RED1-21-22 Part I

IECC: SECTION 202, IECC2024P1_RE_Ch02_SecR202_DefRENEWABLE_ENERGY_RESOURCES

Proponents: Tom Ortiz, representing National Propane Gas Association (tortiz@npga.org); Bruce Swiecicki, representing National Propane Gas Association (bswiecicki@npga.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

RENEWABLE ENERGY RESOURCES. Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, renewable biomass, renewable hydrocarbon sources, or extracted from hot fluid or steam heated within the earth.

Add new definition as follows:

RENEWABLE BIOMASS. Each of the following (including any incidental, de minimis contaminants that are impractical to remove and are related to customary feedstock production and transport): (1) Planted crops and crop residue harvested from existing agricultural land cleared or cultivated prior to December 19, 2007 and that was nonforested and either actively managed or fallow on December 19, 2007. (2) Planted trees and tree residue from a tree plantation located on non-federal land (including land belonging to an Indian tribe or an Indian individual that is held in trust by the U.S. or subject to a restriction against alienation imposed by the U.S.) that was cleared at any time prior to December 19, 2007 and actively managed on December 19, 2007. (3) Animal waste material and animal byproducts. (4) Slash and pre-commercial thinnings from non-federal forestland (including forestland belonging to an Indian tribe or an Indian individual, that are held in trust by the United States or subject to a restriction against alienation imposed by the United States) that is not ecologically sensitive forestland. (5) Biomass (organic matter that is available on a renewable or recurring basis) obtained from within 200 feet of buildings and other areas regularly occupied by people, or of public infrastructure, in an area at risk of wildfire. (6) Algae. (7) Separated yard waste or food waste, including recycled cooking and trap grease.

RENEWABLE HYDROCARBON SOURCES. Hydrocarbon gases and liquids recovered from renewable biomass, or from reclamation of plastics (as polymer, monomer, or constituent chemical building blocks) in such a manner that they displace the primary or raw materials that are used as chemical building blocks in the production of plastics, or from synthesis of clean hydrogen and associated chemical feedstocks.

Reason: The definition of renewable energy resources excludes renewable hydrocarbons, which can be manufactured from clean hydrogen and captured carbon, recovered from recycled plastics, or derived from waste fats and oils. This proposal is based on extensive research that has been done and is ongoing, as well as the terminology currently found in the regulations promulgated by the U.S. Environmental Protection Agency[1]. Recent work regarding the recycling of plastics into useable forms of energy has demonstrated processes that can be used to help rid the world of an environmental scourge[2], or the use of clean hydrogen to convert captured carbon dioxide into propane and other hydrocarbons[3].[4]
All notions of renewability rely on circularity, the regeneration of raw materials from existing finished products in a way that allows for replenishment of those materials on the timescale of a human lifetime.

Naturally occurring hydrocarbons are generated chemically via the decomposition of organic material. Hydrocarbons can also be recovered from the chemical decomposition of polymers (plastics) and the synthesis of hydrogen and carbon dioxide. Renewable hydrocarbons result where the chemical processes which produce hydrocarbons consume preexisting feedstocks of any of the above types (organic, polymer, or hydrogen), of hydrocarbon, in one of three circular economic cycles.

Each circular, renewable hydrocarbon cycle can begin with an initial quantity of naturally (geologically) produced hydrocarbon feedstock. Imagine a gas well from which a quantity of propane can be isolated cryogenically in a processing plant. This propane can be burned as fuel, processed in a petrochemical plant into plastics, or used to produce organic materials[5]. From this point, three paths can be traversed.

In the first ("bottom-up inorganic recovery") case, propane burned as fuel generates carbon dioxide as a byproduct. This carbon dioxide can be captured, either immediately at the point of combustion, or later via direct air capture of carbon dioxide. The captured carbon is then blended with clean (renewable) hydrogen in a synthesis reaction that results in new propane[6]. This propane can subsequently be burned, and its carbon dioxide byproduct recaptured, beginning the cycle again.

In the second ("top-down inorganic recovery") case, propane is processed into plastics, the latter which eventually reach the end of their economically useful life. These plastics are decomposed in a catalytic reactor into new propane[7], which can either be burned or else reprocessed in petrochemical plants into fresh plastics, beginning the cycle again. It is immaterial whether the propane generated during each period are burned as fuel or processed into plastics; either product may be recovered and replenished.

The third ("organic recovery") case involves industrial decomposition of renewable organic materials (e.g. wood, crops, fats, oils) into small chain hydrocarbons. Propane generated via industrial organic decomposition can likewise be burned or processed into plastics, and—as described above—regenerated into fresh propane using either the circular top-down or bottom-up inorganic processes.

Thus, we see that hydrocarbons may indeed be renewable and can be generated in a variety of equivalently circular processes. There is no

RED1-21-22 Part II

IRCECC: SECTION 202, IRCECC2024P1_Pt04_Ch11_SecN1101.6_DefRENEWABLE_ENERGY_RESOURCES

Proponents: Tom Ortiz, representing National Propane Gas Association (tortiz@npga.org); Bruce Swiecicki, representing National Propane Gas Association (bswiecicki@npga.org)

2024 ENERGY Chapter11

Revise as follows:

RENEWABLE ENERGY RESOURCES. Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, renewable biomass, renewable hydrocarbon sources, or extracted from hot fluid or steam heated within the earth.

Add new definition as follows:

RENEWABLE BIOMASS. Each of the following (including any incidental, de minimis contaminants that are impractical to remove and are related to customary feedstock production and transport): (1) Planted crops and crop residue harvested from existing agricultural land cleared or cultivated prior to December 19, 2007 and that was nonforested and either actively managed or fallow on December 19, 2007. (2) Planted trees and tree residue from a tree plantation located on non-federal land (including land belonging to an Indian tribe or an Indian individual that is held in trust by the U.S. or subject to a restriction against alienation imposed by the U.S.) that was cleared at any time prior to December 19, 2007 and actively managed on December 19, 2007. (3) Animal waste material and animal byproducts. (4) Slash and pre-commercial thinnings from non-federal forestland (including forestland belonging to an Indian tribe or an Indian individual, that are held in trust by the United States or subject to a restriction against alienation imposed by the United States) that is not ecologically sensitive forestland. (5) Biomass (organic matter that is available on a renewable or recurring basis) obtained from within 200 feet of buildings and other areas regularly occupied by people, or of public infrastructure, in an area at risk of wildfire. (6) Algae. (7) Separated yard waste or food waste, including recycled cooking and trap grease.

RENEWABLE HYDROCARBON SOURCES. Hydrocarbon gases and liquids recovered from renewable biomass, or from reclamation of plastics (as polymer, monomer, or constituent chemical building blocks) in such a manner that they displace the primary or raw materials that are used as chemical building blocks in the production of plastics, or from synthesis of clean hydrogen and associated chemical feedstocks."

Reason: The definition of renewable energy resources excludes renewable hydrocarbons, which can be manufactured from clean hydrogen and captured carbon, recovered from recycled plastics, or derived from waste fats and oils.
This proposal is based on extensive research that has been done and is ongoing, as well as the terminology currently found in the regulations promulgated by the U.S. Environmental Protection Agency[1]. Recent work regarding the recycling of plastics into useable forms of energy has demonstrated processes that can be used to help rid the world of an environmental scourge[2], or the use of clean hydrogen to convert captured carbon dioxide into propane and other hydrocarbons[3],[4].

All notions of renewability rely on circularity, the regeneration of raw materials from existing finished products in a way that allows for replenishment of those materials on the timescale of a human lifetime.

Naturally occurring hydrocarbons are generated chemically via the decomposition of organic material. Hydrocarbons can also be recovered from the chemical decomposition of polymers (plastics) and the synthesis of hydrogen and carbon dioxide. Renewable hydrocarbons result where the chemical processes which produce hydrocarbons consume preexisting feedstocks of any of the above types (organic, polymer, or hydrogen), of hydrocarbon, in one of three circular economic cycles.

Each circular, renewable hydrocarbon cycle can begin with an initial quantity of naturally (geologically) produced hydrocarbon feedstock. Imagine a gas well from which a quantity of propane can be isolated cryogenically in a processing plant. This propane can be burned as fuel, processed in a petrochemical plant into plastics, or used to produce organic materials[5]. From this point, three paths can be traversed.

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The third ("organic recovery") case involves industrial decomposition of renewable organic materials (e.g. wood, crops, fats, oils) into small chain hydrocarbons. Propane generated via industrial organic decomposition can likewise be burned or processed into plastics, and—as described above—regenerated into fresh propane using either the circular top-down or bottom-up inorganic processes.

Thus, we see that hydrocarbons may indeed be renewable and can be generated in a variety of equivalently circular processes. There is no distinction chemically, functionally, or from a carbon accounting perspective, among the renewable hydrocarbons generated via the available inorganic or organic recovery processes. Such hydrocarbons are therefore a legitimately renewable fuel source.

[1]

40 CFR Part 80 Subpart M: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-80/subpart-M

[2] CSA Group: https://www.csagroup.org/article/research/defining-recycling-in-the-context-of-plastics/

[3]CSA Group: https://www.csagroup.org/article/research/defining-recycling-in-the-context-of-plastics/

[4] https://news.stanford.edu/2019/10/17/new-catalyst-helps-turn-carbon-dioxide-fuel/

[5] U.S. Patent 540563A (1995), “Process for the extraction of fats and oils”, https://patents.google.com/patent/US5405633A/en

[6] Stanford News (2019), “Stanford researchers create new catalyst that can turn carbon dioxide into fuels”, https://news.stanford.edu/2019/10/17/new-catalyst-helps-turn-carbon-dioxide-fuel/ .

[7] Guido Zichittella, Amani M. Ebrahim, Jie Zhu, Anna E. Brenner, Griffin Drake, Gregg T. Beckham, Simon R. Bare, Julie E. Rorrer, and Yuriy Román-Leshkov (2022), “Hydrogenolysis of Polyethylene and Polypropylene into Propane over Cobalt-Based Catalysts”, *JACS Au Article ASAP*, DOI: 10.1021/jacsau.2c00402 .

Bibliography: [1] 40 CFR Part 80 Subpart M: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-80/subpart-M
[2] CSA Group: https://www.csagroup.org/article/research/defining-recycling-in-the-context-of-plastics/

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Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This code change will allow more options for energy and will potentially decrease the cost of construction.

distinction chemically, functionally, or from a carbon accounting perspective, among the renewable hydrocarbons generated via the available inorganic or organic recovery processes. Such hydrocarbons are therefore a legitimately renewable fuel source.

[1] 40 CFR Part 80 Subpart M: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-80/subpart-M

[2] CSA Group: https://www.csagroup.org/article/research/defining-recycling-in-the-context-of-plastics/

[3]CSA Group: https://www.csagroup.org/article/research/defining-recycling-in-the-context-of-plastics/

[4] https://news.stanford.edu/2019/10/17/new-catalyst-helps-turn-carbon-dioxide-fuel/

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[7] Guido Zichittella, Amani M. Ebrahim, Jie Zhu, Anna E. Brenner, Griffin Drake, Gregg T. Beckham, Simon R. Bare, Julie E. Rorrer, and Yuriy Román-Leshkov (2022), “Hydrogenolysis of Polyethylene and Polypropylene into Propane over Cobalt-Based Catalysts”, *JACS Au Article ASAP*, DOI: 10.1021/jacsau.2c00402 .

Bibliography:

[1] 40 CFR Part 80 Subpart M: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-80/subpart-M

[2] CSA Group: https://www.csagroup.org/article/research/defining-recycling-in-the-context-of-plastics/

[3]CSA Group: https://www.csagroup.org/article/research/defining-recycling-in-the-context-of-plastics/

[4] https://news.stanford.edu/2019/10/17/new-catalyst-helps-turn-carbon-dioxide-fuel/

[5] U.S. Patent 540563A (1995), “Process for the extraction of fats and oils”, https://patents.google.com/patent/US5405633A/en

[6] Stanford News (2019), “Stanford researchers create new catalyst that can turn carbon dioxide into fuels”, https://news.stanford.edu/2019/10/17/new-catalyst-helps-turn-carbon-dioxide-fuel/ .

[7] Guido Zichittella, Amani M. Ebrahim, Jie Zhu, Anna E. Brenner, Griffin Drake, Gregg T. Beckham, Simon R. Bare, Julie E. Rorrer, and Yuriy Román-Leshkov (2022), “Hydrogenolysis of Polyethylene and Polypropylene into Propane over Cobalt-Based Catalysts”, *JACS Au Article ASAP*, DOI: 10.1021/jacsau.2c00402 .

Cost Impact: The code change proposal will decrease the cost of construction.
This proposal will broaden the choices for renewable energy so it will decrease the cost of construction.

RED1-22-22

IECC: SECTION 202, SECTION 202 (New), CARB (New), EU (New)

Proponents: Diana Burk, representing New Buildings Institute (diana@newbuildings.org)

2024 International Energy Conservation Code [RE Project]

Revise as follows:

RENEWABLE ENERGY RESOURCES. Energy derived from solar radiation, wind, waves, tides, ~~landfill gas, biogas, biomass~~ *renewable fuels* or extracted from hot fluid or steam heated within the earth.

Add new definition as follows:

RENEWABLE FUEL. Fuels that achieve a 70% greenhouse gas emission reduction from a comparable fossil fuel calculated in accordance with California Air Resources Board's Low Carbon Fuel Standard or Annex V or Annex VI of the European Union Renewable Energy Directive 2018/2001.

Add new standard(s) as follows:

CARB California Air Resources Board. Low Carbon Fuel Standard: CA- GREET 3.0 model

EU European Parliament. Annex V and VI of the European Union Renewable Energy Directive 2018/2001 (RED II)

Reason: NBI submitted proposal CEPI-12 Part II to revise the definition of renewable energy resource by removing the word "biomass" from the definition and substituting it with "biomass waste" to more accurately address the types of biomass that are likely to reduce and not increase pollutants and greenhouse gas emissions. Several conversations with industry stakeholders during the debate of this proposed amendment raised valid concerns with this approach namely, the revised definition approved in the draft 2024 IECC may be both difficult to enforce and could eliminate certain fuels that reduce greenhouse gas emissions not sourced from biomass waste products.

The ICC should instead model the definition of a renewable fuel on existing policies used to reduce greenhouse gas emissions from fuels. This new proposed definition is based on current policies for transportation fuels in California, Washington and Oregon, Green-e's renewable fuel standard, and requirements for renewable fuels in Europe. Like the Green-e certified renewable fuel standard, the proposed definition relies on a method for calculating the greenhouse gas emission reduction from a renewable fuel product using California Air Resource Board's Low Carbon Fuel Standard. [1], [2] A similar calculation developed by the European Union for their Renewable Energy Directive II is also provided as an optional method for calculating emissions. Both methods include both direct greenhouse gas emission from the production and consumption of the fuel and indirect greenhouse gas emissions from land use changes. [3]

The required greenhouse gas emission reduction target of 70% when compared to fossil fuels is equivalent to the requirements for renewable building fuels in Europe as of 2021. Europe will increase the required percentage to 80% by 2026. [3] NBI believes the IECC should eventually follow Europe's lead and reduce the greenhouse gas emission requirement for renewable fuels as the US transitions to a more renewable grid.
This revised renewable fuel definition proposed is easier to enforce, technology neutral, and will ensure the renewable energy requirement proposed for inclusion in the 2024 IECC will prevent increased localized criteria air pollution while still reducing carbon emissions from the building. A similar amendment has been proposed for inclusion in the commercial energy code so that the definition for renewable energy resources can be consistent between both versions of the code.

Bibliography: [1] California Air Resources Board. (2022, July 7). LCFS Pathway Certified Carbon Intensities. Retrieved from https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities.
[2] Center for Resource Solutions. (2021, September 16). Green-e. Retrieved from Green-e Renewable Fuels Standard, Version 1.0: https://www.green-e.org/docs/rf/Green-e%20Renewable%20Fuels%20Standard.pdf
[3] European Commission. (2022, July 7). Renewable Energy – Recast to 2030 (RED II). Retrieved from EU Science Hub: https://joint-research-centre.ec.europa.eu/welcome-jec-website/reference-regulatory-framework/renewable-energy-recast-2030-red-ii_en

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This code change proposal will not affect the cost of construction.

Attached Files

- **Annex V and VI of the European Union Renewable Energy Directive 2018 2001 (RED II).pdf**
  https://energy.cdpaccess.com/proposal/1070/2535/files/download/452/

DIRECTIVES

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)

(Text with EEA relevance)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 194(2) thereof,

Having regard to the proposal from the European Commission,

After transmission of the draft legislative act to the national parliaments,

Having regard to the opinion of the European Economic and Social Committee ([1]),

Having regard to the opinion of the Committee of the Regions ([2]),

Acting in accordance with the ordinary legislative procedure ([3]),

Whereas:

(1) Directive 2009/28/EC of the European Parliament and of the Council ([4]) has been substantially amended several times ([5]). Since further amendments are to be made, that Directive should be recast in the interests of clarity.

