiency, defined as the annual electricity produced divided by the annual bioliquid input based on its energy content

η_h = The heat efficiency, defined as the annual useful heat output divided by the annual bioliquid input based on its energy content.

(iii) For the electricity or mechanical energy coming from energy installations delivering useful heat together with electricity and/or mechanical energy:

$$EC_{el} = \frac{E}{\eta_{el}}\left(\frac{C_{el} \cdot \eta_{el}}{C_{el} \cdot \eta_{el} + C_h \cdot \eta_h}\right)$$

(iv) For the useful heat coming from energy installations delivering heat together with electricity and/or mechanical energy:

$$EC_h = \frac{E}{\eta_h}\left(\frac{C_h \cdot \eta_h}{C_{el} \cdot \eta_{el} + C_h \cdot \eta_h}\right)$$

where:

$EC_{h,el}$ =Total greenhouse gas emissions from the final energy commodity.

E =Total greenhouse gas emissions of the bioliquid before end-conversion.

η_{el} =The electrical efficiency, defined as the annual electricity produced divided by the annual fuel input based on its energy content.

η_h = The heat efficiency, defined as the annual useful heat output divided by the annual fuel input based on its energy content.

C_{el} = Fraction of exergy in the electricity, and/or mechanical energy, set to 100 % (C_{el} = 1).

C_h = Carnot efficiency (fraction of exergy in the useful heat).

The Carnot efficiency, C_h, for useful heat at different temperatures is defined as:

$$C_h = \frac{T_h - T_0}{T_h}$$

where

T_h = Temperature, measured in absolute temperature (kelvin) of the useful heat at point of delivery.

T_0 = Temperature of surroundings, set at 273.15 kelvin (equal to 0 °C)

If the excess heat is exported for heating of buildings, at a temperature below 150°C (423.15 kelvin), C_h can alternatively be defined as follows:

C_h = Carnot efficiency in heat at 150 °C (423.15 kelvin), which is: 0.3546

For the purposes of that calculation, the following definitions apply:

(a) "cogeneration" means the simultaneous generation in one process of thermal energy and electricity and/or mechanical energy;

(b "useful heat" means heat generated to satisfy an economical justifiable demand for heat, for heating and cooling purposes;

(c) "economically justifiable demand" means the demand that does not exceed the needs for heat or cooling and which would otherwise be satisfied at market conditions.

2. Greenhouse gas emissions from biofuels and bioliquids shall be expressed as follows:

(a) greenhouse gas emissions from biofuels, E, shall be expressed in terms of grams of CO_2 equivalent per MJ of fuel, g CO_2eq/MJ.

(b) greenhouse gas emissions from bioliquids, EC, in terms of grams of CO_2 equivalent per MJ of final energy commodity (heat or electricity), g CO_2eq/MJ.

When heating and cooling are co-generated with electricity, emissions shall be allocated between heat and electricity (as under 1(*b*)), irrespective if the heat is used for actual heating purposes or for cooling ([Note 1]).

Where the greenhouse gas emissions from the extraction or cultivation of raw materials e_{ec} are expressed in unit g CO_2eq/dry-ton of feedstock, the conversion to grams of CO_2 equivalent per MJ of fuel, g CO_2eq/MJ, shall be calculated as follows ([Note 2]):

$$e_{ec}fuel_a\left[\frac{gCO_2eq}{MJfuel}\right]_{ec} = \frac{e_{ec}feedstock_a\left[\frac{gCO_2eq}{t_{dry}}\right]}{LHV_a\left[\frac{MJ\,feedstock}{t\,dry\,feedstock}\right]} \times Fuel\ feedstock\ factor_a \times Allocation\ factor\ fuel_a$$

where:

$$Allocator\ factor\ fuel_a = \left[\frac{Energy\ in\ fuel}{Energy\ fuel + Energy\ in\ coproducts}\right]$$

Fuel feedstock $factor_a$ = [Ratio of MJ feedstock required to make 1MJ fuel]

Emissions per dry-ton feedstock shall be calculated as follows:

$$e_{ec}feedstock_a\left[\frac{gCO_2eq}{t_{dry}}\right] = \frac{e_{ec}feedstock_a\left[\frac{gCO_2eq}{t_{moist}}\right]}{(1 - moisture\ content)}$$

3. Greenhouse gas emissions savings from biofuels and bioliquids shall be calculated as follows:

(a) greenhouse gas emissions savings from biofuels:

SAVING = $(E_{F(t)} - E_B)/E_{F(t)}$,

where:

E_B = total emissions from the biofuel; and

$E_{F(t)}$ = total emissions from the fossil fuel comparator for transport

(b) greenhouse gas emissions savings from heat and cooling, and electricity being generated from bioliquids:

$$SAVING = (EC_{F(h\&c,el)} – EC_{B(h\&c,el)})/EC_{F(h\&c,el)},$$

where:

$EC_{B(h\&c,el)}$ = total emissions from the heat or electricity; and

$EC_{F(h\&c,el)}$ = total emissions from the fossil fuel comparator for useful heat or electricity.

4. The greenhouse gases taken into account for the purposes of item 1 shall be CO_2, N_2O and CH_4. For the purposes of calculating CO_2 equivalence, those gases shall be valued as follows:

CO_2	:	1
N_2O	:	298
CH_4	:	25

5. Emissions from the extraction or cultivation of raw materials, e_{ec}, shall include emissions from the extraction or cultivation process itself; from the collection, drying and storage of raw materials; from waste and leakages; and from the production of chemicals or products used in extraction or cultivation. Capture of CO_2 in the cultivation of raw materials shall be excluded. Estimates of emissions from agriculture biomass cultivation may be derived from the use of regional averages for cultivation emissions included in the reports referred to in Article 31(4) of the Directive or the information on the disaggregated default values for cultivation emissions included in this Schedule, as an alternative to using actual values. In the absence of relevant information in those reports it is allowed to calculate averages based on local farming practises based for instance on data of a group of farms, as an alternative to using actual values.

6. For the purposes of the calculation referred to in paragraph (a) of item 1, greenhouse gas emissions savings from improved agriculture management, e_{sca}, such as shifting to reduced or zero-tillage, improved crop/rotation, the use of cover crops, including crop residue management, and the use of organic soil improver (e.g. compost, manure fermentation digestate), shall be taken into account only if solid and verifiable evidence is provided that the soil carbon has increased or that it is reasonable to expect to have increased over the period in which the raw materials concerned were cultivated while

taking into account the emissions where such practices lead to increased fertiliser and herbicide use ([Note 3]).

7. Annualised emissions from carbon stock changes caused by land-use change, e_l, shall be calculated by dividing total emissions equally over twenty (20) years. For the calculation of those emissions, the following rule shall be applied:

$e_l = (CS_R – CS_A) \times 3.664 \times 1/20 \times 1/P – e_B$, ([Note 4])

where:

e_l	=	annualised greenhouse gas emissions from carbon stock change due to land-use change (measured as mass (grams) of CO_2-equivalent per unit of biofuel or bioliquid energy (megajoules)). "Cropland" ([1]) and "perennial cropland" ([2]) shall be regarded as one land use;
CS_R	=	the carbon stock per unit area associated with the reference land-use (measured as mass (tonnes) of carbon per unit area, including both soil and vegetation). The reference land-use shall be the land-use in January 2008 or twenty (20) years before the raw material was obtained, whichever was the later;
CS_A	=	the carbon stock per unit area associated with the actual land-use (measured as mass (tonnes) of carbon per unit area, including both soil and vegetation). In cases where the carbon stock accumulates over more than one year, the value attributed to CS_A shall be the estimated stock per unit area after twenty (20) years or when the crop reaches maturity, whichever the earlier;
P	=	the productivity of the crop (measured as biofuel or bioliquid energy per unit area per year) and
e_B	=	bonus of 29 g CO_2eq/MJ biofuel or bioliquid if biomass is obtained from restored degraded land under the conditions laid down in item 8.

([1])
Cropland as defined by IPCC.
([2])
Perennial crops are defined as multi-annual crops, the stem of which is usually not annually harvested such as short rotation coppice and oil palm.

8. The bonus of 29g CO_2eq/MJ shall be attributed if evidence is provided that the land:

(a) was not in use for agriculture or any other activity in January 2008; and

(b) is severely degraded land, including such land that was formerly in agricultural use.

The bonus of 29g CO_2eq/MJ shall apply for a period of up to twenty (20) years from the date of conversion of the land to agricultural use, provided that a steady increase in carbon stocks as well as a sizable reduction in erosion phenomena for land falling under (*b*) are ensured.

9. "Severely degraded land" means land that, for a significant period of time, has either been significantly salinated or presented significantly low organic matter content and has been severely eroded.

10. The Commission shall review, by 31 December 2020, guidelines for the calculation of land carbon stocks ([Note 5]) drawing on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories – volume 4 and in accordance with Regulation (EU) No 525/2013 and Regulation (EU) 2018/841 of the European Parliament and of the Council ([Note 6]). The Commission guidelines shall serve as the basis for the calculation of land carbon stocks for the purposes of the Directive.

11. Emissions from processing, e_p, shall include emissions from the processing itself; from waste and leakages; and from the production of chemicals or products used in processing including the CO_2 emissions corresponding to the carbon contents of fossil inputs, whether or not actually combusted in the process.

In accounting for the consumption of electricity not produced within the fuel production plant, the greenhouse gas emissions intensity of the production and distribution of that electricity shall be assumed to be equal to the average emission intensity of the production and distribution of electricity in a defined region. By way of derogation from this rule, producers may use an average value for an individual electricity production plant for electricity produced by that plant, if that plant is not connected to the electricity grid.

Emissions from processing shall include emissions from drying of interim products and materials where relevant.

12. Emissions from transport and distribution, e_{td}, shall include emissions from the transport of raw and semi-finished materials and from the storage and distribution of finished materials. Emissions from transport and distribution to be taken into account under item 5 shall not be covered by this item.

13. Emissions of the fuel in use, e_u, shall be taken to be zero for biofuels and bioliquids.

Emissions of non-CO_2 greenhouse gases (N_2O and CH_4) of the fuel in use shall be included in the e_u factor for bioliquids.

14. Emission savings from CO_2 capture and geological storage, e_{ccs}, that have not already been accounted for in e_p, shall be limited to emissions avoided through the capture and storage of emitted CO_2 directly related to the extraction, transport, processing and distribution of fuel if stored in compliance with Directive 2009/31/EC of the European Parliament and of the Council ([Note 7]).

15. Emission savings from CO_2 capture and replacement, e_{ccr}, shall be related directly to the production of biofuel or bioliquid they are attributed to, and shall be limited to emissions avoided through the capture of CO_2 of which the carbon originates from biomass and which is used to replace fossil-derived CO_2 in production of commercial products and services.

16. Where a cogeneration unit – providing heat and/or electricity to a fuel production process for which emissions are being calculated – produces excess electricity and/or excess useful heat, the greenhouse gas emissions shall be divided between the electricity and the useful heat according to the temperature of the heat (which reflects the usefulness (utility) of the heat). The useful part of the heat is found by multiplying its energy content with the Carnot efficiency, C_h, calculated as follows:

$$C_h = \frac{T_h - T_0}{T_h}$$

where:

T_h = Temperature, measured in absolute temperature (kelvin) of the useful heat at point of delivery.

T_0 = Temperature of surroundings, set at 273.15 kelvin (equal to 0°C)

If the excess heat is exported for heating of buildings, at a temperature below 150°C (423.15 kelvin), C_h can alternatively be defined as follows:

C_h = Carnot efficiency in heat at 150°C (423.15 kelvin), which is: 0.3546

For the purposes of that calculation, the actual efficiencies shall be used, defined as the annual mechanical energy, electricity and heat produced respectively divided by the annual energy input.

For the purposes of that calculation, the following definitions apply:

(a) "cogeneration" shall mean the simultaneous generation in one process of thermal energy and electrical and/or mechanical energy;

(b) "useful heat" shall mean heat generated to satisfy an economical justifiable demand for heat, for heating or cooling purposes;

(c) "economically justifiable demand" shall mean the demand that does not exceed the needs for heat or cooling and which would otherwise be satisfied at market conditions.

17. Where a fuel production process produces, in combination, the fuel for which emissions are being calculated and one or more other products (co-products), greenhouse gas emissions shall be divided between the fuel or its intermediate product and the co-products in proportion to their energy content (determined by lower heating value in the case of co-products other than electricity and heat). The greenhouse gas intensity of excess useful heat or excess electricity is the same as the greenhouse gas intensity of heat or electricity delivered to the fuel production process and is determined from calculating the greenhouse intensity of all inputs and emissions, including the feedstock and CH_4 and N_2O emissions, to and from the cogeneration unit, boiler or other apparatus delivering heat or electricity to the fuel production process. In the case of cogeneration of electricity and heat, the calculation is performed following item 16.

18. For the purposes of the calculation referred to in item 17, the emissions to be divided shall be e_{ec}+ e_l+ e_{sca}+ those fractions of e_p, e_{td}, e_{ccs}, and e_{ccr} that take place up to and including the process step at which a co-product is produced. If any allocation to co-products has taken place at an earlier process step in the life-cycle, the fraction of those emissions assigned in the last such process step to the intermediate fuel product shall be used for those purposes instead of the total of those emissions.