(2) In accordance with Article 194(1) of the Treaty on the Functioning of the European Union (TFEU), promoting renewable forms of energy is one of the goals of the Union energy policy. That goal is pursued by this Directive. The increased use of energy from renewable sources or 'renewable energy' constitutes an important part of the package of measures needed to reduce greenhouse gas emissions and comply with the Union's commitment under the 2015 Paris Agreement on Climate Change following the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (the 'Paris Agreement'), and with the Union 2030 energy and climate framework, including the Union's binding target to cut emissions by at least 40 % below 1990 levels by 2030. The Union's binding renewable energy target for 2030 and Member States' contributions to that target, including their baseline shares in relation to their national overall targets for 2020, are among the elements which have an overarching importance for the Union's energy and environmental policy. Other such elements are contained in the framework set out in this Directive, for instance, for the development of renewable heating and cooling and the development of renewable transport fuels.

(3) The increased use of energy from renewable sources also has a fundamental part to play in promoting the security of energy supply, sustainable energy at affordable prices, technological development and innovation as well as technological and industrial leadership while providing environmental, social and health benefits as well as major opportunities for employment and regional development, especially in rural and isolated areas, in regions or territories with low population density or undergoing partial deindustrialisation.

([1]) OJ C 246, 28.7.2017, p. 55.
([2]) OJ C 342, 12.10.2017, p. 79.
([3]) Position of the European Parliament of 13 November 2018 (not yet published in the Official Journal) and decision of the Council of 4 December 2018.
([4]) Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (OJ L 140, 5.6.2009, p. 16).
([5]) See Annex X, Part A.

(4) In particular, reducing energy consumption, increasing technological improvements, incentives for the use and expansion of public transport, the use of energy efficiency technologies and the promotion of the use of renewable energy in the electricity sector, the heating and cooling sector and the transport sector are effective tools, together with energy efficiency measures, for reducing greenhouse gas emissions in the Union and the Union's energy dependence.

(5) Directive 2009/28/EC established a regulatory framework for the promotion of the use of energy from renewable sources which set binding national targets on the share of renewable energy in energy consumption and in the transport sector to be met by 2020. The Commission Communication of 22 January 2014 entitled 'A policy framework for climate and energy in the period from 2020 to 2030', established a framework for future Union energy and climate policies and promoted a common understanding of how to develop those policies after 2020. The Commission proposed that the Union 2030 target for the share of renewable energy consumed in the Union should be at least 27 %. That proposal was endorsed by the European Council in its conclusions of 23 and 24 October 2014, which indicated that Member States should be able to set their own, more ambitious, national targets in order to deliver their planned contributions to the Union 2030 target and exceed them.

(6) In its resolutions of 5 February 2014 entitled 'A 2030 framework for climate and energy policies' and of 23 June 2016 entitled 'The renewable energy progress report', the European Parliament went further than the Commission proposal or the European Council conclusions, stressing that, in light of the Paris Agreement and the recent renewable technology cost reductions, it was desirable to be significantly more ambitious.

(7) The ambition set out in the Paris Agreement as well as technological developments, including cost reductions for investments in renewable energy, should therefore be taken into account.

(8) It is thus appropriate to establish a binding Union target of a share of at least 32 % of renewable energy. Moreover, the Commission should assess whether that target should be reviewed upwards in light of substantial cost reductions in the production of renewable energy, the Union's international commitments for decarbonisation, or in the case of a significant decrease in energy consumption in the Union. Member States should establish their contribution to the achievement of that target as part of their integrated national energy and climate plans pursuant to the governance process laid down in Regulation (EU) 2018/1999 of the European Parliament and of the Council ([1]).

(9) The establishment of a binding Union renewable energy target for 2030 would continue to encourage the development of technologies which produce renewable energy and provide certainty for investors. A target defined at Union level would leave greater flexibility for Member States to meet their greenhouse gas reduction targets in the most cost-effective manner in accordance with their specific circumstances, energy mix and capacity to produce renewable energy.

(10) In order to ensure consolidation of the results achieved under Directive 2009/28/EC, the national targets set for 2020 should constitute Member States' minimum contributions to the new 2030 framework. Under no circumstances should the national shares of renewable energy fall below those contributions. If they do, the relevant Member States should take appropriate measures as provided for in Regulation (EU) 2018/1999 to ensure that that baseline share is regained. If a Member State does not maintain its baseline share over a 12-month period, it should, within 12 months of the end of that period, take additional measures to regain that baseline share. Where a Member State has effectively taken such additional measures and has fulfilled its obligation to regain the baseline share, it should be deemed to have complied with the mandatory baseline share requirements under this Directive and under Regulation (EU) 2018/1999 for the entire period in question. The Member State in question cannot therefore be considered to have failed to fulfil its obligation to maintain its baseline share for the period in time where the gap occurred. Both the 2020 and 2030 frameworks serve the environmental and energy policy objectives of the Union.

(11) Member States should take additional measures in the event that the share of renewable energy at Union level does not meet the Union trajectory towards the renewable energy target of at least 32 %. Under Regulation (EU) 2018/1999 the Commission may take measures at Union level in order to ensure achievement of the target if an ambition gap is identified by the Commission during the assessment of the integrated national energy and

([1]) Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council (see page 1 of this Official Journal).

climate plans. If the Commission identifies a delivery gap during its assessment of the integrated national energy and climate progress reports, Member States should apply the measures provided for in Regulation (EU) 2018/1999 to close that gap.

(12) In order to support Member States' ambitious contributions to the Union target, a financial framework aiming to facilitate investments in renewable energy projects in those Member States should be established, including through the use of financial instruments.

(13) The Commission should focus the allocation of funds on the reduction of the cost of capital of renewable energy projects since such cost has a material impact on the cost of renewable energy projects and on their competitiveness, as well as on the development of essential infrastructure for an enhanced technically feasible and economically affordable uptake of renewable energy such as transmission and distribution grid infrastructure, intelligent networks and interconnections.

(14) The Commission should facilitate the exchange of best practices between the competent national or regional authorities or bodies, for instance through regular meetings, to find a common approach to promote a higher uptake of cost-efficient renewable energy projects. The Commission should also encourage investments in new, flexible and clean technologies, and establish an adequate strategy to manage the retirement of technologies which do not contribute to the reduction of emissions or deliver sufficient flexibility, based on transparent criteria and reliable market price signals.

(15) Regulation (EC) No 1099/2008 of the European Parliament and of the Council ([1]), Directives 2001/77/EC ([2]) and 2003/30/EC ([3]) of the European Parliament and of the Council, and Directive 2009/28/EC established definitions for different types of energy from renewable sources. Union law on the internal market for energy establishes definitions for the electricity sector in general. In the interests of clarity and legal certainty it is appropriate to apply those definitions in this Directive.

(16) Support schemes for electricity from renewable sources or 'renewable electricity' have been demonstrated to be an effective way of fostering deployment of renewable electricity. If and when Member States decide to implement support schemes, such support should be provided in a form that is as non-distortive as possible for the functioning of electricity markets. To that end, an increasing number of Member States allocate support in a form by means of which support is granted in addition to market revenues and introduce market-based systems to determine the necessary level of support. Together with steps by which to make the market fit for increasing shares of renewable energy, such support is a key element of increasing the market integration of renewable electricity, while taking into account the different capabilities of small and large producers to respond to market signals.

(17) Small-scale installations can be of great benefit to increase public acceptance and to ensure the rollout of renewable energy projects, in particular at local level. In order to ensure participation of such small-scale installations, specific conditions, including feed-in tariffs, might therefore still be necessary to ensure a positive cost-benefit ratio, in accordance with Union law relating to the electricity market. The definition of small-scale installations for the purposes of obtaining such support is important to provide legal certainty for investors. State aid rules contain definitions of small-scale installations.

(18) Pursuant to Article 108 TFEU, the Commission has exclusive competence to assess the compatibility of State aid measures with the internal market which the Member States may put in place for deployment of energy from renewable sources. That assessment is carried out on the basis of Article 107(3) TFEU and in accordance with the relevant provisions and guidelines which the Commission may adopt to that effect. This Directive is without prejudice to the Commission's exclusive competence granted by the TFEU.

(19) Electricity from renewable sources should be deployed at the lowest possible cost to consumers and taxpayers. When designing support schemes and when allocating support, Member States should seek to

([1]) Regulation (EC) No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics (OJ L 304, 14.11.2008, p. 1).

([2]) Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market (OJ L 283, 27.10.2001, p. 33).

([3]) Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport (OJ L 123, 17.5.2003, p. 42).

minimise the overall system cost of deployment along the decarbonisation pathway towards the objective of a low-carbon economy by the year 2050. Market-based mechanisms, such as tendering procedures, have been demonstrated to reduce support cost effectively in competitive markets in many circumstances. However, in specific circumstances, tendering procedures may not necessarily lead to efficient price discovery. Balanced exemptions may therefore need to be considered to ensure cost-effectiveness and minimise overall support cost. In particular, Member States should be allowed to grant exemptions from tendering procedures and direct marketing to small-scale installations and demonstration projects in order to take into account their more limited capabilities. Since the Commission assesses the compatibility of support for renewable energy with the internal market on a case-by-case basis, such exemptions should comply with the relevant thresholds set out in the latest Commission Guidelines on State aid for environmental protection and energy. In the Guidelines for 2014 to 2020, those thresholds are set at 1 MW (and 6 MW or 6 generation units for wind energy) and 500 kW (and 3 MW or 3 generation units for wind energy) in terms of exemptions from, respectively, tendering procedures and direct marketing. To increase the effectiveness of tendering procedures to minimise overall support costs, tendering procedures should, in principle, be open to all producers of electricity from renewable sources on a non-discriminatory basis. While Member States develop their support schemes, they may limit tendering procedures to specific technologies where this is needed to avoid sub-optimal results with regard to network constraints and grid stability, system integration costs, the need to achieve diversification of the energy mix, and the long-term potential of technologies.

(20) In its conclusions of 23 and 24 October 2014 on the '2030 Climate and Energy Policy Framework', the European Council stressed the importance of a more interconnected internal energy market and the need for sufficient support to integrate ever increasing levels of variable renewable energy and thus allow the Union to fulfil its leadership ambitions for the energy transition. It is therefore important and urgent to increase the level of interconnection and to make progress towards the European Council's objectives, in order to maximise the Energy Union's full potential.

(21) When developing support schemes for renewable sources of energy, Member States should consider the available sustainable supply of biomass and take due account of the principles of the circular economy and of the waste hierarchy established in Directive 2008/98/EC of the European Parliament and of the Council ([1]) in order to avoid unnecessary distortions of raw materials markets. Waste prevention and recycling of waste should be the priority option. Member States should avoid creating support schemes which would be counter to targets on treatment of waste and which would lead to the inefficient use of recyclable waste.

(22) Member States have different renewable energy potentials and operate different support schemes at national level. The majority of Member States apply support schemes that grant benefits solely to energy from renewable sources that is produced on their territory. For the proper functioning of national support schemes, it is vital that Member States continue to be able to control the effect and costs of their national support schemes in accordance with their different potentials. One important means by which to achieve the aim of this Directive remains to guarantee the proper functioning of national support schemes under Directives 2001/77/EC and 2009/28/EC, in order to maintain investor confidence and allow Member States to design effective national measures for their respective contributions to the Union's 2030 target for renewable energy and for the national targets that they have set for themselves. This Directive should facilitate cross-border support for renewable energy without affecting national support schemes in a disproportionate manner.

(23) The opening of support schemes to cross-border participation limits negative impacts on the internal energy market and can, under certain conditions, help Member States achieve the Union target more cost-efficiently. Cross-border participation is also the natural corollary to the development of the Union renewable energy policy, fostering convergence and cooperation to contribute to the Union's binding target. It is therefore appropriate to encourage Member States to open support to projects located in other Member States, and define several ways in which such progressive opening may be implemented, ensuring compliance with the TFEU, in particular Articles 30, 34 and 110 thereof. As electricity flows cannot be traced, it is appropriate to link the opening of support schemes to cross-border participation to shares representing an aspiration towards actual levels of physical interconnection and to allow Member States to restrict their open support schemes to Member States with which they have a direct network connection as a practical proxy for demonstrating the existence of physical flows between the Member States. This should not, however, in any way affect the cross-zonal or cross-border functioning of the electricity markets.

([1]) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008, p. 3).

(24) In order to ensure that the opening of support schemes is reciprocal and brings mutual benefits, cooperation agreements should be signed between participating Member States. Member States should retain control over the pace of deployment of renewable electricity capacity on their territory in order, in particular, to take account of associated integration costs and required grid investments. Member States should thus be allowed to limit the participation of installations located on their territory to tenders opened to them by other Member States. Those cooperation agreements should address all relevant aspects, such as accounting for costs relating to a project built by one Member State on the territory of another, including the expenditure relating to strengthening networks, energy transfer, storage and back-up capacity, as well as possible congestions in the network. In those agreements Member States should also take into account measures that may allow for the cost-effective integration of such additional renewable electricity capacity, whether they are of a regulatory nature (for instance related to market design) or provide for additional investments in various sources of flexibility (for instance interconnections, storage, demand response or flexible generation).

(25) Member States should avoid distortive situations resulting in the extensive importation of resources from third countries. A life-cycle approach should be considered and promoted in that respect.

(26) Member States should ensure that renewable energy communities can participate in available support schemes on an equal footing with large participants. To that end, Member States should be allowed to take measures, such as providing information, providing technical and financial support, reducing administrative requirements, including community-focused bidding criteria, creating tailored bidding windows for renewable energy communities, or allowing renewable energy communities to be remunerated through direct support where they comply with requirements of small installations.

(27) The planning of the infrastructure needed for the production of electricity from renewable sources should take into account policies relating to the participation of those affected by the projects, in particular local populations.

(28) Consumers should be provided with comprehensive information, including information on the energy performance of heating and cooling systems and on the lower running costs of electric vehicles, to allow them to make individual consumer choices with regard to renewable energy and avoid technology lock-in.

(29) Without prejudice to Articles 107 and 108 TFEU, policies supporting renewable energy should be predictable and stable and should avoid frequent or retroactive changes. Policy unpredictability and instability have a direct impact on capital financing costs, on the costs of project development and therefore on the overall cost of deploying renewable energy in the Union. Member States should prevent the revision of any support granted to renewable energy projects from having a negative impact on their economic viability. In that context, Member States should promote cost-effective support policies and ensure their financial sustainability. Moreover, a long-term indicative schedule covering the main aspects of the expected support should be published, without affecting the ability of Member States to decide on budget allocation in the years covered by the schedule.

(30) Member States' obligations to draft renewable energy action plans and progress reports and the Commission's obligation to report on Member States' progress are essential in order to increase transparency, provide clarity to investors and consumers and allow for effective monitoring. Regulation (EU) 2018/1999 integrates those obligations in the Energy Union governance system, where planning, reporting and monitoring obligations in the energy and climate fields are streamlined. The transparency platform on renewable energy is also integrated in the broader e-platform established in that Regulation.

(31) It is necessary to provide for transparent and unambiguous rules for calculating the share of energy from renewable sources and for defining those sources.

(32) In calculating the contribution of hydropower and wind power for the purposes of this Directive, the effects of climatic variation should be smoothed through the use of a normalisation rule. Further, electricity produced in pumped storage units from water that has previously been pumped uphill should not be considered to be renewable electricity.

(33) In order to function, heat pumps enabling the use of ambient and geothermal energy at a useful temperature level or systems providing cooling need electricity or other auxiliary energy. The energy used to drive those systems should therefore be deducted from the total usable energy or energy removed from the area. Only heating and cooling systems where the output or energy removed from an area significantly exceeds the primary energy needed to drive them should be taken into account. Cooling systems contribute to energy use in Member States and it is therefore appropriate that the calculation methods take into account the share of renewable energy used in such systems in all end-use sectors.

(34) Passive energy systems use building design to harness energy. This is considered to be saved energy. To avoid double counting, energy harnessed in this way should not be taken into account for the purposes of this Directive.

(35) Some Member States have a large share of aviation in their gross final consumption of energy. In view of the current technological and regulatory constraints that prevent the commercial use of biofuels in aviation, it is therefore appropriate to provide those Member States with a partial exemption within the calculation of the gross final consumption of energy in the national air transport sector in order to allow them to exclude from that calculation the amount by which they exceed one-and-a-half times the Union average gross final consumption of energy in aviation in 2005, as assessed by Eurostat, namely, 6,18 %. Due to their insular and peripheral character, Cyprus and Malta rely in particular on aviation as a mode of transport, which is essential for their citizens and their economy. As a result, their gross final consumption of energy in the national air transport sector is disproportionally high, namely, more than three times the Union average in 2005. They are thus disproportionately affected by the current technological and regulatory constraints. It is therefore appropriate to provide that they benefit from an exemption covering the amount by which they exceed the Union average gross final consumption of energy in aviation in 2005 as assessed by Eurostat, namely, 4,12 %.

(36) The communication of the Commission of 20 July 2016 entitled 'A European Strategy for Low-Emission Mobility', highlighted the particular importance, in the medium term, of advanced biofuels and renewable liquid and gaseous fuels of non-biological origin for aviation.

(37) In order to ensure that the list of feedstock to produce advanced biofuels, other biofuels and biogas, as set out in an annex to this Directive, takes into account the principles of the waste hierarchy established in Directive 2008/98/EC, the Union sustainability criteria, and the need to ensure that that annex does not create additional demand for land while promoting the use of wastes and residues, the Commission, when regularly evaluating that annex, should consider the inclusion of additional feedstock that does not cause significant distortive effects on markets for (by-)products, wastes or residues.

(38) To create opportunities for reducing the cost of meeting the Union target laid down in this Directive and to give flexibility to Member States to comply with their obligation not to fall below their 2020 national targets after 2020, it is appropriate both to facilitate the consumption in Member States of energy produced from renewable sources in other Member States, and to enable Member States to count energy from renewable sources consumed in other Member States towards their own renewable energy share. For that reason, the Commission should put in place a Union renewable development platform ('URDP'), enabling trading renewable energy shares between Member States, in addition to bilateral cooperation agreements. The URDP is intended to complement the voluntary opening of support schemes to projects located in other Member States. The agreements between Member States include statistical transfers, joint projects between Member States or joint support schemes.

(39) Member States should be encouraged to pursue all appropriate forms of cooperation in relation to the objectives set out in this Directive and to inform citizens about the benefits stemming from the use of cooperation mechanisms. Such cooperation can take place at all levels, bilaterally or multilaterally. Apart from the mechanisms which have an effect on target renewable energy share calculation and target compliance, and which are exclusively provided for in this Directive, namely statistical transfers between Member States –whether put in place bilaterally or through the URDP – joint projects and joint support schemes, cooperation can also take the form of, for example, exchanges of information and best practices, as provided for, in particular, in the e-platform established by Regulation (EU) 2018/1999, and other voluntary coordination between all types of support schemes.

(40) It should be possible for imported electricity produced from renewable sources outside the Union to count towards Member States' renewable energy shares. In order to guarantee an adequate effect of renewable energy replacing non-renewable energy in the Union as well as in third countries, it is appropriate to ensure that such imports can be tracked and accounted for in a reliable way. Agreements with third countries concerning the organisation of such trade in renewable electricity will be considered. If, by virtue of a decision taken under the Energy Community Treaty ([1]) to that effect, the contracting parties thereto are bound by the relevant provisions of this Directive, the measures of cooperation between Member States provided for in this Directive should be applicable to them.

(41) When Member States undertake joint projects with one or more third countries regarding the production of renewable electricity, it is appropriate that those joint projects relate only to newly constructed installations or to installations with newly increased capacity. This will help ensure that the proportion of energy from renewable sources in the third country's total energy consumption is not reduced due to the importation of energy from renewable sources into the Union.

(42) In addition to establishing a Union framework for the promotion of energy from renewable sources, this Directive also contributes to the potential positive impact which the Union and the Member States can have in boosting the development of the renewable energy sector in third countries. The Union and the Member States should promote research, development and investment in the production of renewable energy in developing and other partner countries while fully respecting international law, thereby strengthening their environmental and economic sustainability and their export capacity of renewable energy.

(43) The procedure used for the authorisation, certification and licensing of renewable energy plants should be objective, transparent, non-discriminatory and proportionate when applying the rules to specific projects. In particular, it is appropriate to avoid any unnecessary burden that could arise by classifying renewable energy projects under installations which represent a high risk to health.

(44) For the benefit of the rapid deployment of energy from renewable sources and in view of their overall high sustainable and environmental beneficial quality, Member States should, when applying administrative rules or planning structures and legislation which are designed for licensing installations with respect to pollution reduction and control of industrial plants, for combating air pollution, or for the prevention or minimisation of the discharge of dangerous substances in the environment, take into account the contribution of energy from renewable sources towards meeting environmental and climate change objectives, in particular when compared to non-renewable energy installations.

(45) The coherence between the objectives of this Directive and the Union's other environmental law should be ensured. In particular, during assessment, planning or licensing procedures for renewable energy installations, Member States should take account of all Union environmental law and the contribution made by energy from renewable sources towards meeting environmental and climate change objectives, in particular when compared to non-renewable energy installations.

(46) Geothermal energy is an important local renewable energy source which usually has considerably lower emissions than fossil fuels, and certain types of geothermal plants produce near-zero emission. However, depending on the geological characteristics of an area, the production of geothermal energy may release greenhouse gases and other substances from underground fluids, and other subsoil geological formations, which are harmful for health and the environment. The Commission should therefore facilitate only the deployment of geothermal energy with a low environmental impact and resulting in greenhouse gas emissions savings compared to non-renewable sources.

(47) At national, regional and where applicable local level, rules and obligations for minimum requirements for the use of energy from renewable sources in new and renovated buildings have led to considerable increases in the use of energy from renewable sources. Those measures should be encouraged in a wider Union context, while promoting the use of more energy-efficient applications of energy from renewable sources in combination with energy-savings and energy-efficiency measures through building regulations and codes.

([1]) OJ L 198, 20.7.2006, p. 18.

(48) In order to facilitate and accelerate the setting of minimum levels for the use of energy from renewable sources in buildings, the calculation of those minimum levels in new and existing buildings subject to major renovation should provide a sufficient basis for assessing whether the inclusion of minimum levels of renewable energy is technically, functionally and economically feasible. Member States should allow, *inter alia*, the use of efficient district heating and cooling or, where district heating and cooling systems are not available, other energy infrastructure to fulfil those requirements.

(49) To ensure that national measures for developing renewable heating and cooling are based on comprehensive mapping and analysis of the national renewable and waste energy potential and that such measures provide for increased integration of renewable energy, by supporting, *inter alia*, innovative technologies such as heat pumps, geothermal and solar thermal technologies, and waste heat and cold, it is appropriate to require that Member States carry out an assessment of their potential of energy from renewable sources and the use of waste heat and cold in the heating and cooling sector, in particular to promote energy from renewable sources in heating and cooling installations and promote competitive and efficient district heating and cooling. To ensure consistency with energy efficiency requirements for heating and cooling and reduce administrative burden, that assessment should be included in the comprehensive assessments carried out and notified in accordance with Article 14 of Directive 2012/27/EU of the European Parliament and of the Council ([1]).

(50) The lack of transparent rules and coordination between the different authorisation bodies has been shown to hinder the deployment of energy from renewable sources. Providing guidance to applicants throughout their administrative permit application and granting processes by means of an administrative contact point is intended to reduce complexity for project developers and increase efficiency and transparency, including for renewables self-consumers and renewable energy communities. Such guidance is to be provided at an appropriate level of governance, taking into account the specificities of Member States. The single contact points should guide the applicant and facilitate through the entire administrative process so that the applicant is not obliged to contact other administrative bodies in order to complete the permit-granting process, unless the applicant prefers to do so.

(51) Lengthy administrative procedures constitute a major administrative barrier and are costly. The simplification of administrative permit granting processes, and clear time-limits for decisions to be taken by the authorities competent for issuing the authorisation for the electricity generation installation on the basis of a completed application, should stimulate a more efficient handling of procedures, thereby reducing administrative costs. A manual of procedures should be made available to facilitate the understanding of procedures for project developers and citizens wishing to invest in renewable energy. In order to foster the uptake of renewable energy by microenterprises and small and medium-sized enterprises (SMEs) and individual citizens, in accordance with the objectives set out in this Directive, a simple-notification procedure for grid connections to the competent body should be established for small renewable energy projects, including those that are decentralised, such as rooftop solar installations. In order to respond to the increasing need for the repowering of existing renewable energy plants, streamlined permit-granting procedures should be provided for. This Directive, in particular the provisions on the organisation and duration of the administrative permit granting process, should apply without prejudice to international and Union law, including provisions to protect the environment and human health. Where duly justified on the grounds of extraordinary circumstances, it should be possible to extend the initial timeframes by up to one year.

(52) Information and training gaps, especially in the heating and cooling sector, should be removed in order to encourage the deployment of energy from renewable sources.

(53) In so far as the access or pursuit of the profession of installer is a regulated profession, the preconditions for the recognition of professional qualifications are laid down in Directive 2005/36/EC of the European Parliament and of the Council ([2]). This Directive therefore applies without prejudice to Directive 2005/36/EC.

([1]) Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (OJ L 315, 14.11.2012, p. 1).

([2]) Directive 2005/36/EC of the European Parliament and of the Council of 7 September 2005 on the recognition of professional qualifications (OJ L 255, 30.9.2005, p. 22).

(54) While Directive 2005/36/EC lays down requirements for the mutual recognition of professional qualifications, including for architects, there is also a need to ensure that planners and architects properly consider an optimal combination of renewable energy and high-efficiency technologies in their plans and designs. Member States should therefore provide clear guidance in that regard. This should be done without prejudice to that Directive and in particular Articles 46 and 49 thereof.

(55) Guarantees of origin issued for the purposes of this Directive have the sole function of showing to a final customer that a given share or quantity of energy was produced from renewable sources. A guarantee of origin can be transferred, independently of the energy to which it relates, from one holder to another. However, with a view to ensuring that a unit of renewable energy is disclosed to a customer only once, double counting and double disclosure of guarantees of origin should be avoided. Energy from renewable sources in relation to which the accompanying guarantee of origin has been sold separately by the producer should not be disclosed or sold to the final customer as energy from renewable sources. It is important to distinguish between green certificates used for support schemes and guarantees of origin.

(56) It is appropriate to allow the consumer market for renewable electricity to contribute to the development of energy from renewable sources. Member States should therefore require electricity suppliers who disclose their energy mix to final customers pursuant to Union law on the internal market for electricity, or who market energy to consumers with a reference to the consumption of energy from renewable sources, to use guarantees of origin from installations producing energy from renewable sources.

(57) It is important to provide information on how supported electricity is allocated to final customers. In order to improve the quality of that information to consumers, Member States should ensure that guarantees of origin are issued for all units of renewable energy produced, except where they decide not to issue guarantees of origin to producers that also receive financial support. If Member States decide to issue guarantees of origin to producers that also receive financial support or not to issue guarantees of origin directly to producers, they should be able to choose by which means and mechanisms to take into account the market value of those guarantees of origin. Where renewable energy producers also receive financial support, the market value of the guarantees of origin for the same production should be appropriately taken into account in the relevant support scheme.

(58) Directive 2012/27/EU provides for guarantees of origin for proving the origin of electricity produced from high-efficiency cogeneration plants. However, no use is specified for such guarantees of origin, so their use may also be enabled when disclosing the use of energy from high-efficiency cogeneration.

(59) Guarantees of origin which are currently in place for renewable electricity should be extended to cover renewable gas. Extending the guarantees of origin system to energy from non-renewable sources should be an option for Member States. This would provide a consistent means of proving to final customers the origin of renewable gas such as biomethane and would facilitate greater cross-border trade in such gas. It would also enable the creation of guarantees of origin for other renewable gas such as hydrogen.

(60) There is a need to support the integration of energy from renewable sources into the transmission and distribution grid and the use of energy storage systems for integrated variable production of energy from renewable sources, in particular as regards the rules regulating dispatch and access to the grid. The framework for the integration of renewable electricity is provided for in other Union law relating to the internal electricity market. However, that framework does not include provisions on the integration of gas from renewable sources into the gas grid. It is therefore necessary to include such provisions in this Directive.

(61) The opportunities for establishing economic growth through innovation and a sustainable competitive energy policy have been recognised. Production of energy from renewable sources often depends on local or regional SMEs. The opportunities for local business development, sustainable growth and high-quality employment that investments in regional and local production of energy from renewable sources bring about in the Member States and their regions are important. The Commission and the Member States should therefore foster and support

national and regional development measures in those areas, encourage the exchange of best practices in production of energy from renewable sources between local and regional development initiatives and enhance the provision of technical assistance and training programmes, in order to strengthen regulatory, technical and financial expertise and foster knowledge on available funding possibilities, including a more targeted use of Union funds, such as the use of cohesion policy funding in that area.

(62) Regional and local authorities often set more ambitious renewable targets that exceed national targets. Regional and local commitments to stimulating development of renewable energy and energy efficiency are currently supported through networks, such as the Covenant of Mayors, Smart Cities or Smart Communities initiatives, and the development of sustainable energy action plans. Such networks are essential and should be expanded, as they raise awareness and facilitate exchanges of best practices and available financial support. In that context, the Commission should support interested innovative regions and local authorities to work across borders by assisting in setting up cooperation mechanisms, such as the European Grouping of Territorial Cooperation, which enables public authorities of various Member States to collaborate and deliver joint services and projects, without requiring a prior international agreement to be signed and ratified by national parliaments. Other innovative measures to attract more investment into new technologies, such as energy-performance contracts and standardisation processes in public financing, should also be considered.

(63) When favouring the development of the market for energy from renewable sources, it is necessary to take into account the positive impact on regional and local development opportunities, export prospects, social cohesion and employment opportunities, in particular as concerns SMEs and independent energy producers, including renewables self-consumers and renewable energy communities.

(64) The specific situation of the outermost regions is recognised in Article 349 TFEU. The energy sector in the outermost regions is often characterised by isolation, limited supply and dependence on fossil fuels while those regions benefit from significant local renewable sources of energy. The outermost regions could thus serve as examples of the application of innovative energy technologies for the Union. It is therefore necessary to promote the uptake of renewable energy in order to achieve a higher degree of energy autonomy for those regions and recognise their specific situation in terms of renewable energy potential and public support needs. Provision should be made for a derogation of limited local impact that allows Member States to adopt specific criteria in order to ensure eligibility for financial support for the consumption of certain biomass fuels. Member States should be able to adopt such specific criteria for installations using biomass fuels and located in an outermost region as referred to in Article 349 TFEU, as well as for biomass that is used as fuel in such installations and that does not comply with the harmonised sustainability, energy efficiency and greenhouse gas emissions saving criteria set out in this Directive. Such specific criteria for biomass fuels should apply irrespective of whether the place of origin of that biomass is a Member State or a third country. Moreover, any specific criteria should be objectively justified on the grounds of energy independence of the outermost region concerned and of ensuring a smooth transition to the sustainability criteria, the energy efficiency criteria and the greenhouse gas emissions saving criteria for biomass fuels of this Directive in such an outermost region.

Considering that the energy mix for electricity generation for the outermost regions is made up to a large extent of fuel oil, it is necessary to allow an appropriate consideration of greenhouse gas emissions saving criteria in those regions. It would therefore be appropriate to provide for a specific fossil fuel comparator for the electricity produced in the outermost regions. Member States should ensure effective compliance with their specific criteria. Finally, Member States should, without prejudice to support granted in accordance with support schemes in accordance with this Directive, not refuse to take into account, on other sustainability grounds, biofuels and bioliquids obtained in accordance with this Directive. This prohibition is intended to ensure that biofuels and bioliquids that comply with the harmonised criteria provided for in this Directive continue to benefit from the trade facilitation objectives of this Directive, including as regards the outermost regions concerned.

(65) It is appropriate to allow for the development of decentralised renewable energy technologies and storage under non-discriminatory conditions and without hampering the financing of infrastructure investments. The move towards decentralised energy production has many benefits, including the utilisation of local energy sources, increased local security of energy supply, shorter transport distances and reduced energy transmission losses. Such decentralisation also fosters community development and cohesion by providing income sources and creating jobs locally.

(66) With the growing importance of self-consumption of renewable electricity, there is a need for a definition of 'renewables self-consumers' and of 'jointly acting renewables self-consumers'. It is also necessary to establish a regulatory framework which would empower renewables self-consumers to generate, consume, store, and sell electricity without facing disproportionate burdens. Citizens living in apartments for example should be able to benefit from consumer empowerment to the same extent as households in single family homes. However, Member States should be allowed to differentiate between individual renewables self-consumers and jointly acting renewables self-consumers due to their different characteristics to the extent that any such differentiation is proportionate and duly justified.

(67) Empowering jointly acting renewables self-consumers also provides opportunities for renewable energy communities to advance energy efficiency at household level and helps fight energy poverty through reduced consumption and lower supply tariffs. Member States should take appropriate advantage of that opportunity by, *inter alia*, assessing the possibility to enable participation by households that might otherwise not be able to participate, including vulnerable consumers and tenants.

(68) Renewables self-consumers should not face discriminatory or disproportionate burdens or costs and should not be subject to unjustified charges. Their contribution to the achievement of the climate and energy target and the costs and benefits that they bring about in the wider energy system should be taken into account. Member States should therefore generally not apply charges to electricity produced and consumed within the same premises by renewables self-consumers. However, Member States should be allowed to apply non-discriminatory and proportionate charges to such electricity if necessary to ensure the financial sustainability of the electricity system, to limit the support to what is objectively needed and to make efficient use of their support schemes. At the same time, Member States should ensure that renewables self-consumers contribute in a balanced and adequate way to the overall cost-sharing system of producing, distributing and consuming electricity, when electricity is fed into the grid.

(69) To that end, Member States should as a general principle not apply charges to electricity individually produced and consumed by renewables self-consumers within the same premises. However, in order to prevent that incentive from affecting the financial stability of support schemes for renewable energy, that incentive could be limited to small installations with an electrical capacity of 30 kW or less. In certain cases, Member States should be allowed to apply charges to renewables self-consumers for self-consumed electricity, where they make efficient use of their support schemes and apply non-discriminatory and effective access to their support schemes. Member States should also be able to apply partial exemptions from charges, levies, or a combination thereof and support, up to the level needed to ensure the economic viability of such projects.

(70) The participation of local citizens and local authorities in renewable energy projects through renewable energy communities has resulted in substantial added value in terms of local acceptance of renewable energy and access to additional private capital which results in local investment, more choice for consumers and greater participation by citizens in the energy transition. Such local involvement is all the more crucial in a context of increasing renewable energy capacity. Measures to allow renewable energy communities to compete on an equal footing with other producers also aim to increase the participation of local citizens in renewable energy projects and therefore increase acceptance of renewable energy.