In the case of biofuels and bioliquids, all co-products shall be taken into account for the purposes of that calculation. No emissions shall be allocated to wastes and residues. Co-products that have a negative energy content shall be considered to have an energy content of zero for the purposes of the calculation.

Wastes and residues, including tree tops and branches, straw, husks, cobs and nut shells, and residues from processing, including crude glycerine (glycerine that is not refined) and bagasse, shall be considered to have zero life-cycle greenhouse gas emissions up to the process of collection of those materials irrespectively of whether they are processed to interim products before being transformed into the final product.

In the case of fuels produced in refineries, other than the combination of processing plants with boilers or cogeneration units providing heat and/or electricity to the processing plant, the unit of analysis for the purposes of the calculation referred to in item 17 shall be the refinery.

19. For biofuels, for the purposes of the calculation referred to in item 3, the fossil fuel comparator $E_{F(t)}$ shall be 94g CO_2eq/MJ.

For bioliquids used for the production of electricity, for the purposes of the calculation referred to in item 3, the fossil fuel comparator $EC_{F(e)}$ shall be 183g CO_2eq/MJ.

For bioliquids used for the production of useful heat, as well as for the production of heating and/or cooling, for the purposes of the calculation referred to in item 3, the fossil fuel comparator $EC_{F(h\&c)}$ shall be 80g CO_2eq/MJ.

Notes to Part C of this Schedule

(Note 1) Heat or waste heat is used to generate cooling (chilled air or water) through absorption chillers. Therefore, it is appropriate to calculate only the emissions associated to the heat produced per MJ of heat, irrespectively if the end-use of the heat is actual heating or cooling via absorption chillers.

(Note 2) The formula for calculating greenhouse gas emissions from the extraction or cultivation of raw materials e_{ec} describes cases where feedstock is converted into biofuels in one step. For more complex supply chains, adjustments are needed for calculating greenhouse gas emissions from the extraction or cultivation of raw materials e_{ec} for intermediate products.

(Note 3) Measurements of soil carbon can constitute such evidence, e.g. by a first measurement in advance of the cultivation and subsequent ones at regular intervals several years apart. In such a case, before the second measurement is available, increase in soil carbon would be estimated on the basis of representative experiments or soil models. From the second measurement onwards, the measurements would constitute the basis for determining the existence of an increase in soil carbon and its magnitude.

(Note 4) The quotient obtained by dividing the molecular weight of CO_2 (44.010 g/mol) by the molecular weight of carbon (12.011 g/

mol) is equal to 3.664.

(Note 5) Commission Decision 2010/335/EU of 10 June 2010 on guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive 2009/28/EC (OJL 151, 17.6.2010, p.19).

(Note 6) Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU (OJL 156, 19.6.2018, p.1).

(Note 7) Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006 (OJL 140, 5.6.2009, p.114).

Part D
DISAGGREGATED DEFAULT VALUES FOR BIOFUELS AND BIOLIQUIDS

Disaggregated default values for cultivation: "e_{ec}" as defined in Part C of this Schedule, including soil N_2O emissions

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$)**	**Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$)**
sugar beet ethanol	9.6	9.6
corn (maize) ethanol	25.5	25.5
other cereals excluding corn (maize) ethanol	27.0	27.0
sugar cane ethanol	17.1	17.1
the part from renewable sources of ETBE	Equal to that of the ethanol production pathway used	
the part from renewable sources of TAEE	Equal to that of the ethanol production pathway used	
rape seed biodiesel	32.0	32.0
sunflower biodiesel	26.1	26.1
soybean biodiesel	21.2	21.2
palm oil biodiesel	26.0	26.0
waste cooking oil biodiesel	0	0
animal fats from rendering biodiesel ([*1])	0	0

hydrotreated vegetable oil from rape seed	33.4	33.4
hydrotreated vegetable oil from sunflower	26.9	26.9
hydrotreated vegetable oil from soybean	22.1	22.1
hydrotreated vegetable oil from palm oil	27.3	27.3
hydrotreated oil from waste cooking oil	0	0
hydrotreated oil from animal fats from rendering (*1)	0	0
pure vegetable oil from rape seed	33.4	33.4
pure vegetable oil from sunflower	27.2	27.2
pure vegetable oil from soybean	22.2	22.2
pure vegetable oil from palm oil	27.1	27.1
pure oil from waste cooking oil	0	0
(*1) Applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.		

Disaggregated default values for cultivation: "e_{ec}" – for soil N_2O emissions only (these are already included in the disaggregated values for cultivation emissions in the "e_{ec}" table)

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$)**	**Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$)**
sugar beet ethanol	4.9	4.9
corn (maize) ethanol	13.7	13.7
other cereals excluding corn (maize) ethanol	14.1	14.1
sugar cane ethanol	2.1	2.1
the part from renewable sources of ETBE	Equal to that of the ethanol production pathway used	
the part from renewable sources of TAEE	Equal to that of the ethanol production pathway used	
rape seed biodiesel	17.6	17.6
sunflower biodiesel	12.2	12.2
soybean biodiesel	13.4	13.4
palm oil biodiesel	16.5	16.5

waste cooking oil biodiesel	0	0
animal fats from rendering biodiesel (*1)	0	0
hydrotreated vegetable oil from rape seed	18.0	18.0
hydrotreated vegetable oil from sunflower	12.5	12.5
hydrotreated vegetable oil from soybean	13.7	13.7
hydrotreated vegetable oil from palm oil	16.9	16.9
hydrotreated oil from waste cooking oil	0	0
hydrotreated oil from animal fats from rendering (*1)	0	0
pure vegetable oil from rape seed	17.6	17.6
pure vegetable oil from sunflower	12.2	12.2
pure vegetable oil from soybean	13.4	13.4
pure vegetable oil from palm oil	16.5	16.5
pure oil from waste cooking oil	0	0
(*1) Note: applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.		

Disaggregated default values for processing: "e_p" as defined in Part C of this Schedule

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value** **(g CO_2eq/MJ)**	**Greenhouse gas emissions – default value** **(g CO_2eq/MJ)**
sugar beet ethanol (no biogas from slop, natural gas as process fuel in conventional boiler)	18.8	26.3
sugar beet ethanol (with biogas from slop, natural gas as process fuel in conventional boiler)	9.7	13.6
sugar beet ethanol (no biogas from slop, natural gas as process fuel in CHP plant (*1))	13.2	18.5

sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*1))	7.6	10.6
sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*1))	27.4	38.3
sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*1))	15.7	22.0
corn (maize) ethanol (natural gas as process fuel in conventional boiler)	20.8	29.1
corn (maize) ethanol, (natural gas as process fuel in CHP plant (*1))	14.8	20.8
corn (maize) ethanol (lignite as process fuel in CHP plant (*1))	28.6	40.1
corn (maize) ethanol (forest residues as process fuel in CHP plant (*1))	1.8	2.6
other cereals excluding maize ethanol (natural gas as process fuel in conventional boiler)	21.0	29.3
other cereals excluding maize ethanol (natural gas as process fuel in CHP plant (*1))	15.1	21.1
other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*1))	30.3	42.5
other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*1))	1.5	2.2
sugar cane ethanol	1.3	1.8
the part from renewable sources of ETBE	Equal to that of the ethanol production pathway used	
the part from renewable sources of TAEE	Equal to that of the ethanol production pathway used	
rape seed biodiesel	11.7	16.3
sunflower biodiesel	11.8	16.5
soybean biodiesel	12.1	16.9
palm oil biodiesel (open effluent pond)	30.4	42.6
palm oil biodiesel (process with methane capture at oil mill)	13.2	18.5
waste cooking oil biodiesel	9.3	13.0
animal fats from rendering biodiesel (*2)	13.6	19.1
hydrotreated vegetable oil from rape seed	10.7	15.0

hydrotreated vegetable oil from sunflower	10.5	14.7
hydrotreated vegetable oil from soybean	10.9	15.2
hydrotreated vegetable oil from palm oil (open effluent pond)	27.8	38.9
hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	9.7	13.6
hydrotreated oil from waste cooking oil	10.2	14.3
hydrotreated oil from animal fats from rendering (*2)	14.5	20.3
pure vegetable oil from rape seed	3.7	5.2
pure vegetable oil from sunflower	3.8	5.4
pure vegetable oil from soybean	4.2	5.9
pure vegetable oil from palm oil (open effluent pond)	22.6	31.7
pure vegetable oil from palm oil (process with methane capture at oil mill)	4.7	6.5
pure oil from waste cooking oil	0.6	0.8

(*1)

Default values for processes using CHP are valid only if all the process heat is supplied by CHP.

(*2)

Note: applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.

Disaggregated default values for oil extraction only (these are already included in the disaggregated values for processing emissions in the "e_p" table)

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
rape seed biodiesel	3.0	4.2
sunflower biodiesel	2.9	4.0
soybean biodiesel	3.2	4.4
palm oil biodiesel (open effluent pond)	20.9	29.2
palm oil biodiesel (process with methane capture at oil mill)	3.7	5.1
waste cooking oil biodiesel	0	0

animal fats from rendering biodiesel (*1)	4.3	6.1
hydrotreated vegetable oil from rape seed	3.1	4.4
hydrotreated vegetable oil from sunflower	3.0	4.1
hydrotreated vegetable oil from soybean	3.3	4.6
hydrotreated vegetable oil from palm oil (open effluent pond)	21.9	30.7
hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	3.8	5.4
hydrotreated oil from waste cooking oil	0	0
hydrotreated oil from animal fats from rendering (*1)	4.3	6.0
pure vegetable oil from rape seed	3.1	4.4
pure vegetable oil from sunflower	3.0	4.2
pure vegetable oil from soybean	3.4	4.7
pure vegetable oil from palm oil (open effluent pond)	21.8	30.5
pure vegetable oil from palm oil (process with methane capture at oil mill)	3.8	5.3
pure oil from waste cooking oil	0	0

(*1)

Note: applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.

Disaggregated default values for transport and distribution: "e_{td}" as defined in Part C of this Schedule

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
sugar beet ethanol (no biogas from slop, natural gas as process fuel in conventional boiler)	2.3	2.3
sugar beet ethanol (with biogas from slop, natural gas as process fuel in conventional boiler)	2.3	2.3
sugar beet ethanol (no biogas from slop, natural gas as process fuel in CHP plant (*1))	2.3	2.3

sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*1))	2.3	2.3
sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*1))	2.3	2.3
sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*1))	2.3	2.3
corn (maize) ethanol (natural gas as process fuel in CHP plant (*1))	2.2	2.2
corn (maize) ethanol (natural gas as process fuel in conventional boiler)	2.2	2.2
corn (maize) ethanol (lignite as process fuel in CHP plant (*1))	2.2	2.2
corn (maize) ethanol (forest residues as process fuel in CHP plant (*1))	2.2	2.2
other cereals excluding maize ethanol (natural gas as process fuel in conventional boiler)	2.2	2.2
other cereals excluding maize ethanol (natural gas as process fuel in CHP plant (*1))	2.2	2.2
other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*1))	2.2	2.2
other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*1))	2.2	2.2
sugar cane ethanol	9.7	9.7
the part from renewable sources of ETBE	Equal to that of the ethanol production pathway used	
the part from renewable sources of TAEE	Equal to that of the ethanol production pathway used	
rape seed biodiesel	1.8	1.8
sunflower biodiesel	2.1	2.1
soybean biodiesel	8.9	8.9
palm oil biodiesel (open effluent pond)	6.9	6.9
palm oil biodiesel (process with methane capture at oil mill)	6.9	6.9
waste cooking oil biodiesel	1.9	1.9
animal fats from rendering biodiesel (*1)	1.6	1.6
hydrotreated vegetable oil from rape seed	1.7	1.7

hydrotreated vegetable oil from sunflower	2.0	2.0
hydrotreated vegetable oil from soybean	9.2	9.2
hydrotreated vegetable oil from palm oil (open effluent pond)	7.0	7.0
hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	7.0	7.0
hydrotreated oil from waste cooking oil	1.7	1.7
hydrotreated oil from animal fats from rendering (*2)	1.5	1.5
pure vegetable oil from rape seed	1.4	1.4
pure vegetable oil from sunflower	1.7	1.7
pure vegetable oil from soybean	8.8	8.8
pure vegetable oil from palm oil (open effluent pond)	6.7	6.7
pure vegetable oil from palm oil (process with methane capture at oil mill)	6.7	6.7
pure oil from waste cooking oil	1.4	1.4

(*1)

Default values for processes using CHP are valid only if all the process heat is supplied by CHP.

(*2)

Note: applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.

Disaggregated default values for transport and distribution of final fuel only. These are already included in the table of "transport and distribution emissions e_{td}" as defined in Part C of this Schedule, but the following values are useful if an economic operator wishes to declare actual transport emissions for crops or oil transport only).