(71) The specific characteristics of local renewable energy communities in terms of size, ownership structure and the number of projects can hamper their competition on an equal footing with large-scale players, namely competitors with larger projects or portfolios. Therefore, it should be possible for Member States to choose any form of entity for renewable energy communities, provided that such an entity may, acting in its own name, exercise rights and be subject to obligations. To avoid abuse and to ensure broad participation, renewable energy communities should be capable of remaining autonomous from individual members and other traditional market actors that participate in the community as members or shareholders, or who cooperate through other means such as investment. Participation in renewable energy projects should be open to all potential local members based on objective, transparent and non-discriminatory criteria. Measures to offset the disadvantages relating to the specific characteristics of local renewable energy communities in terms of size, ownership structure and the number of projects include enabling renewable energy communities to operate in the energy system and easing their market integration. Renewable energy communities should be able to share between themselves energy that is produced by their community-owned installations. However, community members should not be exempt from

relevant costs, charges, levies and taxes that would be borne by final consumers who are not community members, producers in a similar situation, or where public grid infrastructure is used for those transfers.

(72) Household consumers and communities engaging in renewables self-consumption should maintain their rights as consumers, including the rights to have a contract with a supplier of their choice and to switch supplier.

(73) Representing around half of the final energy consumption of the Union, the heating and cooling sector is considered to be a key sector in accelerating the decarbonisation of the energy system. Moreover, it is also a strategic sector in terms of energy security, as around 40 % of the renewable energy consumption by 2030 is projected to come from renewable heating and cooling. However, the absence of a harmonised strategy at Union level, the lack of internalisation of external costs and the fragmentation of heating and cooling markets have, to date, led to relatively slow progress in the sector.

(74) Several Member States have implemented measures in the heating and cooling sector to reach their 2020 renewable energy target. However, in the absence of binding national targets post-2020, the remaining national incentives may not be sufficient to reach the long-term decarbonisation goals for 2030 and 2050. In order to meet such goals, reinforce investor certainty and foster the development of a Union-wide renewable heating and cooling market, while respecting the energy efficiency first principle, it is appropriate to encourage the efforts of Member States in the supply of renewable heating and cooling to contribute to the progressive increase of the share of renewable energy. Given the fragmented nature of some heating and cooling markets, it is of utmost importance to ensure flexibility in designing such an effort. It is also important to ensure that a potential uptake of renewable heating and cooling does not have detrimental environmental side-effects or lead to disproportionate overall costs. In order to minimise that risk, the increase of the share of renewable energy in the heating and cooling sector should take into account the situation of those Member States where the share is already very high, or where waste heat and cold is not used, such as in Cyprus and Malta.

(75) District heating and cooling currently represents around 10 % of the heat demand across the Union, with large discrepancies between Member States. The Commission's heating and cooling strategy has recognised the potential for decarbonisation of district heating through increased energy efficiency and renewable energy deployment.

(76) The Energy Union strategy also recognised the role of the citizen in the energy transition, where citizens take ownership of the energy transition, benefit from new technologies to reduce their bills, and participate actively in the market.

(77) The potential synergies between an effort to increase the uptake of renewable heating and cooling and the existing schemes under Directive 2010/31/EU of the European Parliament and of the Council [1] and Directive 2012/27/EU should be emphasised. Member States should, to the extent possible, have the possibility to use existing administrative structures to implement such effort, in order to mitigate the administrative burden.

(78) In the area of district heating, it is therefore crucial to enable the fuel-switching to energy from renewable sources and prevent regulatory and technology lock-in and technology lock-out through reinforced rights for renewable energy producers and final consumers, and bring the tools to final consumers to facilitate their choice between the highest energy-performance solutions that take into account future heating and cooling needs in accordance with expected building performance criteria. Final consumers should be given transparent and reliable information on the efficiency of district heating and cooling systems and the share of energy from renewable sources in their specific heating or cooling supply.

(79) In order to protect consumers of district heating and cooling systems that are not efficient district heating and cooling systems and to allow them to produce their heating or cooling from renewable sources and with significantly better energy performance, consumers should be entitled to disconnect and thus discontinue the heating or cooling service from non-efficient district heating and cooling systems at a whole building level by terminating their contract or, where the contract covers several buildings, by modifying the contract with the district heating or cooling operator.

[1] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (OJ L 153, 18.6.2010, p. 13).

(80) To prepare for the transition towards advanced biofuels and minimise the overall direct and indirect land-use change impacts, it is appropriate to limit the amount of biofuels and bioliquids produced from cereal and other starch-rich crops, sugars and oil crops that can be counted towards the targets laid down in this Directive, without restricting the overall possibility of using such biofuels and bioliquids. The establishment of a limit at Union level should not prevent Member States from providing for lower limits to the amount of biofuels and bioliquids produced from cereal and other starch-rich crops, sugars and oil crops that can be counted at national level towards the targets laid down in this Directive, without restricting the overall possibility of using such biofuels and bioliquids.

(81) Directive 2009/28/EC introduced a set of sustainability criteria, including criteria protecting land with high biodiversity value and land with high-carbon stock, but did not cover the issue of indirect land-use change. Indirect land-use change occurs when the cultivation of crops for biofuels, bioliquids and biomass fuels displaces traditional production of crops for food and feed purposes. Such additional demand increases the pressure on land and can lead to the extension of agricultural land into areas with high-carbon stock, such as forests, wetlands and peatland, causing additional greenhouse gas emissions. Directive (EU) 2015/1513 of the European Parliament and of the Council [1] recognises that the magnitude of greenhouse gas emissions-linked indirect land-use change is capable of negating some or all greenhouse gas emissions savings of individual biofuels, bioliquids or biomass fuels. While there are risks arising from indirect land-use change, research has shown that the scale of the effect depends on a variety of factors, including the type of feedstock used for fuel production, the level of additional demand for feedstock triggered by the use of biofuels, bioliquids and biomass fuels, and the extent to which land with high-carbon stock is protected worldwide.

While the level of greenhouse gas emissions caused by indirect land-use change cannot be unequivocally determined with the level of precision required to be included in the greenhouse gas emission calculation methodology, the highest risks of indirect land-use change have been identified for biofuels, bioliquids and biomass fuels produced from feedstock for which a significant expansion of the production area into land with high-carbon stock is observed. It is therefore appropriate, in general, to limit food and feed crops-based biofuels, bioliquids and biomass fuels promoted under this Directive and, in addition, to require Member States to set a specific and gradually decreasing limit for biofuels, bioliquids and biomass fuels produced from food and feed crops for which a significant expansion of the production area into land with high-carbon stock is observed. Low indirect land-use change-risk biofuels, bioliquids and biomass fuels should be exempt from the specific and gradually decreasing limit.

(82) Yield increases in agricultural sectors by means of improved agricultural practices, investments in better machinery and knowledge transfer, beyond levels which would have prevailed in the absence of productivity-promoting schemes for food and feed crop-based biofuels, bioliquids and biomass fuels, as well as the cultivation of crops on land not previously used for the cultivation of crops, can mitigate indirect land-use change. Where there is evidence that such measures have led to an increase of production going beyond the expected increase in productivity, biofuels, bioliquids and biomass fuels produced from such additional feedstock should be considered to be low indirect land-use change-risk biofuels, bioliquids and biomass fuels. Annual yield fluctuations should be taken into account in that context.

(83) Directive (EU) 2015/1513 called on the Commission to submit, without delay, a comprehensive proposal for a cost-effective and technology-neutral post-2020 policy in order to create a long-term perspective for investment in sustainable biofuels with a low risk of causing indirect land-use change with a headline target of decarbonising the transport sector. An obligation on Member States to require fuel suppliers to deliver an overall share of fuels from renewable sources can provide certainty for investors and encourage the continuous development of alternative renewable transport fuels including advanced biofuels, renewable liquid and gaseous transport fuels of non-biological origin, and renewable electricity in the transport sector. Since renewable alternatives might not be available or cost-efficient to all fuel suppliers, it is appropriate to allow Member States to distinguish between fuel

[1] Directive (EU) 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources (OJ L 239, 15.9.2015, p. 1).

suppliers and to exempt, if necessary, particular types of fuel supplier from the obligation. As transport fuels are traded easily, fuel suppliers in Member States with low supplies of the relevant resources are likely easily to obtain renewable fuels from other sources.

(84) A Union database should be put in place to ensure transparency and traceability of renewable fuels. While Member States should be allowed to continue to use or establish national databases, those national databases should be linked to the Union database, in order to ensure instant data transfers and harmonisation of data flows.

(85) Advanced biofuels and other biofuels and biogas produced from feedstock listed in an annex to this Directive, renewable liquid and gaseous transport fuels of non-biological origin, and renewable electricity in the transport sector can contribute to low carbon emissions, stimulating the decarbonisation of the Union transport sector in a cost-effective manner, and improving, *inter alia*, energy diversification in the transport sector while promoting innovation, growth and jobs in the Union economy and reducing reliance on energy imports. An obligation on Member States to require fuel suppliers to ensure a minimum share of advanced biofuels and certain biogases, is intended to encourage continuous development of advanced fuels, including biofuels. It is important to ensure that that obligation also promotes improvements in the greenhouse gas performance of the fuels supplied to meet it. The Commission should assess the greenhouse gas performance, technical innovation and sustainability of those fuels.

(86) With regard to Intelligent Transport, it is important to increase the development and deployment of electric mobility for road, as well as to accelerate the integration of advanced technologies into innovative rail.

(87) Electromobility is expected to constitute a substantial part of the renewable energy in the transport sector by the year 2030. Further incentives should be provided considering the swift development of electromobility and the potential of that sector in terms of growth and jobs in the Union. Multipliers for renewable electricity supplied for the transport sector should be used for the promotion of renewable electricity in the transport sector and in order to reduce the comparative disadvantage in energy statistics. Since it is not possible to account for all electricity supplied for road vehicles in statistics through dedicated metering, such as charging at home, multipliers should be used in order to ensure that the positive impacts of electrified renewable energy-based transport are properly accounted for. Options should be explored to ensure that the new demand for electricity in the transport sector is met with additional generation capacity of energy from renewable sources.

(88) In light of climatic constraints that limit the possibility of consuming certain types of biofuels due to environmental, technical or health concerns, and due to the size and structure of their fuel markets, it is appropriate that Cyprus and Malta, for the purposes of demonstrating compliance with national renewable energy obligations placed on fuel suppliers, be allowed to take into account those inherent limitations.

(89) The promotion of recycled carbon fuels can contribute towards the policy objectives of energy diversification and decarbonisation of the transport sector where they fulfil the appropriate minimum greenhouse gas emissions savings threshold. It is therefore appropriate to include those fuels in the obligation on fuel supplier, whilst giving Member States the option not to consider those fuels in the obligation if they do not wish to do so. Since those fuels are not renewable, they should not be counted towards the overall Union target for energy from renewable sources.

(90) Renewable liquid and gaseous transport fuels of non-biological origin are important to increase the share of renewable energy in sectors that are expected to rely on liquid fuels in the long term. To ensure that renewable fuels of non-biological origin contribute to greenhouse gas reduction, the electricity used for the fuel production should be of renewable origin. The Commission should develop, by means of delegated acts, a reliable Union methodology to be applied where such electricity is taken from the grid. That methodology should ensure that there is a temporal and geographical correlation between the electricity production unit with which the producer has a bilateral renewables power purchase agreement and the fuel production. For example, renewable fuels of non-biological origin cannot be counted as fully renewable if they are produced when the contracted renewable generation unit is not generating electricity. Another example is the case of electricity grid congestion, where fuels can be counted as fully renewable only when both the electricity generation and the fuel production plants

are located on the same side in respect of the congestion. Furthermore, there should be an element of additionality, meaning that the fuel producer is adding to the renewable deployment or to the financing of renewable energy.

(91) Feedstock which has low indirect land-use change impacts when used for biofuels, should be promoted for its contribution to the decarbonisation of the economy. Feedstock for advanced biofuels and biogas for transport, for which technology is more innovative and less mature and therefore needs a higher level of support, should, in particular, be included in an annex to this Directive. In order to ensure that it is updated in accordance with the latest technological developments while avoiding unintended negative effects, the Commission should review that annex in order to assess whether new feedstock should be added.

(92) The costs of connecting new producers of gas from renewable sources to the gas grids should be based on objective, transparent and non-discriminatory criteria and due account should be taken of the benefit that embedded local producers of gas from renewable sources bring to the gas grids.

(93) In order to exploit the full potential of biomass, which does not include peat or material embedded in geological formations and/or transformed to fossil, to contribute to the decarbonisation of the economy through its uses for materials and energy, the Union and the Member States should promote greater sustainable mobilisation of existing timber and agricultural resources and the development of new forestry and agriculture production systems, provided that sustainability and greenhouse gas emissions saving criteria are met.

(94) Biofuels, bioliquids and biomass fuels should always be produced in a sustainable manner. Biofuels, bioliquids and biomass fuels used for compliance with the Union target laid down in this Directive, and those which benefit from support schemes, should therefore be required to fulfil sustainability and greenhouse gas emissions saving criteria. The harmonisation of those criteria for biofuels and bioliquids is essential for the achievement of the energy policy objectives of the Union as set out in Article 194(1) TFEU. Such harmonisation ensures the functioning of the internal energy market and thus facilitates, especially with regard to the obligation of Member States not to refuse to take into account, on other sustainability grounds, biofuels and bioliquids obtained in accordance with this Directive, trade between Member States in compliant biofuels and bioliquids. The positive effects of the harmonisation of those criteria on the smooth functioning of the internal energy market and on the avoidance of distortion of competition in the Union cannot be frustrated. For biomass fuels, Member States should be allowed to establish additional sustainability and greenhouse gas emissions saving criteria.

(95) The Union should take appropriate steps in the context of this Directive, including the promotion of sustainability and greenhouse gas emissions saving criteria for biofuels, and for bioliquids and biomass fuels.

(96) The production of agricultural raw material for biofuels, bioliquids and biomass fuels, and the incentives provided for in this Directive to promote their use, should not have the effect of encouraging the destruction of biodiverse lands. Such finite resources, recognised in various international instruments to be of universal value, should be preserved. It is therefore necessary to provide sustainability and greenhouse gas emissions saving criteria ensuring that biofuels, bioliquids and biomass fuels qualify for the incentives only where it is guaranteed that agricultural raw material does not originate from biodiverse areas or, in the case of areas designated for nature protection purposes or for the protection of rare, threatened or endangered ecosystems or species, the relevant competent authority demonstrates that the production of the agricultural raw material does not interfere with such purposes.

(97) Forests should be considered to be biodiverse in accordance with the sustainability criteria where they are primary forests in accordance with the definition used by the Food and Agriculture Organisation of the United Nations (FAO) in its Global Forest Resource Assessment, or where they are protected by national nature protection law. Areas where the collection of non-wood forest products occurs should be considered to be biodiverse forests, provided that the human impact is small. Other types of forest as defined by the FAO, such as modified natural forests, semi-natural forests and plantations, should not be considered to be primary

forests. Having regard, furthermore, to the highly biodiverse nature of certain grasslands, both temperate and tropical, including highly biodiverse savannahs, steppes, scrublands and prairies, biofuels, bioliquids and biomass fuels made from agricultural raw materials originating in such lands should not qualify for the incentives provided for by this Directive. In order to establish appropriate criteria to define such highly biodiverse grassland in accordance with the best available scientific data and relevant international standards, implementing powers should be conferred on the Commission.

(98) Land should not be converted to accommodate the production of agricultural raw material for biofuels, bioliquids and biomass fuels if its carbon stock loss upon conversion could not, within a reasonable period, taking into account the urgency of tackling climate change, be compensated for by the greenhouse gas emission savings resulting from the production and use of biofuels, bioliquids and biomass fuels. This would prevent unnecessary, burdensome research by economic operators and the conversion of high-carbon-stock land that are demonstrated to be ineligible for producing agricultural raw materials for biofuels bioliquids and biomass fuels. Inventories of worldwide carbon stocks indicate that wetlands and continuously forested areas with a canopy cover of more than 30 % should be included in that category.

(99) In the framework of the Common Agricultural Policy, Union farmers should comply with a comprehensive set of environmental requirements in order to receive direct support. Compliance with those requirements can be most effectively verified in the context of agricultural policy. Including those requirements in the sustainability scheme is not appropriate as the sustainability criteria for bioenergy should set out rules that are objective and apply globally. Verification of compliance under this Directive would also risk causing an unnecessary administrative burden.

(100) Agricultural feedstock for the production of biofuels, bioliquids and biomass fuels should be produced using practices that are consistent with the protection of soil quality and soil organic carbon. Soil quality and soil carbon should therefore be included in monitoring systems of operators or national authorities.

(101) It is appropriate to introduce Union-wide sustainability and greenhouse gas emissions saving criteria for biomass fuels used in the electricity sector and in the heating and cooling sector, in order to continue to ensure high greenhouse gas emissions savings compared to fossil fuel alternatives, to avoid unintended sustainability impacts, and to promote the internal market. The outermost regions should be able to use the potential of their resources in order to increase the production of renewable energy and their energy independence.

(102) To ensure that, despite the growing demand for forest biomass, harvesting is carried out in a sustainable manner in forests where regeneration is ensured, that special attention is given to areas explicitly designated for the protection of biodiversity, landscapes and specific natural elements, that biodiversity resources are preserved and that carbon stocks are tracked, woody raw material should emanate only from forests that are harvested in accordance with the principles of sustainable forest management that are developed under international forest processes such as Forest Europe and that are implemented through national law or the best management practices at sourcing area level. Operators should take the appropriate steps in order to minimise the risk of using unsustainable forest biomass for the production of bioenergy. To that end, operators should put in place a risk-based approach. In this context, it is appropriate for the Commission to develop operational guidance on the verification of compliance with the risk-based approach by means of implementing acts, after consulting the Committee on the Sustainability of Biofuels, Bioliquids and Biomass fuels.

(103) Harvesting for energy purposes has increased and is expected to continue to grow, resulting in higher imports of raw materials from third countries as well as an increase of the production of those materials within the Union. It should be ensured that harvesting is sustainable.

(104) In order to minimise the administrative burden, the Union sustainability and greenhouse gas emissions saving criteria should apply only to electricity and heating from biomass fuels produced in installations with a total rated thermal input equal to or exceeding 20 MW.

(105) Biomass fuels should be converted into electricity and heat in an efficient way in order to maximise energy security and greenhouse gas emissions savings, as well as to limit emissions of air pollutants and minimise the pressure on limited biomass resources.

(106) The minimum greenhouse gas emissions savings threshold for biofuels, bioliquids and biogas for transport produced in new installations should be increased in order to improve their overall greenhouse gas balance and to discourage further investments in installations with a low greenhouse gas emission savings performance. That increase provides investment safeguards for biofuels, bioliquids and biogas for transport production capacity.

(107) Based on experience in the practical implementation of the Union sustainability criteria, it is appropriate to strengthen the role of voluntary international and national certification schemes for verification of compliance with the sustainability criteria in a harmonised manner.

(108) It is in the interests of the Union to encourage the development of voluntary international or national schemes that set standards for the production of sustainable biofuels, bioliquids and biomass fuels and that certify that the production of biofuels, bioliquids and biomass fuels meets those standards. For that reason, provision should be made for schemes to be recognised as providing reliable evidence and data where they meet adequate standards of reliability, transparency and independent auditing. In order to ensure that compliance with the sustainability and greenhouse gas emissions saving criteria is verified in a robust and harmonised manner and in particular to prevent fraud, the Commission should be empowered to adopt detailed implementing rules, including adequate standards of reliability, transparency and independent auditing to be applied by the voluntary schemes.

(109) Voluntary schemes play an increasingly important role in providing evidence of compliance with the sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass fuels. It is therefore appropriate for the Commission to require voluntary schemes, including those already recognised by the Commission, to report regularly on their activity. Such reports should be made public in order to increase transparency and to improve supervision by the Commission. Furthermore, such reporting would provide the necessary information for the Commission to report on the operation of the voluntary schemes with a view to identifying best practices and submitting, if appropriate, a proposal to further promote such best practices.

(110) To facilitate the functioning of the internal market, evidence regarding the sustainability and greenhouse gas emissions criteria for biofuels, bioliquids and biomass fuels that have been obtained in accordance with a scheme that has been recognised by the Commission should be accepted in all Member States. Member States should contribute towards ensuring the correct implementation of the certification principles of voluntary schemes by supervising the operation of certification bodies that are accredited by the national accreditation body and by informing the voluntary schemes about relevant observations.

(111) In order to avoid a disproportionate administrative burden, a list of default values should be laid down for common biofuel, bioliquid and biomass fuel production pathways and that list should be updated and expanded when further reliable data are available. Economic operators should always be entitled to claim the level of greenhouse gas emissions savings for biofuels, bioliquids and biomass fuels established by that list. Where the default value for greenhouse gas emissions savings from a production pathway lies below the required minimum level of greenhouse gas emissions savings, producers wishing to demonstrate their compliance with that minimum level should be required to show that the actual greenhouse gas emissions from their production process are lower than those that were assumed when calculating the default values.

(112) It is necessary to lay down clear rules based on objective and non-discriminatory criteria, for the calculation of greenhouse gas emissions savings from biofuels, bioliquids and biomass fuels and their fossil fuel comparators.

(113) In accordance with current technical and scientific knowledge, the greenhouse gas emissions accounting methodology should take into account the transformation of solid and gaseous biomass fuels into final energy in order to be consistent with the calculation of renewable energy for the purposes of counting towards the Union target laid down in this Directive. The allocation of greenhouse gas emissions to co-products, as distinct from wastes and residues, should also be reviewed in cases where electricity or heating and cooling are produced in co-generation or multi-generation plants.

(114) If land with high stocks of carbon in its soil or in its vegetation is converted for the cultivation of raw materials for biofuels, bioliquids and biomass fuels, some of the stored carbon will generally be released into the atmosphere, leading to the formation of carbon dioxide (CO_2). The resulting negative greenhouse gas impact can offset the positive greenhouse gas impact of the biofuels, bioliquids or biomass fuels, in some cases by a wide margin. The full carbon effects of such conversion should therefore be taken into account in calculating the greenhouse gas emissions savings of particular biofuels, bioliquids and biomass fuels. This is necessary to ensure that the greenhouse gas emissions saving calculation takes into account the totality of the carbon effects of the use of biofuels, bioliquids and biomass fuels.

(115) In calculating the greenhouse gas impact of land conversion, economic operators should be able to use actual values for the carbon stocks associated with the reference land use and the land use after conversion. They should also be able to use standard values. The methodology of the Intergovernmental Panel on Climate Change (IPCC) is the appropriate basis for such standard values. That work is not currently expressed in a form that is immediately applicable by economic operators. The Commission should therefore revise its guidelines of 10 June 2010 for the calculation of land carbon stocks for the purposes of the rules for calculating the greenhouse gas impact of biofuels, bioliquids and their fossil fuel comparators, which are set out in an annex to this Directive, while ensuring consistency with Regulation (EU) No 525/2013 of the European Parliament and of the Council [1].

(116) Co-products from the production and use of fuels should be taken into account in the calculation of greenhouse gas emissions. The substitution method is appropriate for the purposes of policy analysis, but not for the regulation of individual economic operators and individual consignments of transport fuels. In those cases, the energy allocation method is the most appropriate method, as it is easy to apply, is predictable over time, minimises counter-productive incentives and produces results that are generally comparable with those produced by the substitution method. For the purposes of policy analysis, the Commission should also, in its reporting, present results using the substitution method.

(117) Co-products are different from residues and agricultural residues, as they are the primary aim of the production process. It is therefore appropriate to clarify that agricultural crop residues are residues and not co-products. This has no implications on the existing methodology but clarifies the existing provisions.

(118) The established method of using energy allocation as a rule for dividing greenhouse gas emissions between co-products has worked well and should be continued. It is appropriate to align the methodology for calculating greenhouse gas emissions coming from the use of combined heat and power (CHP) when the CHP is used in processing biofuels, bioliquids and biomass fuels to the methodology applied to a CHP being the end-use.

(119) The methodology takes into account the reduced greenhouse gas emissions arising from the use of CHP, compared to the use of electricity plants and heat-only plants, by taking into account the utility of heat compared to electricity, and the utility of heat at different temperatures. It follows that higher temperature should bear a larger part of the total greenhouse gas emissions than heat at low temperature, when the heat is co-produced with electricity. The methodology takes into account the whole pathway to final energy, including conversion to heat or electricity.

(120) It is appropriate for the data used in the calculation of the default values to be obtained from independent, scientifically expert sources and to be updated as appropriate as those sources progress their work. The Commission should encourage those sources to address, when they update their work, emissions from cultivation, the effects of regional and climatological conditions, the effects of cultivation using sustainable agricultural and organic farming methods, and the scientific contributions of producers in the Union and in third countries, and civil society.

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[1] Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (OJ L 165, 18.6.2013, p. 13).

(121) Global demand for agricultural commodities is growing. Part of that increase in demand is likely to be met through an increase in the amount of land devoted to agriculture. The restoration of land that has been severely degraded and therefore cannot otherwise be used for agricultural purposes is a way of increasing the amount of land available for cultivation. The sustainability scheme should promote the use of such restored land because the promotion of biofuels, bioliquids and biomass fuels will contribute to the growth in demand for agricultural commodities.

(122) In order to ensure the harmonised implementation of the greenhouse gas emissions calculation methodology and to align to the latest scientific evidence, implementing powers should be conferred on the Commission to adapt the methodological principles and values necessary for assessing whether greenhouse gas emissions saving criteria have been fulfilled and to assess whether reports submitted by Member States and third countries contain accurate data on cultivation emissions of feedstock.

(123) European gas grids are becoming more integrated. The promotion of the production and use of biomethane, its injection into a natural gas grid and cross-border trade create a need to ensure proper accounting of renewable energy as well as avoiding double incentives resulting from support schemes in different Member States. The mass balance system related to verification of bioenergy sustainability and the new Union database are intended to help address those issues.

(124) The achievement of the objectives of this Directive requires that the Union and Member States dedicate a significant amount of financial resources to research and development in relation to renewable energy technologies. In particular, the European Institute of Innovation and Technology should give high priority to the research and development of renewable energy technologies.

(125) The implementation of this Directive should, where relevant, reflect the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, in particular as implemented through Directive 2003/4/EC of the European Parliament and of the Council ([1]).

(126) In order to amend or supplement non-essential elements of this Directive, the power to adopt acts in accordance with Article 290 TFEU should be delegated to the Commission in respect of establishing the methodology for calculating the quantity of renewable energy used for cooling and district cooling and amending the methodology for calculating energy from heat pumps; establishing the URDP and setting the conditions for finalising transactions of statistical transfer between Member States via the URDP; establishing appropriate minimum thresholds for greenhouse gas emissions savings of recycled carbon fuels; adopting, and if appropriate amending, the criteria for certification of low indirect land-use change-risk biofuels, bioliquids and biomass fuels and for determining the high indirect land-use change-risk feedstock for which significant expansion of the production into land with high-carbon stock is observed and the gradual decrease in their contribution to the targets laid down in this Directive; adapting the energy content of transport fuels to scientific and technical progress; establishing the Union methodology for setting the rules by which economic operators are to comply with the requirements for counting electricity as fully renewable when used for the production of renewable liquid and gaseous transport fuels of non-biological origin or when taken from the grid; specifying the methodology by which to determine the share of biofuel, and biogas for transport, resulting from biomass being processed with fossil fuels in a common process and the methodology by which to assess the greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels in order to ensure that credits from greenhouse gas emissions savings are given only once; amending by adding to, but not removing from, the lists of feedstock for the production of advanced biofuels and other biofuels and biogas; and supplementing or amending the rules for calculating the greenhouse gas impact of biofuels, bioliquids and their fossil fuel comparators. It is of particular importance that the Commission carry out appropriate consultations during its preparatory work, including at expert level, and that those consultations be conducted in

([1]) Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC (OJ L 41, 14.2.2003, p. 26).

accordance with the principles laid down in the Interinstitutional Agreement of 13 April 2016 on Better Law-Making ([1]). In particular, to ensure equal participation in the preparation of delegated acts, the European Parliament and the Council receive all documents at the same time as Member States' experts, and their experts systematically have access to meetings of Commission expert groups dealing with the preparation of delegated acts.

(127) The measures necessary for the implementation of this Directive should be adopted in accordance with Regulation (EU) No 182/2011 of the European Parliament and of the Council ([2]).

(128) Since the objective of this Directive, namely to achieve a share of at least 32 % of energy from renewable sources in the Union's gross final consumption of energy by 2030, cannot be sufficiently achieved by the Member States but can rather, by reason of the scale of the action, be better achieved at Union level, the Union may adopt measures, in accordance with the principle of subsidiarity as set out in Article 5 of the Treaty on European Union. In accordance with the principle of proportionality, as set out in that Article, this Directive does not go beyond what is necessary in order to achieve that objective.

(129) In accordance with the Joint Political Declaration of 28 September 2011 of Member States and the Commission on explanatory documents ([3]), Member States have undertaken to accompany, in justified cases, the notification of their transposition measures with one or more documents explaining the relationship between the components of a directive and the corresponding parts of national transposition instruments. With regard to this Directive, the legislator considers the transmission of such documents to be justified.

(130) The obligation to transpose this Directive into national law should be confined to those provisions which represent a substantive amendment as compared to Directive 2009/28/EC. The obligation to transpose provisions which are unchanged arises under that Directive.

(131) This Directive should be without prejudice to the obligations of the Member States relating to the time-limit for the transposition into national law of Council Directive 2013/18/EU ([4]) and Directive (EU) 2015/1513,

HAVE ADOPTED THIS DIRECTIVE:

Article 1

Subject matter

This Directive establishes a common framework for the promotion of energy from renewable sources. It sets a binding Union target for the overall share of energy from renewable sources in the Union's gross final consumption of energy in 2030. It also lays down rules on financial support for electricity from renewable sources, on self-consumption of such electricity, on the use of energy from renewable sources in the heating and cooling sector and in the transport sector, on regional cooperation between Member States, and between Member States and third countries, on guarantees of origin, on administrative procedures and on information and training. It also establishes sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass fuels.

Article 2

Definitions

For the purposes of this Directive, the relevant definitions in Directive 2009/72/EC of the European Parliament and of the Council ([5]) apply.

([1]) OJ L 123, 12.5.2016, p. 1.
([2]) Regulation (EU) No 182/2011 of the European Parliament and of the Council of 16 February 2011 laying down the rules and general principles concerning mechanisms for control by Member States of the Commission's exercise of implementing powers (OJ L 55, 28.2.2011, p. 13).
([3]) OJ C 369, 17.12.2011, p. 14.
([4]) Council Directive 2013/18/EU of 13 May 2013 adapting Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources, by reason of the accession of the Republic of Croatia (OJ L 158, 10.6.2013, p. 230).
([5]) Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC (OJ L 211, 14.8.2009, p. 55).

The following definitions also apply:

(1) 'energy from renewable sources' or 'renewable energy' means energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas;

(2) 'ambient energy' means naturally occurring thermal energy and energy accumulated in the environment with constrained boundaries, which can be stored in the ambient air, excluding in exhaust air, or in surface or sewage water;

(3) 'geothermal energy' means energy stored in the form of heat beneath the surface of solid earth;

(4) 'gross final consumption of energy' means the energy commodities delivered for energy purposes to industry, transport, households, services including public services, agriculture, forestry and fisheries, the consumption of electricity and heat by the energy branch for electricity, heat and transport fuel production, and losses of electricity and heat in distribution and transmission;

(5) 'support scheme' means any instrument, scheme or mechanism applied by a Member State, or a group of Member States, that promotes the use of energy from renewable sources by reducing the cost of that energy, increasing the price at which it can be sold, or increasing, by means of a renewable energy obligation or otherwise, the volume of such energy purchased, including but not restricted to, investment aid, tax exemptions or reductions, tax refunds, renewable energy obligation support schemes including those using green certificates, and direct price support schemes including feed-in tariffs and sliding or fixed premium payments;

(6) 'renewable energy obligation' means a support scheme requiring energy producers to include a given share of energy from renewable sources in their production, requiring energy suppliers to include a given share of energy from renewable sources in their supply, or requiring energy consumers to include a given share of energy from renewable sources in their consumption, including schemes under which such requirements may be fulfilled by using green certificates;

(7) 'financial instrument' means a financial instrument as defined in point (29) of Article 2 of Regulation (EU, Euratom) 2018/1046 of the European Parliament and of the Council ([1]);

(8) 'SME' means a micro, small or medium-sized enterprise as defined in Article 2 of the Annex to Commission Recommendation 2003/361/EC ([2]);

(9) 'waste heat and cold' means unavoidable heat or cold generated as by-product in industrial or power generation installations, or in the tertiary sector, which would be dissipated unused in air or water without access to a district heating or cooling system, where a cogeneration process has been used or will be used or where cogeneration is not feasible;

(10) 'repowering' means renewing power plants that produce renewable energy, including the full or partial replacement of installations or operation systems and equipment for the purposes of replacing capacity or increasing the efficiency or capacity of the installation;

(11) 'distribution system operator' means an operator as defined in point (6) of Article 2 of Directive 2009/72/EC and in point (6) of Article 2 of Directive 2009/73/EC of the European Parliament and of the Council ([3]);

(12) 'guarantee of origin' means an electronic document which has the sole function of providing evidence to a final customer that a given share or quantity of energy was produced from renewable sources;

([1]) Regulation (EU, Euratom) 2018/1046 of the European Parliament and of the Council of 18 July 2018 on the financial rules applicable to the general budget of the Union, amending Regulations (EU) No 1296/2013, (EU) No 1301/2013, (EU) No 1303/2013, (EU) No 1304/2013, (EU) No 1309/2013, (EU) No 1316/2013, (EU) No 223/2014, (EU) No 283/2014, and Decision No 541/2014/EU and repealing Regulation (EU, Euratom) No 966/2012 (OJ L 193, 30.7.2018, p. 1).

([2]) Commission Recommendation 2003/361/EC of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises (OJ L 124, 20.5.2003, p. 36).

([3]) Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC (OJ L 211, 14.8.2009, p. 94).