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
sugar beet ethanol (no biogas from slop, natural gas as process fuel in conventional boiler)	1.6	1.6
sugar beet ethanol (with biogas from slop, natural gas as process fuel in conventional boiler)	1.6	1.6

sugar beet ethanol (no biogas from slop, natural gas as process fuel in CHP plant (*1))	1.6	1.6
sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*1))	1.6	1.6
sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*1))	1.6	1.6
sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*1))	1.6	1.6
corn (maize) ethanol (natural gas as process fuel in conventional boiler)	1.6	1.6
corn (maize) ethanol (natural gas as process fuel in CHP plant (*1))	1.6	1.6
corn (maize) ethanol (lignite as process fuel in CHP plant (*1))	1.6	1.6
corn (maize) ethanol (forest residues as process fuel in CHP plant (*1))	1.6	1.6
other cereals excluding maize ethanol (natural gas as process fuel in conventional boiler)	1.6	1.6
other cereals excluding maize ethanol (natural gas as process fuel in CHP plant (*1))	1.6	1.6
other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*1))	1.6	1.6
other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*1))	1.6	1.6
sugar cane ethanol	6.0	6.0
the part of ethyl-tertio-butyl-ether (ETBE) from renewable ethanol	Will be considered to be equal to that of the ethanol production pathway used	
the part of tertiary-amyl-ethyl-ether (TAEE) from renewable ethanol	Will be considered to be equal to that of the ethanol production pathway used	
rape seed biodiesel	1.3	1.3
sunflower biodiesel	1.3	1.3
soybean biodiesel	1.3	1.3
palm oil biodiesel (open effluent pond)	1.3	1.3
palm oil biodiesel (process with methane capture at oil mill)	1.3	1.3
waste cooking oil biodiesel	1.3	1.3
animal fats from rendering biodiesel (*2)	1.3	1.3
hydrotreated vegetable oil from rape seed	1.2	1.2

hydrotreated vegetable oil from sunflower	1.2	1.2
hydrotreated vegetable oil from soybean	1.2	1.2
hydrotreated vegetable oil from palm oil (open effluent pond)	1.2	1.2
hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	1.2	1.2
hydrotreated oil from waste cooking oil	1.2	1.2
hydrotreated oil from animal fats from rendering (*2)	1.2	1.2
pure vegetable oil from rape seed	0.8	0.8
pure vegetable oil from sunflower	0.8	0.8
pure vegetable oil from soybean	0.8	0.8
pure vegetable oil from palm oil (open effluent pond)	0.8	0.8
pure vegetable oil from palm oil (process with methane capture at oil mill)	0.8	0.8
pure oil from waste cooking oil	0.8	0.8
(*1) Default values for processes using CHP are valid only if all the process heat is supplied by CHP. (*2) Note: applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.		

Total for cultivation, processing, transport and distribution

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
sugar beet ethanol (no biogas from slop, natural gas as process fuel in conventional boiler)	30.7	38.2
sugar beet ethanol (with biogas from slop, natural gas as process fuel in conventional boiler)	21.6	25.5
sugar beet ethanol (no biogas from slop, natural gas as process fuel in CHP plant (*1))	25.1	30.4
sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*1))	19.5	22.5

sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*1))	39.3	50.2
sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*1))	27.6	33.9
corn (maize) ethanol (natural gas as process fuel in conventional boiler)	48.5	56.8
corn (maize) ethanol, (natural gas as process fuel in CHP plant (*1))	42.5	48.5
corn (maize) ethanol (lignite as process fuel in CHP plant (*1))	56.3	67.8
corn (maize) ethanol (forest residues as process fuel in CHP plant (*1))	29.5	30.3
other cereals excluding maize ethanol (natural gas as process fuel in conventional boiler)	50.2	58.5
other cereals excluding maize ethanol (natural gas as process fuel in CHP plant (*1))	44.3	50.3
other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*1))	59.5	71.7
other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*1)	30.7	31.4
sugar cane ethanol	28.1	28.6
the part from renewable sources of ETBE	Equal to that of the ethanol production pathway used	
the part from renewable sources of TAEE	Equal to that of the ethanol production pathway used	
rape seed biodiesel	45.5	50.1
sunflower biodiesel	40.0	44.7
soybean biodiesel	42.2	47.0
palm oil biodiesel (open effluent pond)	63.3	75.5
palm oil biodiesel (process with methane capture at oil mill)	46.1	51.4
waste cooking oil biodiesel	11.2	14.9
animals fats from rendering biodiesel (*1)	15.2	20.7
hydrotreated vegetable oil from rape seed	45.8	50.1
hydrotreated vegetable oil from sunflower	39.4	43.6
hydrotreated vegetable oil from soybean	42.2	46.5

hydrotreated vegetable oil from palm oil (open effluent pond)	62.1	73.2
hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	44.0	47.9
hydrotreated oil from waste cooking oil	11.9	16.0
hydrotreated oil from animal fats from rendering (*2)	16.0	21.8
pure vegetable oil from rape seed	38.5	40.0
pure vegetable oil from sunflower	32.7	34.3
pure vegetable oil from soybean	35.2	36.9
pure vegetable oil from palm oil (open effluent pond)	56.4	65.5
pure vegetable oil from palm oil (process with methane capture at oil mill)	38.5	40.3
pure oil from waste cooking oil	2.0	2.2

(*1)
Default values for processes using CHP are valid only if all the process heat is supplied by CHP.
(*2)

Note: applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.

Part E

ESTIMATED DISAGGREGATED DEFAULT VALUES FOR FUTURE BIOFUELS AND BIOLIQUIDS THAT WERE NOT ON THE MARKET OR WERE ONLY ON THE MARKET IN NEGLIGIBLE QUANTITIES IN 2016

Disaggregated default values for cultivation: "e_{ec}" as defined in Part C of this Schedule, including N_2O emissions (including chipping of waste or farmed wood)

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
wheat straw ethanol	1.8	1.8
waste wood Fischer-Tropsch diesel in free-standing plant	3.3	3.3
farmed wood Fischer-Tropsch diesel in free-standing plant	8.2	8.2
waste wood Fischer-Tropsch petrol in free-standing plant	3.3	3.3

farmed wood Fischer-Tropsch petrol in free-standing plant	8.2	8.2
waste wood dimethylether (DME) in free-standing plant	3.1	3.1
farmed wood dimethylether (DME) in free-standing plant	7.6	7.6
waste wood methanol in free-standing plant	3.1	3.1
farmed wood methanol in free-standing plant	7.6	7.6
Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill	2.5	2.5
Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill	2.5	2.5
dimethylether (DME) from black-liquor gasification integrated with pulp mill	2.5	2.5
Methanol from black-liquor gasification integrated with pulp mill	2.5	2.5
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Disaggregated default values for soil N_2O emissions (included in disaggregated default values for cultivation emissions in the "e_{ec}" table)

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
wheat straw ethanol	0	0
waste wood Fischer-Tropsch diesel in free-standing plant	0	0
farmed wood Fischer-Tropsch diesel in free-standing plant	4.4	4.4
waste wood Fischer-Tropsch petrol in free-standing plant	0	0
farmed wood Fischer-Tropsch petrol in free-standing plant	4.4	4.4
waste wood dimethylether (DME) in free-standing plant	0	0
farmed wood dimethylether (DME) in free-standing plant	4.1	4.1
waste wood methanol in free-standing plant	0	0

farmed wood methanol in free-standing plant	4.1	4.1
Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill	0	0
Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill	0	0
dimethylether (DME) from black-liquor gasification integrated with pulp mill	0	0
Methanol from black-liquor gasification integrated with pulp mill	0	0
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Disaggregated default values for processing: "e_p" as defined in Part C of this Schedule

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
wheat straw ethanol	4.8	6.8
waste wood Fischer-Tropsch diesel in free-standing plant	0.1	0.1
farmed wood Fischer-Tropsch diesel in free-standing plant	0.1	0.1
waste wood Fischer-Tropsch petrol in free-standing plant	0.1	0.1
farmed wood Fischer-Tropsch petrol in free-standing plant	0.1	0.1
waste wood dimethylether (DME) in free-standing plant	0	0
farmed wood dimethylether (DME) in free-standing plant	0	0
waste wood methanol in free-standing plant	0	0
farmed wood methanol in free-standing plant	0	0
Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill	0	0
Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill	0	0

dimethylether (DME) from black-liquor gasification integrated with pulp mill	0	0
methanol from black-liquor gasification integrated with pulp mill	0	0
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Disaggregated default values for transport and distribution: "e_{td}" as defined in Part C of this Schedule

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
wheat straw ethanol	7.1	7.1
waste wood Fischer-Tropsch diesel in free-standing plant	12.2	12.2
farmed wood Fischer-Tropsch diesel in free-standing plant	8.4	8.4
waste wood Fischer-Tropsch petrol in free-standing plant	12.2	12.2
farmed wood Fischer-Tropsch petrol in free-standing plant	8.4	8.4
waste wood dimethylether (DME) in free-standing plant	12.1	12.1
farmed wood dimethylether (DME) in free-standing plant	8.6	8.6
waste wood methanol in free-standing plant	12.1	12.1
farmed wood methanol in free-standing plant	8.6	8.6
Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill	7.7	7.7
Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill	7.9	7.9
dimethylether (DME) from black-liquor gasification integrated with pulp mill	7.7	7.7
methanol from black-liquor gasification integrated with pulp mill	7.9	7.9
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Disaggregated default values for transport and distribution of final fuel only. These are already included in the table of "transport and distribution emissions e_{td}" as defined in Part C of this Schedule, but the following values are useful if an economic operator wishes to declare actual transport emissions for feedstock transport only).

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
wheat straw ethanol	1.6	1.6
waste wood Fischer-Tropsch diesel in free-standing plant	1.2	1.2
farmed wood Fischer-Tropsch diesel in free-standing plant	1.2	1.2
waste wood Fischer-Tropsch petrol in free-standing plant	1.2	1.2
farmed wood Fischer-Tropsch petrol in free-standing plant	1.2	1.2
waste wood dimethylether (DME) in free-standing plant	2.0	2.0
farmed wood dimethylether (DME) in free-standing plant	2.0	2.0
waste wood methanol in free-standing plant	2.0	2.0
farmed wood methanol in free-standing plant	2.0	2.0
Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill	2.0	2.0
Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill	2.0	2.0
dimethylether (DME) from black-liquor gasification integrated with pulp mill	2.0	2.0
methanol from black-liquor gasification integrated with pulp mill	2.0	2.0
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Total for cultivation, processing, transport and distribution

Biofuel and bioliquid production pathway	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
wheat straw ethanol	13.7	15.7
waste wood Fischer-Tropsch diesel in free-standing plant	15.6	15.6
farmed wood Fischer-Tropsch diesel in free-standing plant	16.7	16.7
waste wood Fischer-Tropsch petrol in free-standing plant	15.6	15.6
farmed wood Fischer-Tropsch petrol in free-standing plant	16.7	16.7
waste wood dimethylether (DME) in free-standing plant	15.2	15.2
farmed wood dimethylether (DME) in free-standing plant	16.2	16.2
waste wood methanol in free-standing plant	15.2	15.2
farmed wood methanol in free-standing plant	16.2	16.2
Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill	10.2	10.2
Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill	10.4	10.4
dimethylether (DME) from black-liquor gasification integrated with pulp mill	10.2	10.2
methanol from black-liquor gasification integrated with pulp mill	10.4	10.4
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

SECOND SCHEDULE
(regulations 2, 3 and 5)

Rules for calculating the greenhouse gas impact of biomass fuels and their fossil fuel comparators

Part A
TYPICAL AND DEFAULT VALUES OF GREENHOUSE GAS EMISSIONS SAVINGS FOR BIOMASS FULELS IF PRODUCED WITH NO NET-CARBON EMISSIONS FROM LAND USE CHANGE

WOODCHIPS					
Biomass fuel production system	**Transport distance**	**Greenhouse gas emissions savings – typical value**		**Greenhouse gas emissions savings – default value**	
		Heat	**Electricity**	**Heat**	**Electricity**
Woodchips from forest residues	1 to 500 km	93%	89%	91%	87%
	500 to 2500 km	89%	84%	87%	81%
	2500 to 10000 km	82%	73%	78%	67%
	Above 10000 km	67%	51%	60%	41%
Woodchips from short rotation coppice (Eucalyptus)	2500 to 10000 km	77%	65%	73%	60%
Woodchips from short rotation coppice (Poplar – Fertilised)	1 to 500 km	89%	83%	87%	81%
	500 to 2500 km	85%	78%	84%	76%
	2500 to 10000 km	78%	67%	74%	62%
	Above 10000 km	63%	45%	57%	35%
Woodchips from short rotation coppice (Poplar – No fertilisation)	1 to 500 km	91%	87%	90%	85%
	500 to 2500 km	88%	82%	86%	79%
	2500 to 10000 km	80%	70%	77%	65%
	Above 10000 km	65%	48%	59%	39%

Woodchips from stemwood	1 to 500 km	93%	89%	92%	88%
	500 to 2500 km	90%	85%	88%	82%
	2500 to 10000 km	82%	73%	79%	68%
	Above 10000 km	67%	51%	61%	42%
Woodchips from industry residues	1 to 500 km	94%	92%	93%	90%
	500 to 2500 km	91%	87%	90%	85%
	2500 to 10000 km	83%	75%	80%	71%
	Above 10000 km	69%	54%	63%	44%

WOOD PELLETS (*1)						
Biomass fuel production system		**Transport distance**	**Greenhouse gas emissions savings – typical value**		**Greenhouse gas emissions savings – default value**	
			Heat	**Electricity**	**Heat**	**Electricity**
Wood briquettes or pellets from forest residues	Case 1	1 to 500 km	58%	37%	49%	24%
		500 to 2500 km	58%	37%	49%	25%
		2500 to 10000 km	55%	34%	47%	21%
		Above 10000 km	50%	26%	40%	11%
	Case 2a	1 to 500 km	77%	66%	72%	59%
		500 to 2500 km	77%	66%	72%	59%
		2500 to 10000 km	75%	62%	70%	55%
		Above 10000 km	69%	54%	63%	45%
	Case 3a	1 to 500 km	92%	88%	90%	85%
		500 to 2500 km	92%	88%	90%	86%
		2500 to 10000 km	90%	85%	88%	81%
		Above 10000 km	84%	76%	81%	72%

Wood briquettes or pellets from short rotation coppice (Eucalyptus)	Case 1	2500 to 10000 km	52%	28%	43%	15%
	Case 2a	2500 to 10000 km	70%	56%	66%	49%
	Case 3a	2500 to 10000 km	85%	78%	83%	75%
Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised)	Case 1	1 to 500 km	54%	32%	46%	20%
		500 to 10000 km	52%	29%	44%	16%
		Above 10000 km	47%	21%	37%	7%
	Case 2a	1 to 500 km	73%	60%	69%	54%
		500 to 10000 km	71%	57%	67%	50%
		Above 10000 km	66%	49%	60%	41%
	Case 3a	1 to 500 km	88%	82%	87%	81%
		500 to 10000 km	86%	79%	84%	77%
		Above 10000 km	80%	71%	78%	67%
Wood briquettes or pellets from short rotation coppice (Poplar – No fertilisation)	Case 1	1 to 500 km	56%	35%	48%	23%
		500 to 10000 km	54%	32%	46%	20%
		Above 10000 km	49%	24%	40%	10%
	Case 2a	1 to 500 km	76%	64%	72%	58%
		500 to 10000 km	74%	61%	69%	54%
		Above 10000 km	68%	53%	63%	45%
	Case 3a	1 to 500 km	91%	86%	90%	85%
		500 to 10000 km	89%	83%	87%	81%
		Above 10000 km	83%	75%	81%	71%

Stemwood	Case 1	1 to 500 km	57%	37%	49%	24%
		500 to 2500 km	58%	37%	49%	25%
		2500 to 10000 km	55%	34%	47%	21%
		Above 10000 km	50%	26%	40%	11%
	Case 2a	1 to 500 km	77%	66%	73%	60%
		500 to 2500 km	77%	66%	73%	60%
		2500 to 10000 km	75%	63%	70%	56%
		Above 10000 km	70%	55%	64%	46%
	Case 3a	1 to 500 km	92%	88%	91%	86%
		500 to 2500 km	92%	88%	91%	87%
		2500 to 10000 km	90%	85%	88%	83%
		Above 10000 km	84%	77%	82%	73%
Wood briquettes or pellets from wood industry residues	Case 1	1 to 500 km	75%	62%	69%	55%
		500 to 2500 km	75%	62%	70%	55%
		2500 to 10000 km	72%	59%	67%	51%
		Above 10000 km	67%	51%	61%	42%
	Case 2a	1 to 500 km	87%	80%	84%	76%
		500 to 2500 km	87%	80%	84%	77%
		2500 to 10000 km	85%	77%	82%	73%
		Above 10000 km	79%	69%	75%	63%
	Case 3a	1 to 500 km	95%	93%	94%	91%
		500 to 2500 km	95%	93%	94%	92%
		2500 to 10000 km	93%	90%	92%	88%
		Above 10000 km	88%	82%	85%	78%

(*1)

Case 1 refers to processes in which a natural gas boiler is used to provide the process heat to the pellet mill. Electricity for the pellet mill is supplied from the grid;

Case 2a refers to processes in which a woodchips boiler, fed with pre-dried chips, is used to provide process heat. Electricity for the pellet mill is supplied from the grid;

Case 3a refers to processes in which a CHP, fed with pre-dried woodchips, is used to provide electricity and heat to the pellet mill.

AGRICULTURE PATHWAYS					
Biomass fuel production system	**Transport distance**	**Greenhouse gas emissions savings – typical value**		**Greenhouse gas emissions savings – default value**	
		Heat	**Electricity**	**Heat**	**Electricity**
Agricultural Residues with density < 0.2 t/m^3 (*1)	1 to 500 km	95%	92%	93%	90%
	500 to 2500 km	89%	83%	86%	80%
	2500 to 10000 km	77%	66%	73%	60%
	Above 10000 km	57%	36%	48%	23%
Agricultural Residues with density > 0.2 t/m^3 (*2)	1 to 500 km	95%	92%	93%	90%
	500 to 2500 km	93%	89%	92%	87%
	2500 to 10000 km	88%	82%	85%	78%
	Above 10000 km	78%	68%	74%	61%
Straw pellets	1 to 500 km	88%	82%	85%	78%
	500 to 10000 km	86%	79%	83%	74%
	Above 10000 km	80%	70%	76%	64%
Bagasse briquettes	500 to 10000 km	93%	89%	91%	87 %
	Above 10000 km	87%	81%	85%	77%
Palm Kernel Meal	Above 10000 km	20%	-18%	11%	-33%
Palm Kernel Meal (no CH_4 emissions from oil mill)	Above 10000 km	46%	20%	42%	14%

(*1)
This group of materials includes agricultural residues with a low bulk density and it comprises materials such as straw bales, oat hulls, rice husks and sugar cane bagasse bales (not exhaustive list).

(*2)
The group of agricultural residues with higher bulk density includes materials such as corn cobs, nut shells, soybean hulls, palm kernel shells (not exhaustive list).

BIOGAS FOR ELECTRICITY (*1)				
Biogas production system		**Technological option**	**Greenhouse gas emissions savings – typical value**	**Greenhouse gas emissions savings – default value**
Wet manure (1)	Case 1	Open digestate (2)	146%	94%
		Close digestate (3)	246%	240%
	Case 2	Open digestate	136%	85%
		Close digestate	227%	219%
	Case 3	Open digestate	142%	86%
		Close digestate	243%	235%
Maize whole plant (4)	Case 1	Open digestate	36%	21%
		Close digestate	59%	53%
	Case 2	Open digestate	34%	18%
		Close digestate	55%	47%
	Case 3	Open digestate	28%	10%
		Close digestate	52%	43%
Biowaste	Case 1	Open digestate	47%	26%
		Close digestate	84%	78%
	Case 2	Open digestate	43%	21%
		Close digestate	77%	68%
	Case 3	Open digestate	38%	14%
		Close digestate	76%	66%

(*1)

Case 1 refers to pathways in which electricity and heat required in the process are supplied by the CHP engine itself.

Case 2 refers to pathways in which the electricity required in the process is taken from the grid and the process heat is supplied by the CHP engine itself. In some Member States, operators are not allowed to claim the gross production for subsidies and case 1 is the more likely configuration.

Case 3 refers to pathways in which the electricity required in the process is taken from the grid and the process heat is supplied by a biogas boiler. This case applies to some installations in which the CHP engine is not on-site and biogas is sold (but not upgraded to biomethane).

(1)

The values for biogas production from manure include negative emissions for emissions saved from raw manure management. The value of e_{sca} considered is equal to – 45 g CO_2eq/MJ manure used in anaerobic digestion.

(2)

Open storage of digestate accounts for additional emissions of CH_4 and N_2O. The magnitude of those emissions changes with ambient conditions, substrate types and the digestion efficiency.

(3)

Close storage means that the digestate resulting from the digestion process is stored in a gas-tight tank and that the additional biogas released during storage is considered to be recovered for production of additional electricity or biomethane. No greenhouse gas emissions are included in that process.

(4)

Maize whole plant means maize harvested as fodder and ensiled for preservation.

BIOGAS FOR ELECTRICITY – MIXTURES OF MANURE AND MAIZE				
Biogas production system		**Technological option**	**Greenhouse gas emissions savings – typical value**	**Greenhouse gas emissions savings – default value**
Manure – Maize 80% - 20%	Case 1	Open digestate	72%	45%
		Close digestate	120%	114%
	Case 2	Open digestate	67%	40%
		Close digestate	111%	103%
	Case 3	Open digestate	65%	35%
		Close digestate	114%	106%

Manure – Maize 70% - 30%	Case 1	Open digestate	60%	37%
		Close digestate	100%	94%
	Case 2	Open digestate	57%	32%
		Close digestate	93%	85%
	Case 3	Open digestate	53%	27%
		Close digestate	94%	85%
Manure – Maize 60% - 40%	Case 1	Open digestate	53%	32%
		Close digestate	88%	82%
	Case 2	Open digestate	50%	28%
		Close digestate	82%	73%
	Case 3	Open digestate	46%	22%
		Close digestate	81%	72%

BIOMETHANE FOR TRANSPORT (*1)			
Biomethane production system	**Technological options**	**Greenhouse gas emissions savings – typical value**	**Greenhouse gas emissions savings – default value**
Wet manure	Open digestate, no off-gas combustion	117%	72%
	Open digestate, off-gas combustion	133%	94%
	Close digestate, no off-gas combustion	190%	179%
	Close digestate, off-gas combustion	206%	202%
Maize whole plant	Open digestate, no off-gas combustion	35%	17%
	Open digestate, off-gas combustion	51%	39%
	Close digestate, no off-gas combustion	52%	41%
	Close digestate, off-gas combustion	68%	63%
Biowaste	Open digestate, no off-gas combustion	43%	20%
	Open digestate, off-gas combustion	59%	42%
	Close digestate, no off-gas combustion	70%	58%
	Close digestate, off-gas combustion	86%	80%

([*1]) The greenhouse gas emissions savings for biomethane only refer to compressed biomethane relative to the fossil fuel comparator for transport of 94 g CO_2eq/MJ.

BIOMETHANE – MIXTURES OF MANURE AND MAIZE ([*1])			
Biomethane production system	**Technological options**	**Greenhouse gas emissions savings – typical value**	**Greenhouse gas emissions savings – default value**
Manure – Maize 80% - 20%	Open digestate, no off-gas combustion ([1])	62%	35%
	Open digestate, off-gas combustion ([2])	78%	57%
	Close digestate, no off-gas combustion	97%	86%
	Close digestate, off-gas combustion	113%	108%
Manure – Maize 70% - 30%	Open digestate, no off-gas combustion	53%	29%
	Open digestate, off-gas combustion	69%	51%
	Close digestate, no off-gas combustion	83%	71%
	Close digestate, off-gas combustion	99%	94%
Manure – Maize 60% - 40%	Open digestate, no off-gas combustion	48%	25%
	Open digestate, off-gas combustion	64%	48%
	Close digestate, no off-gas combustion	74%	62%
	Close digestate, off-gas combustion	90%	84%

(*1)
The greenhouse gas emissions savings for biomethane only refer to compressed biomethane relative to the fossil fuel comparator for transport of 94 g CO_2eq/MJ.

(1)
This category includes the following categories of technologies for biogas upgrade to biomethane: Pressure Swing Adsorption (PSA), Pressure Water Scrubbing (PWS), Membranes, Cryogenic, and Organic Physical Scrubbing (OPS). It includes an emission of 0.03 MJ CH_4/MJ biomethane for the emission of methane in the off-gases.

(2)
This category includes the following categories of technologies for biogas upgrade to biomethane: Pressure Water Scrubbing (PWS) when water is recycled, Pressure Swing Adsorption (PSA), Chemical Scrubbing, Organic Physical Scrubbing (OPS), Membranes and Cryogenic upgrading. No methane emissions are considered for this category (the methane in the off-gas is combusted, if any).

Part B
METHODOLOGY

1. Greenhouse gas emissions from the production and use of biomass fuels, shall be calculated as follows:

(a) Greenhouse gas emissions from the production and use of biomass fuels before conversion into electricity, heating and cooling, shall be calculated as:

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr},$$

Where

E = total emissions from the production of the fuel before energy conversion;

e_{ec} = emissions from the extraction or cultivation of raw materials;

e_l = annualised emissions from carbon stock changes caused by land-use change;

e_p = emissions from processing;

e_{td} = emissions from transport and distribution;

e_u = emissions from the fuel in use;

e_{sca} = emission savings from soil carbon accumulation via improved agricultural management;

e_{ccs} = emission savings from CO_2 capture and geological storage; and

e_{ccr} = emission savings from CO_2 capture and replacement.

Emissions from the manufacture of machinery and equipment shall not be taken into account.

(b) In the case of co-digestion of different substrates in a biogas plant for the production of biogas or biomethane, the typical and default values of greenhouse gas emissions shall be calculated as:

$$E = \sum_{1}^{n} S_n \cdot E_n$$

where:

E = greenhouse gas emissions per MJ biogas or biomethane produced from co-digestion of the defined mixture of substrates

S_n = Share of feedstock n in energy content

E_n = Emission in g CO_2/MJ for pathway n as provided in Part D of this Schedule (*)

$$S_n = \frac{P_n \cdot W_n}{\sum_1^n P_n \cdot W_n}$$

where:

P_n = energy yield [MJ] per kilogram of wet input of feedstock n (**)

W_n = weighting factor of substrate n defined as:

$$W_n = \frac{I_n}{\sum_1^n I_n} \cdot \left(\frac{1 - AM_n}{1 - SM_n}\right)$$

where:

I_n = Annual input to digester of substrate n [tonne of fresh matter]

AM_n = Average annual moisture of substrate n [kg water/kg fresh matter]

SM_n = Standard moisture for substrate n (***).