(13) 'residual energy mix' means the total annual energy mix for a Member State, excluding the share covered by cancelled guarantees of origin;

(14) 'renewables self-consumer' means a final customer operating within its premises located within confined boundaries or, where permitted by a Member State, within other premises, who generates renewable electricity for its own consumption, and who may store or sell self-generated renewable electricity, provided that, for a non-household renewables self-consumer, those activities do not constitute its primary commercial or professional activity;

(15) 'jointly acting renewables self-consumers' means a group of at least two jointly acting renewables self-consumers in accordance with point (14) who are located in the same building or multi-apartment block;

(16) 'renewable energy community' means a legal entity:

(a) which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity;

(b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities;

(c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits;

(17) 'renewables power purchase agreement' means a contract under which a natural or legal person agrees to purchase renewable electricity directly from an electricity producer;

(18) 'peer-to-peer trading' of renewable energy means the sale of renewable energy between market participants by means of a contract with pre-determined conditions governing the automated execution and settlement of the transaction, either directly between market participants or indirectly through a certified third-party market participant, such as an aggregator. The right to conduct peer-to-peer trading shall be without prejudice to the rights and obligations of the parties involved as final customers, producers, suppliers or aggregators;

(19) 'district heating' or 'district cooling' means the distribution of thermal energy in the form of steam, hot water or chilled liquids, from central or decentralised sources of production through a network to multiple buildings or sites, for the use of space or process heating or cooling;

(20) 'efficient district heating and cooling' means efficient district heating and cooling as defined in point (41) of Article 2 of Directive 2012/27/EU;

(21) 'high-efficiency cogeneration' means high-efficiency cogeneration as defined in point (34) of Article 2 of Directive 2012/27/EU;

(22) 'energy performance certificate' means energy performance certificate as defined in point (12) of Article 2 of Directive 2010/31/EU;

(23) 'waste' means waste as defined in point (1) of Article 3 of Directive 2008/98/EC, excluding substances that have been intentionally modified or contaminated in order to meet this definition;

(24) 'biomass' means the biodegradable fraction of products, waste and residues from biological origin from agriculture, including vegetal and animal substances, from forestry and related industries, including fisheries and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin;

(25) 'agricultural biomass' means biomass produced from agriculture;

(26) 'forest biomass' means biomass produced from forestry;

(27) 'biomass fuels' means gaseous and solid fuels produced from biomass;

(28) 'biogas' means gaseous fuels produced from biomass;

(29) 'biowaste' means biowaste as defined in point (4) of Article 3 of Directive 2008/98/EC;

(30) '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;

(31) '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;

(32) 'bioliquids' means liquid fuel for energy purposes other than for transport, including electricity and heating and cooling, produced from biomass;

(33) 'biofuels' means liquid fuel for transport produced from biomass;

(34) 'advanced biofuels' means biofuels that are produced from the feedstock listed in Part A of Annex IX;

(35) 'recycled carbon fuels' means liquid and gaseous fuels that are produced from liquid or solid waste streams of non-renewable origin which are not suitable for material recovery in accordance with Article 4 of Directive 2008/98/EC, or from waste processing gas and exhaust gas of non-renewable origin which are produced as an unavoidable and unintentional consequence of the production process in industrial installations;

(36) 'renewable liquid and gaseous transport fuels of non-biological origin' means liquid or gaseous fuels which are used in the transport sector other than biofuels or biogas, the energy content of which is derived from renewable sources other than biomass;

(37) 'low indirect land-use change-risk biofuels, bioliquids and biomass fuels' means biofuels, bioliquids and biomass fuels, the feedstock of which was produced within schemes which avoid displacement effects of food and feed-crop based biofuels, bioliquids and biomass fuels through improved agricultural practices as well as through the cultivation of crops on areas which were previously not used for cultivation of crops, and which were produced in accordance with the sustainability criteria for biofuels, bioliquids and biomass fuels laid down in Article 29;

(38) 'fuel supplier' means an entity supplying fuel to the market that is responsible for passing fuel through an excise duty point or, in the case of electricity or where no excise is due or where duly justified, any other relevant entity designated by a Member State;

(39) 'starch-rich crops' means crops comprising mainly cereals, regardless of whether the grains alone or the whole plant, such as in the case of green maize, are used; tubers and root crops, such as potatoes, Jerusalem artichokes, sweet potatoes, cassava and yams; and corm crops, such as taro and cocoyam;

(40) 'food and feed crops' means starch-rich crops, sugar crops or oil crops produced on agricultural land as a main crop excluding residues, waste or ligno-cellulosic material and intermediate crops, such as catch crops and cover crops, provided that the use of such intermediate crops does not trigger demand for additional land;

(41) 'ligno-cellulosic material' means material composed of lignin, cellulose and hemicellulose, such as biomass sourced from forests, woody energy crops and forest-based industries' residues and wastes;

(42) 'non-food cellulosic material' means feedstock mainly composed of cellulose and hemicellulose, and having a lower lignin content than ligno-cellulosic material, including food and feed crop residues, such as straw, stover, husks and shells; grassy energy crops with a low starch content, such as ryegrass, switchgrass, miscanthus, giant cane; cover crops before and after main crops; ley crops; industrial residues, including from food and feed crops after vegetal oils, sugars, starches and protein have been extracted; and material from biowaste, where ley and cover crops are understood to be temporary, short-term sown pastures comprising grass-legume mixture with a low starch content to obtain fodder for livestock and improve soil fertility for obtaining higher yields of arable main crops;

(43) 'residue' means a substance that is not the end product(s) that a production process directly seeks to produce; it is not a primary aim of the production process and the process has not been deliberately modified to produce it;

(44) '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;

(45) 'actual value' means the greenhouse gas emissions savings 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 Annex V or Part B of Annex VI;

(46) 'typical value' means an estimate of the greenhouse gas emissions and greenhouse gas emissions savings for a particular biofuel, bioliquid or biomass fuel production pathway, which is representative of the Union consumption;

(47) 'default value' means a value derived from a typical value by the application of pre-determined factors and that may, in circumstances specified in this Directive, be used in place of an actual value.

Article 3

Binding overall Union target for 2030

1. Member States shall collectively ensure that the share of energy from renewable sources in the Union's gross final consumption of energy in 2030 is at least 32 %. The Commission shall assess that target with a view to submitting a legislative proposal by 2023 to increase it where there are further substantial costs reductions in the production of renewable energy, where needed to meet the Union's international commitments for decarbonisation, or where a significant decrease in energy consumption in the Union justifies such an increase.

2. Member States shall set national contributions to meet, collectively, the binding overall Union target set in paragraph 1 of this Article as part of their integrated national energy and climate plans in accordance with Articles 3 to 5 and 9 to 14 of Regulation (EU) 2018/1999. In preparing their draft integrated national energy and climate plans, Member States may consider the formula referred to in Annex II to that Regulation.

If, on the basis of the assessment of the draft integrated national energy and climate plans submitted pursuant to Article 9 of Regulation (EU) 2018/1999, the Commission concludes that the national contributions of the Member States are insufficient for the collective achievement of the binding overall Union target, it shall follow the procedure laid down in Articles 9 and 31 of that Regulation.

3. Member States shall ensure that their national policies, including the obligations deriving from Articles 25 to 28 of this Directive, and their support schemes, are designed with due regard to the waste hierarchy as set out in Article 4 of Directive 2008/98/EC to aim to avoid undue distortive effects on the raw material markets. Member States shall grant no support for renewable energy produced from the incineration of waste if the separate collection obligations laid down in that Directive have not been complied with.

4. From 1 January 2021, the share of energy from renewable sources in each Member State's gross final consumption of energy shall not be lower than the baseline share shown in the third column of the table in Part A of Annex I to this Directive. Member States shall take the necessary measures to ensure compliance with that baseline share. If a Member State does not maintain its baseline share as measured over any one-year period, the first and second sub-paragraphs of Article 32(4) of Regulation (EU) 2018/1999 shall apply.

5. The Commission shall support the high ambition of Member States through an enabling framework comprising the enhanced use of Union funds, including additional funds to facilitate a just transition of carbon intensive regions towards increased shares of renewable energy, in particular financial instruments, especially for the following purposes:

(a) reducing the cost of capital for renewable energy projects;

(b) developing projects and programmes for integrating renewable sources into the energy system, for increasing flexibility of the energy system, for maintaining grid stability and for managing grid congestions;

(c) developing transmission and distribution grid infrastructure, intelligent networks, storage facilities and interconnections, with the objective of arriving at a 15 % electricity interconnection target by 2030, in order to increase the technically feasible and economically affordable level of renewable energy in the electricity system;

(d) enhancing regional cooperation between Member States and between Member States and third countries, through joint projects, joint support schemes and the opening of support schemes for renewable electricity to producers located in other Member States.

6. The Commission shall establish a facilitative platform in order to support Member States that use cooperation mechanisms to contribute to the binding overall Union target set in paragraph 1.

Article 4

Support schemes for energy from renewable sources

1. In order to reach or exceed the Union target set in Article 3(1), and each Member State's contribution to that target set at a national level for the deployment of renewable energy, Member States may apply support schemes.

2. Support schemes for electricity from renewable sources shall provide incentives for the integration of electricity from renewable sources in the electricity market in a market-based and market-responsive way, while avoiding unnecessary distortions of electricity markets as well as taking into account possible system integration costs and grid stability.

3. Support schemes for electricity from renewable sources shall be designed so as to maximise the integration of electricity from renewable sources in the electricity market and to ensure that renewable energy producers are responding to market price signals and maximise their market revenues.

To that end, with regard to direct price support schemes, support shall be granted in the form of a market premium, which could be, *inter alia*, sliding or fixed.

Member States may exempt small-scale installations and demonstration projects from this paragraph, without prejudice to the applicable Union law on the internal market for electricity.

4. Member States shall ensure that support for electricity from renewable sources is granted in an open, transparent, competitive, non-discriminatory and cost-effective manner.

Member States may exempt small-scale installations and demonstration projects from tendering procedures.

Member States may also consider establishing mechanisms to ensure the regional diversification in the deployment of renewable electricity, in particular to ensure cost-efficient system integration.

5. Member States may limit tendering procedures to specific technologies where opening support schemes to all producers of electricity from renewable sources would lead to a suboptimal result, in view of:

(a) the long-term potential of a particular technology;

(b) the need to achieve diversification;

(c) grid integration costs;

(d) network constraints and grid stability;

(e) for biomass, the need to avoid distortions of raw materials markets.

6. Where support for electricity from renewable sources is granted by means of a tendering procedure, Member States shall, in order to ensure a high project realisation rate:

(a) establish and publish non-discriminatory and transparent criteria to qualify for the tendering procedure and set clear dates and rules for delivery of the project;

(b) publish information about previous tendering procedures, including project realisation rates.

7. In order to increase the generation of energy from renewable sources in the outermost regions and small islands, Member States may adapt financial support schemes for projects located in those regions in order to take into account the production costs associated with their specific conditions of isolation and external dependence.

8. By 31 December 2021 and every three years thereafter, the Commission shall report to the European Parliament and to the Council on the performance of support for electricity from renewable sources granted by means of tendering procedures in the Union, analysing in particular the ability of tendering procedures to:

(a) achieve cost-reduction;

(b) achieve technological improvement;

(c) achieve high realisation rates;

(d) provide non-discriminatory participation of small actors and, where applicable, local authorities;

(e) limit environmental impact;

(f) ensure local acceptability;

(g) ensure security of supply and grid integration.

9. This Article shall apply without prejudice to Articles 107 and 108 TFEU.

Article 5

Opening of support schemes for electricity from renewable sources

1. Member States shall have the right, in accordance with Articles 7 to 13 of this Directive, to decide to which extent they support electricity from renewable sources which is produced in another Member State. However, Member States may open participation in support schemes for electricity from renewable sources to producers located in other Member States, subject to the conditions laid down in this Article.

When opening participation in support schemes for electricity from renewable sources, Member States may provide that support for an indicative share of the newly-supported capacity, or of the budget allocated thereto, in each year is open to producers located in other Member States.

Such indicative shares may, in each year, amount to at least 5 % from 2023 to 2026 and at least 10 % from 2027 to 2030, or, where lower, to the level of interconnectivity of the Member State concerned in any given year.

In order to acquire further implementation experience, Member States may organise one or more pilot schemes where support is open to producers located in other Member States.

2. Member States may require proof of physical import of electricity from renewable sources. To that end, Member States may limit participation in their support schemes to producers located in Member States with which there is a direct connection via interconnectors. However, Member States shall not change or otherwise affect cross-zonal schedules and capacity allocation due to producers participating in cross-border support schemes. Cross-border electricity transfers shall be determined only by the outcome of capacity allocation pursuant to Union law on the internal market in electricity.

3. If a Member State decides to open participation in support schemes to producers located in other Member States, the relevant Member States shall agree on the principles of such participation. Such agreements shall cover at least the principles of allocation of renewable electricity that is the subject of cross-border support.

4. The Commission shall, upon the request of the relevant Member States, assist them throughout the negotiation process with the setting up of cooperation arrangements by providing information and analysis, including quantitative and qualitative data on the direct and indirect costs and benefits of cooperation, as well as with guidance and technical expertise. The Commission may encourage or facilitate the exchange of best practices and may develop templates for cooperation agreements in order to facilitate the negotiation process. The Commission shall assess, by 2025, the costs and benefits of the deployment of electricity from renewable sources in the Union pursuant to this Article.

5. By 2023, the Commission shall carry out an evaluation of the implementation of this Article. That evaluation shall assess the need to introduce an obligation on Member States partially to open participation in their support schemes for electricity from renewable sources to producers located in other Member States with a view to a 5 % opening by 2025 and a 10 % opening by 2030.

Article 6

Stability of financial support

1. Without prejudice to adaptations necessary to comply with Articles 107 and 108 TFEU, Member States shall ensure that the level of, and the conditions attached to, the support granted to renewable energy projects are not revised in a way that negatively affects the rights conferred thereunder and undermines the economic viability of projects that already benefit from support.

2. Member States may adjust the level of support in accordance with objective criteria, provided that such criteria are established in the original design of the support scheme.

3. Member States shall publish a long-term schedule anticipating the expected allocation of support, covering, as a reference, at least the following five years, or, in the case of budgetary planning constraints, the following three years, including the indicative timing, the frequency of tendering procedures where appropriate, the expected capacity and budget or maximum unitary support expected to be allocated, and the expected eligible technologies, if applicable. That schedule shall be updated on an annual basis or, where necessary, to reflect recent market developments or expected allocation of support.

4. Member States shall, at least every five years, assess the effectiveness of their support schemes for electricity from renewable sources and their major distributive effects on different consumer groups, and on investments. That assessment shall take into account the effect of possible changes to the support schemes. The indicative long-term planning governing the decisions of the support and design of new support shall take into account the results of that assessment. Member States shall include the assessment in the relevant updates of their integrated national energy and climate plans and progress reports in accordance with Regulation (EU) 2018/1999.

Article 7

Calculation of the share of energy from renewable sources

1. The gross final consumption of energy from renewable sources in each Member State shall be calculated as the sum of:

(a) gross final consumption of electricity from renewable sources;

(b) gross final consumption of energy from renewable sources in the heating and cooling sector; and

(c) final consumption of energy from renewable sources in the transport sector.

With regard to point (a), (b), or (c) of the first subparagraph, gas, electricity and hydrogen from renewable sources shall be considered only once for the purposes of calculating the share of gross final consumption of energy from renewable sources.

Subject to the second subparagraph of Article 29(1), biofuels, bioliquids and biomass fuels that do not fulfil the sustainability and greenhouse gas emissions saving criteria laid down in Article 29(2) to (7) and (10) shall not be taken into account.

2. For the purposes of point (a) of the first subparagraph of paragraph 1, gross final consumption of electricity from renewable sources shall be calculated as the quantity of electricity produced in a Member State from renewable sources, including the production of electricity from renewables self-consumers and renewable energy communities and excluding the production of electricity in pumped storage units from water that has previously been pumped uphill.

In multi-fuel plants using renewable and non-renewable sources, only the part of electricity produced from renewable sources shall be taken into account. For the purposes of that calculation, the contribution of each energy source shall be calculated on the basis of its energy content.

The electricity generated by hydropower and wind power shall be accounted for in accordance with the normalisation rules set out in Annex II.

3. For the purposes of point (b) of the first subparagraph of paragraph 1, gross final consumption of energy from renewable sources in the heating and cooling sector shall be calculated as the quantity of district heating and cooling produced in a Member State from renewable sources, plus the consumption of other energy from renewable sources in industry, households, services, agriculture, forestry and fisheries, for heating, cooling and processing purposes.

In multi-fuel plants using renewable and non-renewable sources, only the part of heating and cooling produced from renewable sources shall be taken into account. For the purposes of that calculation, the contribution of each energy source shall be calculated on the basis of its energy content.

Ambient and geothermal energy used for heating and cooling by means of heat pumps and district cooling systems shall be taken into account for the purposes of point (b) of the first subparagraph of paragraph 1, provided that the final energy output significantly exceeds the primary energy input required to drive the heat pumps. The quantity of heat or cold to be considered to be energy from renewable sources for the purposes of this Directive shall be calculated in accordance with the methodology set out in Annex VII and shall take into account energy use in all end-use sectors.

Thermal energy generated by passive energy systems, under which lower energy consumption is achieved passively through building design or from heat generated by energy from non-renewable sources, shall not be taken into account for the purposes of point (b) of the first subparagraph of paragraph 1.

By 31 December 2021, the Commission shall adopt delegated acts in accordance with Article 35 to supplement this Directive by establishing a methodology for calculating the quantity of renewable energy used for cooling and district cooling and to amend Annex VII.

That methodology shall include minimum seasonal performance factors for heat pumps operating in reverse mode.

4. For the purposes of point (c) of the first subparagraph of paragraph 1, the following requirements shall apply:

(a) Final consumption of energy from renewable sources in the transport sector shall be calculated as the sum of all biofuels, biomass fuels and renewable liquid and gaseous transport fuels of non-biological origin consumed in the transport sector. However, renewable liquid and gaseous transport fuels of non-biological origin that are produced from renewable electricity shall be considered to be part of the calculation pursuant to point (a) of the first subparagraph of paragraph 1 only when calculating the quantity of electricity produced in a Member State from renewable sources.

(b) For the calculation of final consumption of energy in the transport sector, the values regarding the energy content of transport fuels, as set out in Annex III, shall be used. For the determination of the energy content of transport fuels not included in Annex III, Member States shall use the relevant European Standards Organisation (ESO) standards in order to determine the calorific values of fuels. Where no ESO standard has been adopted for that purpose, Member States shall use the relevant International Organization for Standardisation (ISO) standards.

5. The share of energy from renewable sources shall be calculated as the gross final consumption of energy from renewable sources divided by the gross final consumption of energy from all energy sources, expressed as a percentage.

For the purposes of the first subparagraph of this paragraph, the sum referred to in the first subparagraph of paragraph 1 of this Article shall be adjusted in accordance with Articles 8, 10, 12 and 13.

In calculating a Member State's gross final consumption of energy for the purposes of measuring its compliance with the targets and indicative trajectory laid down in this Directive, the amount of energy consumed in aviation shall, as a proportion of that Member State's gross final consumption of energy, be considered to be no more than 6,18 %. For Cyprus and Malta the amount of energy consumed in aviation shall, as a proportion of those Member States' gross final consumption of energy, be considered to be no more than 4,12 %.

6. The methodology and definitions used in the calculation of the share of energy from renewable sources shall be those provided for in Regulation (EC) No 1099/2008.

Member States shall ensure coherence of the statistical information used in calculating those sectoral and overall shares and of the statistical information reported to the Commission pursuant to that Regulation.

Article 8

Union renewable development platform and statistical transfers between Member States

1. Member States may agree on the statistical transfer of a specified amount of energy from renewable sources from one Member State to another Member State. The transferred quantity shall be:

(a) deducted from the amount of energy from renewable sources that is taken into account in calculating the renewable energy share of the Member State making the transfer for the purposes of this Directive; and

(b) added to the amount of energy from renewable sources that is taken into account in calculating the renewable energy share of the Member State accepting the transfer for the purposes of this Directive.

2. In order to facilitate the achievement of the Union target set in Article 3(1) of this Directive and of each Member State's contribution to that target in accordance with Article 3(2) of this Directive, and to facilitate statistical transfers in accordance with paragraph 1 of this Article, the Commission shall establish a Union renewable development platform ('URDP'). Member States may, on a voluntary basis, submit to the URDP annual data on their national contributions to the Union target or any benchmark set for monitoring progress in Regulation (EU) 2018/1999, including the amount by which they expect to fall short of or exceed their contribution, and an indication of the price at which they would accept to transfer any excess production of energy from renewable sources from or to another Member State. The price of those transfers shall be set on a case-by-case basis based on the URDP demand-and-supply matching mechanism.

3. The Commission shall ensure that the URDP is able to match the demand for and supply of the amounts of energy from renewable sources that are taken into account in the calculation of the renewable energy share of a Member State based on prices or other criteria specified by the Member State accepting the transfer.

The Commission is empowered to adopt delegated acts in accordance with Article 35 to supplement this Directive by establishing the URDP and setting the conditions for the finalisation of transfers as referred to in paragraph 5 of this Article.

4. The arrangements referred to in paragraphs 1 and 2 may have a duration of one or more calendar years. Such arrangements shall be notified to the Commission or finalised on the URDP not later than 12 months after the end of each year in which they have effect. The information sent to the Commission shall include the quantity and price of the energy involved. For transfers finalised on the URDP, the parties involved and the information on the particular transfer shall be disclosed to the public.

5. Transfers shall become effective after all Member States involved in the transfer have notified the transfer to the Commission or after all clearing conditions are met on the URDP, as applicable.

Article 9

Joint projects between Member States

1. Two or more Member States may cooperate on all types of joint projects with regard to the production of electricity, heating or cooling from renewable sources. Such cooperation may involve private operators.

2. Member States shall notify the Commission of the proportion or amount of electricity, heating or cooling from renewable sources produced by any joint project in their territory that became operational after 25 June 2009, or by the increased capacity of an installation that was refurbished after that date, which is to be regarded as counting towards the renewable energy share of another Member State for the purposes of this Directive.

3. The notification referred to in paragraph 2 shall:

(a) describe the proposed installation or identify the refurbished installation;

(b) specify the proportion or amount of electricity or heating or cooling produced from the installation which is to be regarded as counting towards the renewable energy share of the other Member State;

(c) identify the Member State in whose favour the notification is being made; and

(d) specify the period, in whole calendar years, during which the electricity or heating or cooling produced by the installation from renewable sources is to be regarded as counting towards the renewable energy share of the other Member State.

4. The duration of a joint project as referred to in this Article may extend beyond 2030.

5. A notification made under this Article shall not be varied or withdrawn without the joint agreement of the Member State making the notification and the Member State identified in accordance with point (c) of paragraph 3.

6. The Commission shall, upon the request of the Member States concerned, facilitate the establishment of joint projects between Member States, in particular via dedicated technical assistance and project development assistance.

Article 10

Effects of joint projects between Member States

1. Within three months of the end of each year falling within the period referred to in point (d) of Article 9(3), the Member State that made the notification under Article 9 shall issue a letter of notification stating:

(a) the total amount of electricity or heating or cooling produced from renewable sources during that year by the installation which was the subject of the notification under Article 9; and

(b) the amount of electricity or heating or cooling produced from renewable sources during that year by that installation which is to count towards the renewable energy share of another Member State in accordance with the terms of the notification.

2. The notifying Member State shall submit the letter of notification to the Member State in whose favour the notification was made and to the Commission.

3. For the purposes of this Directive, the amount of electricity or heating or cooling from renewable sources notified in accordance with point (b) of paragraph 1 shall be:

(a) deducted from the amount of electricity or heating or cooling from renewable sources that is taken into account in calculating the renewable energy share of the Member State issuing the letter of notification pursuant to paragraph 1; and

(b) added to the amount of electricity or heating or cooling from renewable sources that is taken into account in calculating the renewable energy share of the Member State receiving the letter of notification pursuant to paragraph 2.

Article 11

Joint projects between Member States and third countries

1. One or more Member States may cooperate with one or more third countries on all types of joint projects with regard to the production of electricity from renewable sources. Such cooperation may involve private operators and shall take place in full respect of international law.

2. Electricity from renewable sources produced in a third country shall be taken into account for the purposes of calculating the renewable energy shares of the Member States only where the following conditions are met:

(a) the electricity is consumed in the Union, which is deemed to be met where:

(i) an equivalent amount of electricity to the electricity accounted for has been firmly nominated to the allocated interconnection capacity by all responsible transmission system operators in the country of origin, the country of destination and, if relevant, each third country of transit;

(ii) an equivalent amount of electricity to the electricity accounted for has been firmly registered in the schedule of balance by the responsible transmission system operator on the Union side of an interconnector; and

(iii) the nominated capacity and the production of electricity from renewable sources by the installation referred to in point (b) refer to the same period of time;

(b) the electricity is produced by an installation that became operational after 25 June 2009 or by the increased capacity of an installation that was refurbished after that date, under a joint project as referred to in paragraph 1;

(c) the amount of electricity produced and exported has not received support from a support scheme of a third country other than investment aid granted to the installation; and

(d) the electricity has been produced in accordance with international law, in a third country that is a signatory to the Council of Europe Convention for the Protection of Human Rights and Fundamental Freedoms, or other international conventions or treaties on human rights.

3. For the purposes of paragraph 4, Member States may apply to the Commission for account to be taken of electricity from renewable sources produced and consumed in a third country, in the context of the construction of an interconnector with a very long lead-time between a Member State and a third country where the following conditions are met:

(a) construction of the interconnector started by 31 December 2026;

(b) it is not possible for the interconnector to become operational by 31 December 2030;

(c) it is possible for the interconnector to become operational by 31 December 2032;

(d) after it becomes operational, the interconnector will be used for the export to the Union, in accordance with paragraph 2, of electricity from renewable sources;

(e) the application relates to a joint project that fulfils the criteria set out in points (b) and (c) of paragraph 2 and that will use the interconnector after it becomes operational, and to a quantity of electricity that is no greater than the quantity that will be exported to the Union after the interconnector becomes operational.

4. The proportion or amount of electricity produced by any installation in the territory of a third country, which is to be regarded as counting towards the renewable energy share of one or more Member States for the purposes of this Directive, shall be notified to the Commission. When more than one Member State is concerned, the distribution between Member States of that proportion or amount shall be notified to the Commission. The proportion or amount shall not exceed the proportion or amount actually exported to, and consumed in, the Union, shall correspond to the amount referred to in point (a)(i) and (ii) of paragraph 2 and shall meet the conditions set out in point (a) of that paragraph. The notification shall be made by each Member State towards whose overall national target the proportion or amount of electricity is to count.

5. The notification referred to in paragraph 4 shall:

(a) describe the proposed installation or identify the refurbished installation;

(b) specify the proportion or amount of electricity produced from the installation which is to be regarded as counting towards the renewable energy share of a Member State as well as, subject to confidentiality requirements, the corresponding financial arrangements;

(c) specify the period, in whole calendar years, during which the electricity is to be regarded as counting towards the renewable energy share of the Member State; and

(d) include a written acknowledgement of points (b) and (c) by the third country in whose territory the installation is to become operational and an indication of the proportion or amount of electricity produced by the installation which will be used domestically by that third country.

6. The duration of a joint project as referred to in this Article may extend beyond 2030.

7. A notification made under this Article shall be varied or withdrawn only where there is a joint agreement between the Member State making the notification and the third country that has acknowledged the joint project in accordance with point (d) of paragraph 5.

8. Member States and the Union shall encourage the relevant bodies of the Energy Community to take, in conformity with the Energy Community Treaty, the measures necessary to allow the Contracting Parties to apply the provisions on cooperation between Member States laid down in this Directive.

Article 12

Effects of joint projects between Member States and third countries

1. Within 12 months of the end of each year falling within the period specified under point (c) of Article 11(5), the notifying Member State shall issue a letter of notification stating:

(a) the total amount of electricity produced from renewable sources during that year by the installation which was the subject of the notification under Article 11;

(b) the amount of electricity produced from renewable sources during that year by that installation which is to count towards its renewable energy share in accordance with the terms of the notification under Article 11; and

(c) evidence of compliance with the conditions laid down in Article 11(2).

2. The Member State referred to in paragraph 1 shall submit the letter of notification to the Commission and to the third country that has acknowledged the project in accordance with point (d) of Article 11(5).

3. For the purposes of calculating the renewable energy shares under this Directive, the amount of electricity from renewable sources notified in accordance with point (b) of paragraph 1 shall be added to the amount of energy from renewable sources that is taken into account in calculating the renewable energy shares of the Member State issuing the letter of notification.

Article 13

Joint support schemes

1. Without prejudice to the obligations of Member States under Article 5, two or more Member States may decide, on a voluntary basis, to join or partly coordinate their national support schemes. In such cases, a certain amount of energy from renewable sources produced in the territory of one participating Member State may count towards the renewable energy share of another participating Member State, provided that the Member States concerned:

(a) make a statistical transfer of specified amounts of energy from renewable sources from one Member State to another Member State in accordance with Article 8; or

(b) set up a distribution rule agreed by participating Member States that allocates amounts of energy from renewable sources between the participating Member States.

A distribution rule as referred to in point (b) of the first subparagraph shall be notified to the Commission not later than three months after the end of the first year in which it takes effect.

2. Within three months of the end of each year, each Member State that has made a notification under the second subparagraph of paragraph 1 shall issue a letter of notification stating the total amount of electricity or heating or cooling from renewable sources produced during the year which is to be the subject of the distribution rule.

3. For the purposes of calculating the renewable energy shares under this Directive, the amount of electricity or heating or cooling from renewable sources notified in accordance with paragraph 2 shall be reallocated between the Member States concerned in accordance with the notified distribution rule.

4. The Commission shall disseminate guidelines and best practices, and, upon the request of the Member States concerned, facilitate the establishment of joint support schemes between Member States.

Article 14

Capacity increases

For the purposes of Article 9(2) and point (b) of Article 11(2), units of energy from renewable sources imputable to an increase in the capacity of an installation shall be treated as if they were produced by a separate installation becoming operational at the moment at which the increase of capacity occurred.

Article 15

Administrative procedures, regulations and codes

1. Member States shall ensure that any national rules concerning the authorisation, certification and licensing procedures that are applied to plants and associated transmission and distribution networks for the production of electricity, heating or cooling from renewable sources, to the process of transformation of biomass into biofuels, bioliquids, biomass fuels or other energy products, and to renewable liquid and gaseous transport fuels of non-biological origin are proportionate and necessary and contribute to the implementation of the energy efficiency first principle.

Member States shall, in particular, take the appropriate steps to ensure that:

(a) administrative procedures are streamlined and expedited at the appropriate administrative level and predictable timeframes are established for the procedures referred to in the first subparagraph;

(b) rules concerning authorisation, certification and licensing are objective, transparent and proportionate, do not discriminate between applicants and take fully into account the particularities of individual renewable energy technologies;

(c) administrative charges paid by consumers, planners, architects, builders and equipment and system installers and suppliers are transparent and cost-related; and

(d) simplified and less burdensome authorisation procedures, including a simple-notification procedure, are established for decentralised devices, and for producing and storing energy from renewable sources.

2. Member States shall clearly define any technical specifications which are to be met by renewable energy equipment and systems in order to benefit from support schemes. Where European standards exist, including eco-labels, energy labels and other technical reference systems established by the European standardisation bodies, such technical specifications shall be expressed in terms of those standards. Such technical specifications shall not prescribe where the equipment and systems are to be certified and shall not impede the proper functioning of the internal market.

3. Member States shall ensure that their competent authorities at national, regional and local level include provisions for the integration and deployment of renewable energy, including for renewables self-consumption and renewable energy communities, and the use of unavoidable waste heat and cold when planning, including early spatial planning, designing, building and renovating urban infrastructure, industrial, commercial or residential areas and energy infrastructure, including electricity, district heating and cooling, natural gas and alternative fuel networks. Member States shall, in particular, encourage local and regional administrative bodies to include heating and cooling from renewable sources in the planning of city infrastructure where appropriate, and to consult the network operators to reflect the impact of energy efficiency and demand response programs as well as specific provisions on renewables self-consumption and renewable energy communities, on the infrastructure development plans of the operators.

4. Member States shall introduce appropriate measures in their building regulations and codes in order to increase the share of all kinds of energy from renewable sources in the building sector.

In establishing such measures or in their support schemes, Member States may take into account, where applicable, national measures relating to substantial increases in renewables self-consumption, in local energy storage and in energy efficiency, relating to cogeneration and relating to passive, low-energy or zero-energy buildings.

Member States shall, in their building regulations and codes or by other means with equivalent effect, require the use of minimum levels of energy from renewable sources in new buildings and in existing buildings that are subject to major renovation in so far as technically, functionally and economically feasible, and reflecting the results of the cost-optimal calculation carried out pursuant to Article 5(2) of Directive 2010/31/EU, and in so far as this does not negatively affect indoor air quality. Member States shall permit those minimum levels to be fulfilled, *inter alia*, through efficient district heating and cooling using a significant share of renewable energy and waste heat and cold.

The requirements laid down in the first subparagraph shall apply to the armed forces only to the extent that its application does not cause any conflict with the nature and primary aim of the activities of the armed forces and with the exception of material used exclusively for military purposes.

5. Member States shall ensure that new public buildings, and existing public buildings that are subject to major renovation, at national, regional and local level, fulfil an exemplary role in the context of this Directive from 1 January 2012. Member States may, *inter alia*, allow that obligation to be fulfilled by complying with nearly zero-energy building provisions as required in Directive 2010/31/EU, or by providing for the roofs of public or mixed private-public buildings to be used by third parties for installations that produce energy from renewable sources.

6. With respect to their building regulations and codes, Member States shall promote the use of renewable heating and cooling systems and equipment that achieve a significant reduction of energy consumption. To that end, Member States shall use energy or eco-labels or other appropriate certificates or standards developed at national or Union level, where these exist, and ensure the provision of adequate information and advice on renewable, highly energy efficient alternatives as well as eventual financial instruments and incentives available in the case of replacement, with a view to promoting an increased replacement rate of old heating systems and an increased switch to solutions based on renewable energy in accordance with Directive 2010/31/EU.

7. Member States shall carry out an assessment of their potential of energy from renewable sources and of the use of waste heat and cold in the heating and cooling sector. That assessment shall, where appropriate, include spatial analysis of areas suitable for low-ecological-risk deployment and the potential for small-scale household projects and shall be included in the second comprehensive assessment required pursuant to Article 14(1) of Directive 2012/27/EU for the first time by 31 December 2020 and in the subsequent updates of the comprehensive assessments.

8. Member States shall assess the regulatory and administrative barriers to long-term renewables power purchase agreements, and shall remove unjustified barriers to, and facilitate the uptake of, such agreements. Member States shall ensure that those agreements are not subject to disproportionate or discriminatory procedures or charges.