(*) For animal manure used as substrate, a bonus of 45g CO_2eq/MJ manure (– 54kg CO_2eq/t fresh matter) is added for improved agricultural and manure management.

(**) The following values of P_n shall be used for calculating typical and default values:

P(Maize): 4.16 [$MJ_{biogas}/kg_{\text{wet maize @ 65\% moisture}}$]

P(Manure): 0.50 [$MJ_{biogas}/kg_{\text{wet manure @ 90\% moisture}}$]

P(Biowaste) 3.41 [$MJ_{biogas}/kg_{\text{wet biowaste @ 76\% moisture}}$]

(***) The following values of the standard moisture for substrate SM_n shall be used:

SM(Maize): 0.65 [kg water/kg fresh matter]

SM(Manure): 0.90 [kg water/kg fresh matter]

SM(Biowaste): 0.76 [kg water/kg fresh matter]

(c) In the case of co-digestion of n substrates in a biogas plant for the production of electricity or biomethane, actual greenhouse gas emissions of biogas and biomethane are calculated as follows:

$$E = \sum_{1}^{n} S_n \cdot \left(e_{ec,n} + e_{td,feedtock,n} + e_{l,n} - e_{sca,n}\right) + e_p + e_{td,product} + e_u - e_{ccs} - e_{ccr}$$

where:

E = total emissions from the production of the biogas or biomethane before energy conversion;

S_n = Share of feedstock n, in fraction of input to the digester;

$e_{ec,n}$ = emissions from the extraction or cultivation of feedstock n;

$e_{td,feedstock,n}$ = emissions from transport of feedstock n to the digester;

$e_{l,n}$ = annualised emissions from carbon stock changes caused by land-use change, for feedstock n;

e_{sca} = emission savings from improved agricultural management of feedstock n (*);

e_p = emissions from processing;

$e_{td,product}$ = emissions from transport and distribution of biogas and/or biomethane;

e_u = emissions from the fuel in use, that is greenhouse gases emitted during combustion;

e_{ccs} = emission savings from CO_2 capture and geological storage; and

e_{ccr} = emission savings from CO_2 capture and replacement.

(*) For e_{sca}a bonus of 45g CO_2eq/MJ manure shall be attributed for improved agricultural and manure management in the case animal manure is used as a substrate for the production of biogas and biomethane.

(d) Greenhouse gas emissions from the use of biomass fuels in producing electricity, heating and cooling, including the energy conversion to electricity and/or heat or cooling produced, shall be calculated as follows:

(i) For energy installations delivering only heat:

$$EC_h = \frac{E}{\eta_h}$$

(ii) For energy installations delivering only electricity:

$$EC_{el} = \frac{E}{\eta_{el}}$$

where:

$EC_{h,el}$ = Total greenhouse gas emissions from the final energy commodity.

E = Total greenhouse gas emissions of the fuel before end-conversion.

η_{el} = The electrical efficiency, defined as the annual electricity produced divided by the annual fuel input, based on its energy content.

η_h = The heat efficiency, defined as the annual useful heat output divided by the annual fuel input, based on its energy content.

(iii) For the electricity or mechanical energy coming from energy installations delivering useful heat together with electricity and/or mechanical energy:

$$EC_{el} = \frac{E}{\eta_{el}}\left(\frac{C_{el} \cdot \eta_{el}}{C_{el} \cdot \eta_{el} + C_h \cdot \eta_h}\right)$$

(iv) For the useful heat coming from energy installations delivering heat together with electricity and/or mechanical energy:

$$EC_h = \frac{E}{\eta_h}\left(\frac{C_h \cdot \eta_h}{C_{el} \cdot \eta_{el} + C_h \cdot \eta_h}\right)$$

where:

$EC_{h,el}$ = Total greenhouse gas emissions from the final energy commodity.

E = Total greenhouse gas emissions of the fuel before end-conversion.

η_{el} = The electrical efficiency, defined as the annual electricity produced divided by the annual energy input, based on its energy content.

η_h = The heat efficiency, defined as the annual useful heat output divided by the annual energy input, based on its energy content.

C_{el} = Fraction of exergy in the electricity, and/or mechanical energy, set to 100% (C_{el} = 1).

C_h = Carnot efficiency (fraction of exergy in the useful heat).

The Carnot efficiency, C_h, for useful heat at different temperatures is defined as:

$$C_h = \frac{T_h - T_0}{T_h}$$

where:

T_h = Temperature, measured in absolute temperature (kelvin) of the useful heat at point of delivery.

T_0 = Temperature of surroundings, set at 273.15 kelvin (equal to 0°C).

If the excess heat is exported for heating of buildings, at a temperature below 150°C (423.15 kelvin), C_h can alternatively be defined as follows:

C_h = Carnot efficiency in heat at 150°C (423.15 kelvin), which is: 0.3546

For the purposes of that calculation, the following definitions apply:

(i) "cogeneration" shall mean the simultaneous generation in one process of thermal energy and electricity and/ or mechanical energy;

(ii) "useful heat" shall mean heat generated to satisfy an economical justifiable demand for heat, for heating or cooling purposes;

(iii) "economically justifiable demand" shall mean the demand that does not exceed the needs for heat or cooling and which would otherwise be satisfied at market conditions.

2. Greenhouse gas emissions from biomass fuels shall be expressed as follows:

(a) greenhouse gas emissions from biomass fuels, E, shall be expressed in terms of grams of CO_2 equivalent per MJ of biomass fuel, g CO_2eq/MJ;

(b) greenhouse gas emissions from heating or electricity, produced from biomass fuels, EC, shall be expressed

in terms of grams of CO_2 equivalent per MJ of final energy commodity (heat or electricity), g CO_2eq/MJ.

When heating and cooling are co-generated with electricity, emissions shall be allocated between heat and electricity (as under paragraph (d) of item 1), irrespective if the heat is used for actual heating purposes or for cooling. ([Note 1])

Where the greenhouse gas emissions from the extraction or cultivation of raw materials e_{ec} are expressed in unit g CO_2eq/dry-ton of feedstock, the conversion to grams of CO_2 equivalent per MJ of fuel, g CO_2eq /MJ, shall be calculated as follows ([Note 2])

$$e_{ec}fuel_a \left[\frac{gCO_2eq}{MJfuel}\right]_{ec} = \frac{e_{ec}feedstock_a \left[\frac{gCO_2eq}{t_{dry}}\right]}{LHV_a \left[\frac{MJ\ feedstock}{t\ dry\ feedstock}\right]} \times Fuel\ feedstock\ factor_a \times Allocation\ factor\ fuel_a$$

where:

$$Allocator\ factor\ fuel_a = \left[\frac{Energy\ in\ fuel}{Energy\ fuel + Energy\ in\ coproducts}\right]$$

Fuel feedstock $factor_a$ = [Ratio of MJ feedstock required to make 1MJ fuel]

Emissions per dry-ton feedstock shall be calculated as follows:

$$e_{ec}feedstock_a \left[\frac{gCO_2eq}{t_{dry}}\right] = \frac{e_{ec}feedstock_a \left[\frac{gCO_2eq}{t_{moist}}\right]}{(1 - moisture\ content)}$$

3. Greenhouse gas emissions savings from biomass fuels shall be calculated as follows:

(a) greenhouse gas emissions savings from biomass fuels used as transport fuels:

SAVING = $(E_{F(t)} - E_B)/E_{F(t)}$

where

E_B = total emissions from biomass fuels used as transport fuels; and

$E_{F(t)}$ = total emissions from the fossil fuel comparator for transport

(b) greenhouse gas emissions savings from heat and cooling, and electricity being generated from biomass fuels:

SAVING = $(EC_{F(h\&c,el)} - EC_{B(h\&c,el)})/EC_{F\ (h\&c,el)}$,

where

$EC_{B(h\&c,el)}$ = total emissions from the heat or electricity,

$EC_{F(h\&c,el)}$ = total emissions from the fossil fuel comparator for useful heat or electricity.

4. The greenhouse gases taken into account for the purposes of item1 shall be CO_2, N_2O and CH_4. For the purposes of calculating CO_2 equivalence, those gases shall be valued as follows:

CO_2: 1

N_2O: 298

CH_4: 25

5. Emissions from the extraction, harvesting or cultivation of raw materials, e_{ec}, shall include emissions from the extraction, harvesting or cultivation process itself; from the collection, drying and storage of raw materials; from waste and leakages; and from the production of chemicals or products used in extraction or cultivation. Capture of CO_2 in the cultivation of raw materials shall be excluded. Estimates of emissions from agriculture biomass cultivation may be derived from the regional averages for cultivation emissions included in the reports referred to in Article 31(4) of the Directive or the information on the disaggregated default values for cultivation emissions included in this Schedule, as an alternative to using actual values. In the absence of relevant information in those reports it is allowed to calculate averages based on local farming practises based for instance on data of a group of farms, as an alternative to using actual values.

Estimates of emissions from cultivation and harvesting of forestry biomass may be derived from the use of averages for cultivation and harvesting emissions calculated for geographical areas at national level, as an alternative to using actual values.

6. For the purposes of the calculation referred to in paragraph (*a*) of item 1, emission savings from improved agriculture management, e_{sca}, such as shifting to reduced or zero-tillage, improved crop/rotation, the use of cover crops, including crop residue management, and the use of organic soil improver (e.g. compost, manure fermentation digestate), shall be taken into account only if solid and verifiable evidence is provided that the soil carbon has increased or that it is reasonable to expect to have increased over the period in which the raw materials concerned were cultivated while taking into account the emissions where such practices lead to increased fertiliser and herbicide use ([Note 3]).

7. Annualised emissions from carbon stock changes caused by land-use change, e_l, shall be calculated by dividing total emissions equally over twenty (20) years. For the calculation of those emissions the following rule shall be applied:

$$e_l = (CS_R - CS_A) \times 3.664 \times 1/20 \times 1/P - e_B,$$ ([Note 4])

where

e_l = annualised greenhouse gas emissions from carbon stock change due to land-use change (measured as mass of CO_2-equivalent per unit biomass fuel energy). "Cropland" ([Note 5]) and "perennial cropland" ([Note 6]) shall be regarded as one land use;

CS_R = the carbon stock per unit area associated with the reference land use (measured as mass (tonnes) of carbon per unit area, including both soil and vegetation). The reference land use shall be the land use in January 2008 or twenty (20) years before the raw material was obtained, whichever was the later;

CS_A = the carbon stock per unit area associated with the actual land use (measured as mass (tonnes) of carbon per unit area, including both soil and vegetation). In cases where the carbon stock accumulates over more than one year, the value attributed to CS_A shall be the estimated stock per unit area after twenty (20) years or when the crop reaches maturity, whichever the earlier;

P = the productivity of the crop (measured as biomass fuel energy per unit area per year); and

e_B = bonus of 29g CO_2eq/MJ biomass fuel if biomass is obtained from restored degraded land under the conditions laid down in item 8.

8. The bonus of 29g CO_2eq/MJ shall be attributed if evidence is provided that the land:

(a) was not in use for agriculture in January 2008 or any other activity; and

(b) is severely degraded land, including such land that was formerly in agricultural use.

The bonus of 29g CO_2eq/MJ shall apply for a period of up to twenty (20) years from the date of conversion of the land to agricultural use, provided that a steady increase in carbon stocks as well as a sizable reduction in erosion phenomena for land falling under (*b*) are ensured.

9. "Severely degraded land" means land that, for a significant period of time, has either been significantly salinated or presented significantly low organic matter content and has been severely eroded.

10. In accordance with item 10 of Part C of the First Schedule, Commission Decision 2010/335/EU ([Note 7]), which provides for guidelines for the calculation of land carbon stocks in relation to the Directive, drawing on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories – volume 4, and in accordance with Regulations (EU) No 525/2013 and (EU) 2018/841, shall serve as the

basis for the calculation of land carbon stocks.

11. Emissions from processing, e_p, shall include emissions from the processing itself; from waste and leakages; and from the production of chemicals or products used in processing, including the CO_2 emissions corresponding to the carbon contents of fossil inputs, whether or not actually combusted in the process.

In accounting for the consumption of electricity not produced within the solid or gaseous biomass fuel production plant, the greenhouse gas emissions intensity of the production and distribution of that electricity shall be assumed to be equal to the average emission intensity of the production and distribution of electricity in a defined region. By way of derogation from this rule, producers may use an average value for an individual electricity production plant for electricity produced by that plant, if that plant is not connected to the electricity grid.

Emissions from processing shall include emissions from drying of interim products and materials where relevant.

12. Emissions from transport and distribution, e_{td}, shall include emissions from the transport of raw and semi-finished materials and from the storage and distribution of finished materials. Emissions from transport and distribution to be taken into account under item 5 shall not be covered by this item.

13. Emissions of CO_2 from fuel in use, e_u, shall be taken to be zero for biomass fuels. Emissions of non-CO_2 greenhouse gases (CH_4 and N_2O) from the fuel in use shall be included in the e_u factor.

14. Emission savings from CO_2 capture and geological storage, e_{ccs}, that have not already been accounted for in e_p, shall be limited to emissions avoided through the capture and storage of emitted CO_2 directly related to the extraction, transport, processing and distribution of biomass fuel if stored in compliance with Directive 2009/31/EC.

15. Emission savings from CO_2 capture and replacement, e_{ccr}, shall be related directly to the production of biomass fuel they are attributed to, and shall be limited to emissions avoided through the capture of CO_2 of which the carbon originates from biomass and which is used to replace fossil-derived CO_2 in production of commercial products and services.

16. Where a cogeneration unit – providing heat and, or electricity to a biomass fuel production process for which emissions are being calculated – produces excess electricity and/or excess useful

heat, the greenhouse gas emissions shall be divided between the electricity and the useful heat according to the temperature of the heat (which reflects the usefulness (utility) of the heat). The useful part of the heat is found by multiplying its energy content with the Carnot efficiency, C_h, calculated as follows:

$$C_h = \frac{T_h - T_0}{T_h}$$

where:

T_h = Temperature, measured in absolute temperature (kelvin) of the useful heat at point of delivery.

T_0 = Temperature of surroundings, set at 273.15 kelvin (equal to 0°C).

If the excess heat is exported for heating of buildings, at a temperature below 150°C (423.15 kelvin), C_h can alternatively be defined as follows:

C_h = Carnot efficiency in heat at 150 °C (423.15 kelvin), which is: 0.3546

For the purposes of that calculation, the actual efficiencies shall be used, defined as the annual mechanical energy, electricity and heat produced respectively divided by the annual energy input.

For the purposes of that calculation, the following definitions apply:

(a) "cogeneration" shall mean the simultaneous generation in one process of thermal energy and electrical and/or mechanical energy;

(b) "useful heat" shall mean heat generated to satisfy an economical justifiable demand for heat, for heating or cooling purposes;

(c) "economically justifiable demand" shall mean the demand that does not exceed the needs for heat or cooling and which would otherwise be satisfied at market conditions.

17. Where a biomass fuel production process produces, in combination, the fuel for which emissions are being calculated and one or more other products ("co-products"), greenhouse gas emissions shall be divided between the fuel or its intermediate product and the co-products in proportion to their energy content (determined by lower

heating value in the case of co-products other than electricity and heat). The greenhouse gas intensity of excess useful heat or excess electricity is the same as the greenhouse gas intensity of heat or electricity delivered to the biomass fuel production process and is determined from calculating the greenhouse gas intensity of all inputs and emissions, including the feedstock and CH_4 and N_2O emissions, to and from the cogeneration unit, boiler or other apparatus delivering heat or electricity to the biomass fuel production process. In the case of cogeneration of electricity and heat, the calculation is performed following item16.

18. For the purposes of the calculations referred to in item 17, the emissions to be divided shall be e_{ec}+ e_l+ e_{sca}+ those fractions of e_p, e_{td}, e_{ccs} and e_{ccr} that take place up to and including the process step at which a co-product is produced. If any allocation to co-products has taken place at an earlier process step in the life-cycle, the fraction of those emissions assigned in the last such process step to the intermediate fuel product shall be used for those purposes instead of the total of those emissions.

In the case of biogas and biomethane, all co-products shall be taken into account for the purposes of that calculation. No emissions shall be allocated to wastes and residues. Co-products that have a negative energy content shall be considered to have an energy content of zero for the purposes of the calculation.

Wastes and residues, including tree tops and branches, straw, husks, cobs and nut shells, and residues from processing, including crude glycerine (glycerine that is not refined) and bagasse, shall be considered to have zero life-cycle greenhouse gas emissions up to the process of collection of those materials irrespectively of whether they are processed to interim products before being transformed into the final product.

In the case of biomass fuels produced in refineries, other than the combination of processing plants with boilers or cogeneration units providing heat and/or electricity to the processing plant, the unit of analysis for the purposes of the calculation referred to in item 17 shall be the refinery.

19. For biomass fuels used for the production of electricity, for the purposes of the calculation referred to in item 3, the fossil fuel comparator $EC_{F(el)}$ shall be 183g CO_2eq/MJ electricity or 212g CO_2eq/MJ electricity for the outermost regions.

For biomass fuels used for the production of useful heat, as well as for the production of heating and/or cooling, for the purposes of the calculation referred to in item 3, the fossil fuel comparator $EC_{F(h)}$ shall be 80g CO_2eq/MJ heat.

For biomass fuels used for the production of useful heat, in which a direct physical substitution of coal can be demonstrated, for the purposes of the calculation referred to in item 3, the fossil fuel comparator $EC_{F(h)}$ shall be 124g CO_2eq/MJ heat.

For biomass fuels used as transport fuels, for the purposes of the calculation referred to in item 3, the fossil fuel comparator $E_{F(t)}$ shall be 94g CO_2eq/MJ.

Notes to Part B of this Schedule

(Note 1) Heat or waste heat is used to generate cooling (chilled air or water) through absorption chillers. Therefore, it is appropriate to calculate only the emissions associated to the heat produced, per MJ of heat, irrespectively if the end-use of the heat is actual heating or cooling via absorption chillers.

(Note 2)The formula for calculating greenhouse gas emissions from the extraction or cultivation of raw materials e_{ec} describes cases where feedstock is converted into biofuels in one step. For more complex supply chains, adjustments are needed for calculating greenhouse gas emissions from the extraction or cultivation of raw materials e_{ec} for intermediate products.

(Note 3) Measurements of soil carbon can constitute such evidence, e.g. by a first measurement in advance of the cultivation and subsequent ones at regular intervals several years apart. In such a case, before the second measurement is available, increase in soil carbon would be estimated on the basis of representative experiments or soil models. From the second measurement onwards, the measurements would constitute the basis for determining the existence of an increase in soil carbon and its magnitude.

(Note 4) The quotient obtained by dividing the molecular weight of CO2 (44.010 g/mol) by the molecular weight of carbon (12.011g/mol) is equal to 3.664.

(Note 5) Cropland as defined by IPCC.

(Note 6) Perennial crops are defined as multi-annual crops, the stem of which is usually not annually harvested such as short rotation coppice and oil palm.

(Note 7) Commission Decision 2010/335/EU of 10 June 2010 on guidelines for the calculation of land carbon stocks for the purpose of

Annex V to Directive 2009/28/EC (OJL151, 17.6.2010, p.19).

Part C

DISAGGREGATED DEFAULT VALUES FOR BIOMASS FUELS

Wood briquettes or pellets

Biomass fuel production system	Transport distance	Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$)				Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$)			
		Cultivation	Processing	Transport	Non-CO_2 emissions from the fuel in use	Cultivation	Processing	Transport	Non-CO_2 emissions from the fuel in use
Wood chips from forest residues	1 to 500 km	0.0	1.6	3.0	0.4	0.0	1.9	3.6	0.5
	500 to 2500 km	0.0	1.6	5.2	0.4	0.0	1.9	6.2	0.5
	2500 to 10000 km	0.0	1.6	10.5	0.4	0.0	1.9	12.6	0.5
	Above 10000 km	0.0	1.6	20.5	0.4	0.0	1.9	24.6	0.5
Wood chips from SRC (Eucalyptus)	2500 to 10000 km	4.4	0.0	11.0	0.4	4.4	0.0	13.2	0.5
Wood chips from SRC (Poplar – fertilised)	1 to 500 km	3.9	0.0	3.5	0.4	3.9	0.0	4.2	0.5
	500 to 2500 km	3.9	0.0	5.6	0.4	3.9	0.0	6.8	0.5
	2500 to 10000 km	3.9	0.0	11.0	0.4	3.9	0.0	13.2	0.5
	Above 10000 km	3.9	0.0	21.0	0.4	3.9	0.0	25.2	0.5
Wood chips from SRC (Poplar – Not fertilised)	1 to 500 km	2.2	0.0	3.5	0.4	2.2	0.0	4.2	0.5
	500 to 2500 km	2.2	0.0	5.6	0.4	2.2	0.0	6.8	0.5
	2500 to 10000 km	2.2	0.0	11.0	0.4	2.2	0.0	13.2	0.5
	Above 10000 km	2.2	0.0	21.0	0.4	2.2	0.0	25.2	0.5

Wood chips from stemwood	1 to 500 km	1.1	0.3	3.0	0.4	1.1	0.4	3.6	0.5
	500 to 2500 km	1.1	0.3	5.2	0.4	1.1	0.4	6.2	0.5
	2500 to 10000 km	1.1	0.3	10.5	0.4	1.1	0.4	12.6	0.5
	Above 10000 km	1.1	0.3	20.5	0.4	1.1	0.4	24.6	0.5
Wood chips from wood industry residues	1 to 500 km	0.0	0.3	3.0	0.4	0.0	0.4	3.6	0.5
	500 to 2500 km	0.0	0.3	5.2	0.4	0.0	0.4	6.2	0.5
	2500 to 10000 km	0.0	0.3	10.5	0.4	0.0	0.4	12.6	0.5
	Above 10000 km	0.0	0.3	20.5	0.4	0.0	0.4	24.6	0.5

Wood briquettes or pellets

Biomass fuel production system	**Transport distance**	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**				**Greenhouse gas emissions – default value (g CO_2eq/MJ)**			
		Cultivation	Processing	Transport & distribution	Non-CO_2 emissions from the fuel in use	Cultivation	Processing	Transport & distribution	Non-CO_2 emissions from the fuel in use
Wood briquettes or pellets from forest residues (case 1)	1 to 500 km	0.0	25.8	2.9	0.3	0.0	30.9	3.5	0.3
	500 to 2500 km	0.0	25.8	2.8	0.3	0.0	30.9	3.3	0.3
	2500 to 10000 km	0.0	25.8	4.3	0.3	0.0	30.9	5.2	0.3
	Above 10000 km	0.0	25.8	7.9	0.3	0.0	30.9	9.5	0.3
Wood briquettes or pellets from forest residues (case 2a)	1 to 500 km	0.0	12.5	3.0	0.3	0.0	15.0	3.6	0.3
	500 to 2500 km	0.0	12.5	2.9	0.3	0.0	15.0	3.5	0.3
	2500 to 10000 km	0.0	12.5	4.4	0.3	0.0	15.0	5.3	0.3
	Above 10000 km	0.0	12.5	8.1	0.3	0.0	15.0	9.8	0.3

Wood briquettes or pellets from forest residues (case 3a)	1 to 500 km	0.0	2.4	3.0	0.3	0.0	2.8	3.6	0.3
	500 to 2500 km	0.0	2.4	2.9	0.3	0.0	2.8	3.5	0.3
	2500 to 10000 km	0.0	2.4	4.4	0.3	0.0	2.8	5.3	0.3
	Above 10000 km	0.0	2.4	8.2	0.3	0.0	2.8	9.8	0.3
Wood briquettes from short rotation coppice (Eucalyptus – case 1)	2500 to 10000 km	3.9	24.5	4.3	0.3	3.9	29.4	5.2	0.3
Wood briquettes from short rotation coppice (Eucalyptus – case 2a)	2500 to 10000 km	5.0	10.6	4.4	0.3	5.0	12.7	5.3	0.3
Wood briquettes from short rotation coppice (Eucalyptus – case 3a)	2500 to 10000 km	5.3	0.3	4.4	0.3	5.3	0.4	5.3	0.3
Wood briquettes from short rotation coppice (Poplar – Fertilised – case 1)	1 to 500 km	3.4	24.5	2.9	0.3	3.4	29.4	3.5	0.3
	500 to 10000 km	3.4	24.5	4.3	0.3	3.4	29.4	5.2	0.3
	Above 10 000 km	3.4	24.5	7.9	0.3	3.4	29.4	9.5	0.3
Wood briquettes from short rotation coppice (Poplar – Fertilised – case 2a)	1 to 500 km	4.4	10.6	3.0	0.3	4.4	12.7	3.6	0.3
	500 to 10000 km	4.4	10.6	4.4	0.3	4.4	12.7	5.3	0.3
	Above 10000 km	4.4	10.6	8.1	0.3	4.4	12.7	9.8	0.3

Wood briquettes from short rotation coppice (Poplar – Fertilised – case 3a)	1 to 500 km	4.6	0.3	3.0	0.3	4.6	0.4	3.6	0.3
	500 to 10000 km	4.6	0.3	4.4	0.3	4.6	0.4	5.3	0.3
	Above 10000 km	4.6	0.3	8.2	0.3	4.6	0.4	9.8	0.3
Wood briquettes from short rotation coppice (Poplar – no fertilisation – case 1)	1 to 500 km	2.0	24.5	2.9	0.3	2.0	29.4	3.5	0.3
	500 to 2500 km	2.0	24.5	4.3	0.3	2.0	29.4	5.2	0.3
	2500 to 10000 km	2.0	24.5	7.9	0.3	2.0	29.4	9.5	0.3
Wood briquettes from short rotation coppice (Poplar – no fertilisation – case 2a)	1 to 500 km	2.5	10.6	3.0	0.3	2.5	12.7	3.6	0.3
	500 to 10000 km	2.5	10.6	4.4	0.3	2.5	12.7	5.3	0.3
	Above 10000 km	2.5	10.6	8.1	0.3	2.5	12.7	9.8	0.3
Wood briquettes from short rotation coppice (Poplar – no fertilisation– case 3a)	1 to 500 km	2.6	0.3	3.0	0.3	2.6	0.4	3.6	0.3
	500 to 10000 km	2.6	0.3	4.4	0.3	2.6	0.4	5.3	0.3
	Above 10000 km	2.6	0.3	8.2	0.3	2.6	0.4	9.8	0.3
Wood briquettes or pellets from stemwood (case 1)	1 to 500 km	1.1	24.8	2.9	0.3	1.1	29.8	3.5	0.3
	500 to 2500 km	1.1	24.8	2.8	0.3	1.1	29.8	3.3	0.3
	2500 to 10000 km	1.1	24.8	4.3	0.3	1.1	29.8	5.2	0.3
	Above 10000 km	1.1	24.8	7.9	0.3	1.1	29.8	9.5	0.3

Wood briquettes or pellets from stemwood (case 2a)	1 to 500 km	1.4	11.0	3.0	0.3	1.4	13.2	3.6	0.3
	500 to 2500 km	1.4	11.0	2.9	0.3	1.4	13.2	3.5	0.3
	2500 to 10000 km	1.4	11.0	4.4	0.3	1.4	13.2	5.3	0.3
	Above 10000 km	1.4	11.0	8.1	0.3	1.4	13.2	9.8	0.3
Wood briquettes or pellets from stemwood (case 3a)	1 to 500 km	1.4	0.8	3.0	0.3	1.4	0.9	3.6	0.3
	500 to 2500 km	1.4	0.8	2.9	0.3	1.4	0.9	3.5	0.3
	2500 to 10000 km	1.4	0.8	4.4	0.3	1.4	0.9	5.3	0.3
	Above 10000 km	1.4	0.8	8.2	0.3	1.4	0.9	9.8	0.3
Wood briquettes or pellets from wood industry residues (case 1)	1 to 500 km	0.0	14.3	2.8	0.3	0.0	17.2	3.3	0.3
	500 to 2500 km	0.0	14.3	2.7	0.3	0.0	17.2	3.2	0.3
	2500 to 10000 km	0.0	14.3	4.2	0.3	0.0	17.2	5.0	0.3
	Above 10000 km	0.0	14.3	7.7	0.3	0.0	17.2	9.2	0.3
Wood briquettes or pellets from wood industry residues (case 2a)	1 to 500 km	0.0	6.0	2.8	0.3	0.0	7.2	3.4	0.3
	500 to 2500 km	0.0	6.0	2.7	0.3	0.0	7.2	3.3	0.3
	2500 to 10000 km	0.0	6.0	4.2	0.3	0.0	7.2	5.1	0.3
	Above 10000 km	0.0	6.0	7.8	0.3	0.0	7.2	9.3	0.3
Wood briquettes or pellets from wood industry residues (case 3a)	1 to 500 km	0.0	0.2	2.8	0.3	0.0	0.3	3.4	0.3
	500 to 2500 km	0.0	0.2	2.7	0.3	0.0	0.3	3.3	0.3
	2500 to 10000 km	0.0	0.2	4.2	0.3	0.0	0.3	5.1	0.3
	Above 10000 km	0.0	0.2	7.8	0.3	0.0	0.3	9.3	0.3

Agriculture pathways

Biomass fuel production system	Transport distance	Greenhouse gas emissions – typical value (g CO_2eq/MJ)				Greenhouse gas emissions – default value (g CO_2eq/MJ)			
		Cultivation	Processing	Transport & distribution	Non-CO_2 emissions from the fuel in use	Cultivation	Processing	Transport & distribution	Non-CO_2 emissions from the fuel in use
Agricultural Residues with density < 0.2 t/m^3	1 to 500 km	0.0	0.9	2.6	0.2	0.0	1.1	3.1	0.3
	500 to 2500 km	0.0	0.9	6.5	0.2	0.0	1.1	7.8	0.3
	2500 to 10000 km	0.0	0.9	14.2	0.2	0.0	1.1	17.0	0.3
	Above 10000 km	0.0	0.9	28.3	0.2	0.0	1.1	34.0	0.3
Agricultural Residues with density > 0.2 t/m^3	1 to 500 km	0.0	0.9	2.6	0.2	0.0	1.1	3.1	0.3
	500 to 2500 km	0.0	0.9	3.6	0.2	0.0	1.1	4.4	0.3
	2500 to 10000 km	0.0	0.9	7.1	0.2	0.0	1.1	8.5	0.3
	Above 10000 km	0.0	0.9	13.6	0.2	0.0	1.1	16.3	0.3
Straw pellets	1 to 500 km	0.0	5.0	3.0	0.2	0.0	6.0	3.6	0.3
	500 to 10000 km	0.0	5.0	4.6	0.2	0.0	6.0	5.5	0.3
	Above 10000 km	0.0	5.0	8.3	0.2	0.0	6.0	10.0	0.3
Bagasse briquettes	500 to 10000 km	0.0	0.3	4.3	0.4	0.0	0.4	5.2	0.5
	Above 10000 km	0.0	0.3	8.0	0.4	0.0	0.4	9.5	0.5
Palm Kernel Meal	Above 10 000 km	21.6	21.1	11.2	0.2	21.6	25.4	13.5	0.3
Palm Kernel Meal (no CH_4 emissions from oil mill)	Above 10000 km	21.6	3.5	11.2	0.2	21.6	4.2	13.5	0.3

Disaggregated default values for biogas for the production of

electricity

Biomass fuel production system		Technology	TYPICAL VALUE [g CO_2eq/MJ]					DEFAULT VALUE [g CO_2eq/MJ]				
			Cultivation	Processing	Non-CO_2 emissions from the fuel in use	Transport	Manure credits	Cultivation	Processing	Non-CO_2 emissions from the fuel in use	Transport	Manure credits
Wet manure (1)	case 1	Open digestate	0.0	69.6	8.9	0.8	– 107.3	0.0	97.4	12.5	0.8	– 107.3
		Close digestate	0.0	0.0	8.9	0.8	– 97.6	0.0	0.0	12.5	0.8	– 97.6
	case 2	Open digestate	0.0	74.1	8.9	0.8	– 107.3	0.0	103.7	12.5	0.8	– 107.3
		Close digestate	0.0	4.2	8.9	0.8	– 97.6	0.0	5.9	12.5	0.8	– 97.6
	case 3	Open digestate	0.0	83.2	8.9	0.9	– 120.7	0.0	116.4	12.5	0.9	– 120.7
		Close digestate	0.0	4.6	8.9	0.8	– 108.5	0.0	6.4	12.5	0.8	– 108.5
Maize whole plant (2)	case 1	Open digestate	15.6	13.5	8.9	0.0 (3)	—	15.6	18.9	12.5	0.0	—
		Close digestate	15.2	0.0	8.9	0.0	—	15.2	0.0	12.5	0.0	—
	case 2	Open digestate	15.6	18.8	8.9	0.0	—	15.6	26.3	12.5	0.0	—
		Close digestate	15.2	5.2	8.9	0.0	—	15.2	7.2	12.5	0.0	—
	case 3	Open digestate	17.5	21.0	8.9	0.0	—	17.5	29.3	12.5	0.0	—
		Close digestate	17.1	5.7	8.9	0.0	—	17.1	7.9	12.5	0.0	—
Biowaste	case 1	Open digestate	0.0	21.8	8.9	0.5	—	0.0	30.6	12.5	0.5	—
		Close digestate	0.0	0.0	8.9	0.5	—	0.0	0.0	12.5	0.5	—
	case 2	Open digestate	0.0	27.9	8.9	0.5	—	0.0	39.0	12.5	0.5	—
		Close digestate	0.0	5.9	8.9	0.5	—	0.0	8.3	12.5	0.5	—
	case 3	Open digestate	0.0	31.2	8.9	0.5	—	0.0	43.7	12.5	0.5	—
		Close digestate	0.0	6.5	8.9	0.5	—	0.0	9.1	12.5	0.5	—

([1])
The values for biogas production from manure include negative emissions for emissions saved from raw manure management. The value of e_{sca} considered is equal to – 45 g CO_2eq/MJ manure used in anaerobic digestion.

([2])
Maize whole plant means maize harvested as fodder and ensiled for preservation.

([3])
Transport of agricultural raw materials to the transformation plant is, according to the methodology provided in the Commission's report of 25 February 2010 on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling, included in the "cultivation" value. The value for transport of maize silage accounts for 0.4 g CO_2eq/MJ biogas.

Disaggregated default values for biomethane

Biomethane production system	Technological option		TYPICAL VALUE [g CO_2eq/MJ]						DEFAULT VALUE [g CO_2eq/MJ]					
			Cultivation	Processing	Upgrading	Transport	Compression at filling station	Manure credits	Cultivation	Processing	Upgrading	Transport	Compression at filling station	Manure credits
Wet manure	Open digestate	no off-gas combustion	0.0	84.2	19.5	1.0	3.3	– 124.4	0.0	117.9	27.3	1.0	4.6	– 124.4
		off-gas combustion	0.0	84.2	4.5	1.0	3.3	– 124.4	0.0	117.9	6.3	1.0	4.6	– 124.4
	Close digestate	no off-gas combustion	0.0	3.2	19.5	0.9	3.3	– 111.9	0.0	4.4	27.3	0.9	4.6	– 111.9
		off-gas combustion	0.0	3.2	4.5	0.9	3.3	– 111.9	0.0	4.4	6.3	0.9	4.6	– 111.9
Maize whole plant	Open digestate	no off-gas combustion	18.1	20.1	19.5	0.0	3.3	—	18.1	28.1	27.3	0.0	4.6	—
		off-gas combustion	18.1	20.1	4.5	0.0	3.3	—	18.1	28.1	6.3	0.0	4.6	—
	Close digestate	no off-gas combustion	17.6	4.3	19.5	0.0	3.3	—	17.6	6.0	27.3	0.0	4.6	—
		off-gas combustion	17.6	4.3	4.5	0.0	3.3	—	17.6	6.0	6.3	0.0	4.6	—
Biowaste	Open digestate	no off-gas combustion	0.0	30.6	19.5	0.6	3.3	—	0.0	42.8	27.3	0.6	4.6	—
		off-gas combustion	0.0	30.6	4.5	0.6	3.3	—	0.0	42.8	6.3	0.6	4.6	—
	Close digestate	no off-gas combustion	0.0	5.1	19.5	0.5	3.3	—	0.0	7.2	27.3	0.5	4.6	—
		off-gas combustion	0.0	5.1	4.5	0.5	3.3	—	0.0	7.2	6.3	0.5	4.6	—

Part D

TOTAL TYPICAL AND DEFAULT VALUES FOR BIOMASS FUEL PATHWAYS

Biomass fuel production system	**Transport distance**	**Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$)**	**Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$)**
Woodchips from forest residues	1 to 500 km	5	6
	500 to 2500 km	7	9
	2500 to 10000 km	12	15
	Above 10000 km	22	27
Woodchips from short rotation coppice (Eucalyptus)	2500 to 10000 km	16	18
Woodchips from short rotation coppice (Poplar – Fertilised)	1 to 500 km	8	9
	500 to 2500 km	10	11
	2500 to 10000 km	15	18
	Above 10000 km	25	30
Woodchips from short rotation coppice (Poplar – No fertilisation)	1 to 500 km	6	7
	500 to 2500 km	8	10
	2500 to 10000 km	14	16
	Above 10 000 km	24	28
Woodchips from stemwood	1 to 500 km	5	6
	500 to 2500 km	7	8
	2500 to 10000 km	12	15
	Above 10000 km	22	27
Woodchips from industry residues	1 to 500 km	4	5
	500 to 2500 km	6	7
	2500 to 10000 km	11	13
	Above 10000 km	21	25

Wood briquettes or pellets from forest residues (case 1)	1 to 500 km	29	35
	500 to 2500 km	29	35
	2500 to 10000 km	30	36
	Above 10000 km	34	41
Wood briquettes or pellets from forest residues (case 2a)	1 to 500 km	16	19
	500 to 2500 km	16	19
	2500 to 10000 km	17	21
	Above 10000 km	21	25
Wood briquettes or pellets from forest residues (case 3a)	1 to 500 km	6	7
	500 to 2500 km	6	7
	2500 to 10000 km	7	8
	Above 10000 km	11	13
Wood briquettes or pellets from short rotation coppice (Eucalyptus – case 1)	2500 to 10000 km	33	39
Wood briquettes or pellets from short rotation coppice (Eucalyptus – case 2a)	2500 to 10000 km	20	23
Wood briquettes or pellets from short rotation coppice (Eucalyptus – case 3a)	2500 to 10000 km	10	11
Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised – case 1)	1 to 500 km	31	37
	500 to 10000 km	32	38
	Above 10000 km	36	43
Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised – case 2a)	1 to 500 km	18	21
	500 to 10000 km	20	23
	Above 10000 km	23	27

Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised – case 3a)	1 to 500 km	8	9
	500 to 10000 km	10	11
	Above 10000 km	13	15
Wood briquettes or pellets from short rotation coppice (Poplar – no fertilisation – case 1)	1 to 500 km	30	35
	500 to 10000 km	31	37
	Above 10000 km	35	41
Wood briquettes or pellets from short rotation coppice (Poplar – no fertilisation – case 2a)	1 to 500 km	16	19
	500 to 10000 km	18	21
	Above 10000 km	21	25
Wood briquettes or pellets from short rotation coppice (Poplar – no fertilisation – case 3a)	1 to 500 km	6	7
	500 to 10000 km	8	9
	Above 10000 km	11	13
Wood briquettes or pellets from stemwood (case 1)	1 to 500 km	29	35
	500 to 2500 km	29	34
	2500 to 10000 km	30	36
	Above 10000 km	34	41
Wood briquettes or pellets from stemwood (case 2a)	1 to 500 km	16	18
	500 to 2500 km	15	18
	2500 to 10000 km	17	20
	Above 10000 km	21	25
Wood briquettes or pellets from stemwood (case 3a)	1 to 500 km	5	6
	500 to 2500 km	5	6
	2500 to 10000 km	7	8
	Above 10000 km	11	12

Wood briquettes or pellets from wood industry residues (case 1)	1 to 500 km	17	21
	500 to 2500 km	17	21
	2500 to 10000 km	19	23
	Above 10000 km	22	27
Wood briquettes or pellets from wood industry residues (case 2a)	1 to 500 km	9	11
	500 to 2500 km	9	11
	2500 to 10 000 km	10	13
	Above 10000 km	14	17
Wood briquettes or pellets from wood industry residues (case 3a)	1 to 500 km	3	4
	500 to 2500 km	3	4
	2500 to 10000	5	6
	Above 10000 km	8	10

Case 1 refers to processes in which a Natural Gas boiler is used to provide the process heat to the pellet mill. Process electricity is purchased from the grid.

Case 2a refers to processes in which a boiler fuelled with wood chips is used to provide the process heat to the pellet mill. Process electricity is purchased from the grid.

Case 3a refers to processes in which a CHP, fuelled with wood chips, is used to provide heat and electricity to the pellet mill.

Biomass fuel production system	**Transport distance**	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
Agricultural Residues with density < 0.2 t/m^3 ([1])	1 to 500 km	4	4
	500 to 2500 km	8	9
	2500 to 10000 km	15	18
	Above 10000 km	29	35

Agricultural Residues with density > 0.2 t/m^3 ([2])	1 to 500 km	4	4
	500 to 2500 km	5	6
	2500 to 10000 km	8	10
	Above 10000 km	15	18
Straw pellets	1 to 500 km	8	10
	500 to 10000 km	10	12
	Above 10000 km	14	16
Bagasse briquettes	500 to 10000 km	5	6
	Above 10000 km	9	10
Palm Kernel Meal	Above 10000 km	54	61
Palm Kernel Meal (no CH_4 emissions from oil mill)	Above 10000 km	37	40

([1])
This group of materials includes agricultural residues with a low bulk density and it comprises materials such as straw bales, oat hulls, rice husks and sugar cane bagasse bales (not exhaustive list).
([2])
The group of agricultural residues with higher bulk density includes materials such as corn cobs, nut shells, soybean hulls, palm kernel shells (not exhaustive list).

Typical and default values – biogas for electricity

Biogas production system	Technological option		Typical value Greenhouse gas emissions (g CO_2eq/MJ)	Default value Greenhouse gas emissions (g CO_2eq/MJ)
Biogas for electricity from wet manure	Case 1	Open digestate ([1])	– 28	3
		Close digestate ([2])	– 88	– 84
	Case 2	Open digestate	– 23	10
		Close digestate	– 84	– 78
	Case 3	Open digestate	– 28	9
		Close digestate	– 94	– 89
Biogas for electricity from maize whole plant	Case 1	Open digestate	38	47
		Close digestate	24	28
	Case 2	Open digestate	43	54
		Close digestate	29	35
	Case 3	Open digestate	47	59
		Close digestate	32	38
Biogas for electricity from biowaste	Case 1	Open digestate	31	44
		Close digestate	9	13
	Case 2	Open digestate	37	52
		Close digestate	15	21
	Case 3	Open digestate	41	57
		Close digestate	16	22

([1])
Open storage of digestate accounts for additional emissions of methane which change with the weather, the substrate and the digestion efficiency. In these calculations the amounts are taken to be equal to 0.05 MJ CH_4/MJ biogas for manure, 0.035 MJ CH_4/MJ biogas for maize and 0.01 MJ CH_4/MJ biogas for biowaste.

([2])
Close storage means that the digestate resulting from the digestion process is stored in a gas tight tank and the additional biogas released during storage is considered to be recovered for production of additional electricity or biomethane.

Typical and default values for biomethane

Biomethane production system	**Technological option**	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
Biomethane from wet manure	Open digestate, no off-gas combustion ([1])	– 20	22
	Open digestate, off-gas combustion ([2])	– 35	1
	Close digestate, no off-gas combustion	– 88	– 79
	Close digestate, off-gas combustion	– 103	– 100
Biomethane from maize whole plant	Open digestate, no off-gas combustion	58	73
	Open digestate, off-gas combustion	43	52
	Close digestate, no off-gas combustion	41	51
	Close digestate, off-gas combustion	26	30
Biomethane from biowaste	Open digestate, no off-gas combustion	51	71
	Open digestate, off-gas combustion	36	50
	Close digestate, no off-gas combustion	25	35
	Close digestate, off-gas combustion	10	14

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(1) This category includes the following categories of technologies for biogas upgrade to biomethane: Pressure Swing Adsorption (PSA), Pressure Water Scrubbing (PWS), Membranes, Cryogenic, and Organic Physical Scrubbing (OPS). It includes an emission of 0.03 MJ CH_4/MJ biomethane for the emission of methane in the off-gases.
(2) This category includes the following categories of technologies for biogas upgrade to biomethane: Pressure Water Scrubbing (PWS) when water is recycled, Pressure Swing Adsorption (PSA), Chemical Scrubbing, Organic Physical Scrubbing (OPS), Membranes and Cryogenic upgrading. No methane emissions are considered for this category (the methane in the off-gas is combusted, if any).

Typical and default values – biogas for electricity – mixtures of manure and maize: greenhouse gas emissions with shares given on a fresh mass basis

Biogas production system		**Technological options**	**Greenhouse gas emissions – typical value (g CO_2eq/MJ)**	**Greenhouse gas emissions – default value (g CO_2eq/MJ)**
Manure – Maize 80% - 20%	Case 1	Open digestate	17	33
		Close digestate	– 12	– 9
	Case 2	Open digestate	22	40
		Close digestate	– 7	– 2
	Case 3	Open digestate	23	43
		Close digestate	– 9	– 4
Manure – Maize 70% - 30%	Case 1	Open digestate	24	37
		Close digestate	0	3
	Case 2	Open digestate	29	45
		Close digestate	4	10
	Case 3	Open digestate	31	48
		Close digestate	4	10

Manure – Maize 60% - 40%	Case 1	Open digestate	28	40
		Close digestate	7	11
	Case 2	Open digestate	33	47
		Close digestate	12	18
	Case 3	Open digestate	36	52
		Close digestate	12	18

Comments

Case 1 refers to pathways in which electricity and heat required in the process are supplied by the CHP engine itself.

Case 2 refers to pathways in which the electricity required in the process is taken from the grid and the process heat is supplied by the CHP engine itself. In some Member States, operators are not allowed to claim the gross production for subsidies and case 1 is the more likely configuration.

Case 3 refers to pathways in which the electricity required in the process is taken from the grid and the process heat is supplied by a biogas boiler. This case applies to some installations in which the CHP engine is not on-site and biogas is sold (but not upgraded to biomethane).

Typical and default values – biomethane - mixtures of manure and maize: greenhouse gas emissions with shares given on a fresh mass basis

Biomethane production system	**Technological options**	**Typical value (g CO_2eq/ MJ)**	**Default value (g CO_2eq/ MJ)**
Manure – Maize 80% - 20%	Open digestate, no off-gas combustion	32	57
	Open digestate, off-gas combustion	17	36
	Close digestate, no off-gas combustion	– 1	9
	Close digestate, off-gas combustion	– 16	– 12
Manure – Maize 70% - 30%	Open digestate, no off-gas combustion	41	62
	Open digestate, off-gas combustion	26	41
	Close digestate, no off-gas combustion	13	22
	Close digestate, off-gas combustion	– 2	1

Manure – Maize 60% - 40%	Open digestate, no off-gas combustion	46	66
	Open digestate, off-gas combustion	31	45
	Close digestate, no off-gas combustion	22	31
	Close digestate, off-gas combustion	7	10

Where biomethane is used as Compressed Biomethane as a transport fuel, a value of 3.3g CO_2eq/MJ biomethane needs to be added to the typical values and a value of 4.6g CO_2eq/MJ biomethane to the default values.

THIRD SCHEDULE

Part A
PROVISIONAL ESTIMATED INDIRECT LAND-USE CHANGE EMISSIONS FROM BIOFUEL, BIOLIQUID AND BIOMASS FUEL FEEDSTOCK (g CO_2eq/MJ) ([Note 1])

Feedstock group	**Mean ([1])**	**Interpercentile range derived from the sensitivity analysis ([2])**	
Cereals and other starch-rich crops	12	8 to 16	
Sugars	13	4 to 17	
Oil crops	55	33 to 66	

([1])The mean values included here represent a weighted average of the individually modelled feedstock values.

([2]) The range included here reflects 90% of the results using the fifth and ninety-fifth percentile values resulting from the analysis. The fifth percentile suggests a value below which 5% of the observations were found (namely, 5% of total data used showed results below 8, 4, and 33g CO_2eq/MJ). The ninety-fifth percentile suggests a value below which 95% of the observations were found (namely, 5% of total data used showed results above 16, 17, and 66g CO_2eq/MJ).

Part B
BIOFUELS, BIOLIQUIDS AND BIOMASS FUELS FOR WHICH THE ESTIMATED INDIRECT LAND-USE CHANGE EMISSIONS ARE CONSIDERED TO BE ZERO

Biofuels, bioliquids and biomass fuels produced from the following feedstock categories will be considered to have estimated indirect land-use change emissions of zero:

(1) feedstocks which are not listed under Part A of this Schedule.

(2) feedstocks, the production of which has led to direct land-use change, namely, a change from one of the following IPCC land cover categories: forest land, grassland, wetlands, settlements, or other land, to cropland or perennial cropland ([Note 2]). In such a case a direct land-use change emission value (e_l) should have been calculated in accordance with item 7 of Part C of the First Schedule.

Notes to this Schedule

(Note 1) The mean values reported here represent a weighted average of the individually modelled feedstock values. The magnitude of the values in the Annex is sensitive to the range of assumptions (such as treatment of co-products, yield developments, carbon stocks and displacement of other commodities) used in the economic models developed for their estimation. Although it is therefore not possible to fully characterise the uncertainty range associated with such estimates, a sensitivity analysis conducted on the results based on a random variation of key parameters, a so-called Monte Carlo analysis, was conducted.

(Note 2) Perennial crops are defined as multi-annual crops, the stem of which is usually not annually harvested such as short rotation coppice and oil palm.

FOURTH SCHEDULE

Consequential amendments to other legislation

LEGISLATION	PROVISION	PHRASE THAT IS TO BE AMENDED	AMENDMENT
Lifecycle Greenhouse Emissions from Fuels Regulations – S.L. 423.48	regulation 2 – definition of "low indirect land-use change-risk biofuels"	"set out in regulation 3 of the Biofuels (Sustainability Criteria) Regulations;"	"set out in regulation 3 of the Biofuels, Bioliquids and Biomass Fuels (Sustainability Criteria) Regulations;"
	regulation 3(1)	"set out in regulation 3 of the Biofuels (Sustainability Criteria) Regulations."	"set out in regulation 3 of the Biofuels, Bioliquids and Biomass Fuels (Sustainability Criteria) Regulations."
	regulation 3(4)	"Life cycle greenhouse gas emissions from biofuels shall be calculated in accordance with the provisions of the Biofuels (Sustainability Criteria) Regulations."	"Life cycle greenhouse gas emissions from biofuels shall be calculated in accordance with the provisions of the Biofuels, Bioliquids and Biomass Fuels (Sustainability Criteria) Regulations."
Regulator for Energy and Water Services Act- Cap. 545	FIRST SCHEDULE	"Biofuels (Sustainability Criteria) Regulations (S.L. 545.28)"	"Biofuels, Bioliquids and Biomass Fuels (Sustainability Criteria) Regulations, (S.L. 545.28)"

Biofuels and Bioliquids Market Regulations – S.L. 545.15	regulation 24	"verified to be compliant to the sustainability criteria set out in regulation 4 of the Biofuels (Sustainability Criteria) Regulations."	"verified to be compliant with the sustainability criteria as set out in the Biofuels, Bioliquids and Biomass Fuels (Sustainability Criteria) Regulations."
Petroleum for the Inland (Wholesale) Fuel Market, Bottling of LPG and Primary Storage Facilities Regulations – S.L. 545.17	regulation 33(5)	"the sustainability criteria set out in regulation 3 of the Biofuels (Sustainability Criteria) Regulations"	"the sustainability criteria set out in regulation 3 of the Biofuels, Bioliquids and Biomass Fuels (Sustainability Criteria) Regulations"

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