Member States shall describe policies and measures facilitating the uptake of renewables power purchase agreements in their integrated national energy and climate plans and progress reports pursuant to Regulation (EU) 2018/1999.

Article 16

Organisation and duration of the permit-granting process

1. Member States shall set up or designate one or more contact points. Those contact points shall, upon request by the applicant, guide through and facilitate the entire administrative permit application and granting process. The applicant shall not be required to contact more than one contact point for the entire process. The permit-granting process shall cover the relevant administrative permits to build, repower and operate plants for the production of energy from renewable sources and assets necessary for their connection to the grid. The permit-granting process shall comprise all procedures from the acknowledgment of the receipt of the application to the transmission of the outcome of the procedure referred to in paragraph 2.

2. The contact point shall guide the applicant through the administrative permit application process in a transparent manner up to the delivery of one or several decisions by the responsible authorities at the end of the process, provide the applicant with all necessary information and involve, where appropriate, other administrative authorities. Applicants shall be allowed to submit relevant documents also in digital form.

3. The contact point shall make available a manual of procedures for developers of renewable energy production projects and shall provide that information also online, addressing distinctly also small-scale projects and renewables self-consumers projects. The online information shall indicate the contact point relevant to the applicant's application. If a Member State has more than one contact point, the online information shall indicate the contact point relevant to the applicant's application.

4. Without prejudice to paragraph 7, the permit-granting process referred to in paragraph 1 shall not exceed two years for power plants, including all relevant procedures of competent authorities. Where duly justified on the grounds of extraordinary circumstances, that two-year period may be extended by up to one year.

5. Without prejudice to paragraph 7, the permit-granting process shall not exceed one year for installations with an electrical capacity of less than 150 kW. Where duly justified on the grounds of extraordinary circumstances, that one-year period may be extended by up to one year.

Member States shall ensure that applicants have easy access to simple procedures for the settlement of disputes concerning the permit-granting process and the issuance of permits to build and operate renewable energy plants, including, where applicable, alternative dispute resolution mechanisms.

6. Member States shall facilitate the repowering of existing renewable energy plants by ensuring a simplified and swift permit-granting process. The length of that process shall not exceed one year.

Where duly justified on the grounds of extraordinary circumstances, such as on grounds of overriding safety reasons where the repowering project impacts substantially on the grid or the original capacity, size or performance of the installation, that one-year period may be extended by up to one year.

7. The deadlines established in this Article shall apply without prejudice to obligations under applicable Union environmental law, to judicial appeals, remedies and other proceedings before a court or tribunal, and to alternative dispute resolution mechanisms, including complaints procedures, non-judicial appeals and remedies, and may be extended for the duration of such procedures.

8. Member States may establish a simple-notification procedure for grid connections for repowering projects as referred to in Article 17(1). Where Member States do so, repowering shall be permitted following notification to the relevant authority where no significant negative environmental or social impact is expected. That authority shall decide within six months of receipt of a notification whether this is sufficient.

Where the relevant authority decides that a notification is sufficient, it shall automatically grant the permit. Where that authority decides that the notification is not sufficient, it shall be necessary to apply for a new permit and the time-limits referred to in paragraph 6 shall apply.

Article 17

Simple-notification procedure for grid connections

1. Member States shall establish a simple-notification procedure for grid connections whereby installations or aggregated production units of renewables self-consumers and demonstration projects, with an electrical capacity of 10,8 kW or less, or equivalent for connections other than three-phase connections, are to be connected to the grid following a notification to the distribution system operator.

The distribution system operator may, within a limited period following the notification, reject the requested grid connection or propose an alternative grid connection point on justified grounds of safety concerns or technical incompatibility of the system components. In the case of a positive decision by the distribution system operator, or in the absence of a decision by the distribution system operator within one month following the notification, the installation or aggregated production unit may be connected.

2. Member States may allow a simple-notification procedure for installations or aggregated production units with an electrical capacity of above 10,8 kW and up to 50 kW, provided that grid stability, grid reliability and grid safety are maintained.

Article 18

Information and training

1. Member States shall ensure that information on support measures is made available to all relevant actors, such as consumers including low-income, vulnerable consumers, renewables self-consumers, renewable energy communities, builders, installers, architects, suppliers of heating, cooling and electricity equipment and systems, and suppliers of vehicles compatible with the use of renewable energy and of intelligent transport systems.

2. Member States shall ensure that information on the net benefits, cost and energy efficiency of equipment and systems for the use of heating, cooling and electricity from renewable sources is made available either by the supplier of the equipment or system or by the competent authorities.

3. Member States shall ensure that certification schemes or equivalent qualification schemes are available for installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps. Those schemes may take into account existing schemes and structures as appropriate, and shall be based on the criteria laid down in Annex IV. Each Member State shall recognise the certification awarded by other Member States in accordance with those criteria.

4. Member States shall make information on certification schemes or equivalent qualification schemes as referred to in paragraph 3 available to the public. Member States may also make the list of installers who are qualified or certified in accordance with paragraph 3 available to the public.

5. Member States shall ensure that guidance is made available to all relevant actors, in particular to planners and architects so that they are able properly to consider the optimal combination of energy from renewable sources, of high-efficiency technologies, and of district heating and cooling when planning, designing, building and renovating industrial, commercial or residential areas.

6. Member States, where appropriate with the participation of local and regional authorities, shall develop suitable information, awareness-raising, guidance or training programmes in order to inform citizens of how to exercise their rights as active customers, and of the benefits and practicalities, including technical and financial aspects, of developing and using energy from renewable sources, including by renewables self-consumption or in the framework of renewable energy communities.

Article 19

Guarantees of origin for energy from renewable sources

1. For the purposes of demonstrating to final customers the share or quantity of energy from renewable sources in an energy supplier's energy mix and in the energy supplied to consumers under contracts marketed with reference to the consumption of energy from renewable sources, Member States shall ensure that the origin of energy from renewable sources can be guaranteed as such within the meaning of this Directive, in accordance with objective, transparent and non-discriminatory criteria.

2. To that end, Member States shall ensure that a guarantee of origin is issued in response to a request from a producer of energy from renewable sources, unless Member States decide, for the purposes of accounting for the market value of the guarantee of origin, not to issue such a guarantee of origin to a producer that receives financial support from a support scheme. Member States may arrange for guarantees of origin to be issued for energy from non-renewable sources. Issuance of guarantees of origin may be made subject to a minimum capacity limit. A guarantee of origin shall be of the standard size of 1 MWh. No more than one guarantee of origin shall be issued in respect of each unit of energy produced.

Member States shall ensure that the same unit of energy from renewable sources is taken into account only once.

Member States shall ensure that when a producer receives financial support from a support scheme, the market value of the guarantee of origin for the same production is taken into account appropriately in the relevant support scheme.

It shall be presumed that the market value of the guarantee of origin has been taken into account appropriately in any of the following cases:

(a) where the financial support is granted by way of a tendering procedure or a tradable green certificate system;

(b) where the market value of the guarantees of origin is administratively taken into account in the level of financial support; or

(c) where the guarantees of origin are not issued directly to the producer but to a supplier or consumer who buys the energy from renewable sources either in a competitive setting or in a long-term renewables power purchase agreement.

In order to take into account the market value of the guarantee of origin, Member States may, *inter alia*, decide to issue a guarantee of origin to the producer and immediately cancel it.

The guarantee of origin shall have no function in terms of a Member State's compliance with Article 3. Transfers of guarantees of origin, separately or together with the physical transfer of energy, shall have no effect on the decision of Member States to use statistical transfers, joint projects or joint support schemes for compliance with Article 3 or on the calculation of the gross final consumption of energy from renewable sources in accordance with Article 7.

3. For the purposes of paragraph 1, guarantees of origin shall be valid for 12 months after the production of the relevant energy unit. Member States shall ensure that all guarantees of origin that have not been cancelled expire at the latest 18 months after the production of the energy unit. Member States shall include expired guarantees of origin in the calculation of their residual energy mix.

4. For the purposes of disclosure referred to in paragraphs 8 and 13, Member States shall ensure that energy companies cancel guarantees of origin at the latest six months after the end of the validity of the guarantee of origin.

5. Member States or designated competent bodies shall supervise the issuance, transfer and cancellation of guarantees of origin. The designated competent bodies shall not have overlapping geographical responsibilities, and shall be independent of production, trade and supply activities.

6. Member States or the designated competent bodies shall put in place appropriate mechanisms to ensure that guarantees of origin are issued, transferred and cancelled electronically and are accurate, reliable and fraud-resistant. Member States and designated competent bodies shall ensure that the requirements they impose comply with the standard CEN - EN 16325.

7. A guarantee of origin shall specify at least:

(a) the energy source from which the energy was produced and the start and end dates of production;

(b) whether it relates to:

  (i) electricity;

  (ii) gas, including hydrogen; or

  (iii) heating or cooling;

(c) the identity, location, type and capacity of the installation where the energy was produced;

(d) whether the installation has benefited from investment support and whether the unit of energy has benefited in any other way from a national support scheme, and the type of support scheme;

(e) the date on which the installation became operational; and

(f) the date and country of issue and a unique identification number.

Simplified information may be specified on guarantees of origin from installations of less than 50 kW.

8. Where an electricity supplier is required to demonstrate the share or quantity of energy from renewable sources in its energy mix for the purposes of point (a) of Article 3(9) of Directive 2009/72/EC, it shall do so by using guarantees of origin except:

(a) as regards the share of its energy mix corresponding to non-tracked commercial offers, if any, for which the supplier may use the residual mix; or

(b) where a Member State decides not to issue guarantees of origin to a producer that receives financial support from a support scheme.

Where Member States have arranged to have guarantees of origin for other types of energy, suppliers shall use for disclosure the same type of guarantees of origin as the energy supplied. Likewise, guarantees of origin created pursuant to Article 14(10) of Directive 2012/27/EU may be used to substantiate any requirement to demonstrate the quantity of electricity produced from high-efficiency cogeneration. For the purposes of paragraph 2 of this Article, where electricity is generated from high-efficiency cogeneration using renewable sources, only one guarantee of origin specifying both characteristics may be issued.

9. Member States shall recognise guarantees of origin issued by other Member States in accordance with this Directive exclusively as evidence of the elements referred to in paragraph 1 and points (a) to (f) of the first subparagraph of paragraph 7. A Member State may refuse to recognise a guarantee of origin only where it has well-founded doubts about its accuracy, reliability or veracity. The Member State shall notify the Commission of such a refusal and its justification.

10. If the Commission finds that a refusal to recognise a guarantee of origin is unfounded, the Commission may adopt a decision requiring the Member State in question to recognise it.

11. Member States shall not recognise guarantees of origins issued by a third country except where the Union has concluded an agreement with that third country on mutual recognition of guarantees of origin issued in the Union and compatible guarantees of origin systems established in that third country, and only where there is direct import or export of energy.

12. A Member State may, in accordance with Union law, introduce objective, transparent and non-discriminatory criteria for the use of guarantees of origin in accordance with the obligations laid down in Article 3(9) of Directive 2009/72/EC.

13. The Commission shall adopt a report assessing options to establish a Union-wide green label with a view to promoting the use of renewable energy coming from new installations. Suppliers shall use the information contained in guarantees of origin to demonstrate compliance with the requirements of such a label.

Article 20

Access to and operation of the grids

1. Where relevant, Member States shall assess the need to extend existing gas network infrastructure to facilitate the integration of gas from renewable sources.

2. Where relevant, Member States shall require transmission system operators and distribution system operators in their territory to publish technical rules in accordance with Article 8 of Directive 2009/73/EC, in particular regarding network connection rules that include gas quality, gas odoration and gas pressure requirements. Member States shall also require transmission and distribution system operators to publish the connection tariffs to connect gas from renewable sources based on objective, transparent and non-discriminatory criteria.

3. Subject to their assessment included in the integrated national energy and climate plans in accordance with Annex I to Regulation (EU) 2018/1999 on the necessity to build new infrastructure for district heating and cooling from renewable sources in order to achieve the Union target set in Article 3(1) of this Directive, Member States shall, where relevant, take the necessary steps with a view to developing a district heating and cooling infrastructure to accommodate the development of heating and cooling from large biomass, solar energy, ambient energy and geothermal energy facilities and from waste heat and cold.

Article 21

Renewables self-consumers

1. Member States shall ensure that consumers are entitled to become renewables self-consumers, subject to this Article.

2. Member States shall ensure that renewables self-consumers, individually or through aggregators, are entitled:

(a) to generate renewable energy, including for their own consumption, store and sell their excess production of renewable electricity, including through renewables power purchase agreements, electricity suppliers and peer-to-peer trading arrangements, without being subject:

(i) in relation to the electricity that they consume from or feed into the grid, to discriminatory or disproportionate procedures and charges, and to network charges that are not cost-reflective;

(ii) in relation to their self-generated electricity from renewable sources remaining within their premises, to discriminatory or disproportionate procedures, and to any charges or fees;

(b) to install and operate electricity storage systems combined with installations generating renewable electricity for self-consumption without liability for any double charge, including network charges, for stored electricity remaining within their premises;

(c) to maintain their rights and obligations as final consumers;

(d) to receive remuneration, including, where applicable, through support schemes, for the self-generated renewable electricity that they feed into the grid, which reflects the market value of that electricity and which may take into account its long-term value to the grid, the environment and society.

3. Member States may apply non-discriminatory and proportionate charges and fees to renewables self-consumers, in relation to their self-generated renewable electricity remaining within their premises in one or more of the following cases:

(a) if the self-generated renewable electricity is effectively supported via support schemes, only to the extent that the economic viability of the project and the incentive effect of such support are not undermined;

(b) from 1 December 2026, if the overall share of self-consumption installations exceeds 8 % of the total installed electricity capacity of a Member State, and if it is demonstrated, by means of a cost-benefit analysis performed by the national regulatory authority of that Member State, which is conducted by way of an open, transparent and participatory process, that the provision laid down in point (a)(ii) of paragraph 2 either results in a significant disproportionate burden on the long-term financial sustainability of the electric system, or creates an incentive exceeding what is objectively needed to achieve cost-effective deployment of renewable energy, and that such burden or incentive cannot be minimised by taking other reasonable actions; or

(c) if the self-generated renewable electricity is produced in installations with a total installed electrical capacity of more than 30 kW.

4. Member States shall ensure that renewables self-consumers located in the same building, including multi-apartment blocks, are entitled to engage jointly in activities referred to in paragraph 2 and that they are permitted to arrange sharing of renewable energy that is produced on their site or sites between themselves, without prejudice to the network charges and other relevant charges, fees, levies and taxes applicable to each renewables self-consumer. Member States may differentiate between individual renewables self-consumers and jointly acting renewables self-consumers. Any such differentiation shall be proportionate and duly justified.

5. The renewables self-consumer's installation may be owned by a third party or managed by a third party for installation, operation, including metering and maintenance, provided that the third party remains subject to the renewables self-consumer's instructions. The third party itself shall not be considered to be a renewables self-consumer.

6. Member States shall put in place an enabling framework to promote and facilitate the development of renewables self-consumption based on an assessment of the existing unjustified barriers to, and of the potential of, renewables self-consumption in their territories and energy networks. That enabling framework shall, *inter alia*:

(a) address accessibility of renewables self-consumption to all final customers, including those in low-income or vulnerable households;

(b) address unjustified barriers to the financing of projects in the market and measures to facilitate access to finance;

(c) address other unjustified regulatory barriers to renewables self-consumption, including for tenants;

(d) address incentives to building owners to create opportunities for renewables self-consumption, including for tenants;

(e) grant renewables self-consumers, for self-generated renewable electricity that they feed into the grid, non-discriminatory access to relevant existing support schemes as well as to all electricity market segments;

(f) ensure that renewables self-consumers contribute in an adequate and balanced way to the overall cost sharing of the system when electricity is fed into the grid.

Member States shall include a summary of the policies and measures under the enabling framework and an assessment of their implementation respectively in their integrated national energy and climate plans and progress reports pursuant to Regulation (EU) 2018/1999.

7. This Article shall apply without prejudice to Articles 107 and 108 TFEU.

Article 22

Renewable energy communities

1. Member States shall ensure that final customers, in particular household customers, are entitled to participate in a renewable energy community while maintaining their rights or obligations as final customers, and without being subject to unjustified or discriminatory conditions or procedures that would prevent their participation in a renewable energy community, provided that for private undertakings, their participation does not constitute their primary commercial or professional activity.

2. Member States shall ensure that renewable energy communities are entitled to:

(a) produce, consume, store and sell renewable energy, including through renewables power purchase agreements;

(b) share, within the renewable energy community, renewable energy that is produced by the production units owned by that renewable energy community, subject to the other requirements laid down in this Article and to maintaining the rights and obligations of the renewable energy community members as customers;

(c) access all suitable energy markets both directly or through aggregation in a non-discriminatory manner.

3. Member States shall carry out an assessment of the existing barriers and potential of development of renewable energy communities in their territories.

4. Member States shall provide an enabling framework to promote and facilitate the development of renewable energy communities. That framework shall ensure, *inter alia*, that:

(a) unjustified regulatory and administrative barriers to renewable energy communities are removed;

(b) renewable energy communities that supply energy or provide aggregation or other commercial energy services are subject to the provisions relevant for such activities;

(c) the relevant distribution system operator cooperates with renewable energy communities to facilitate energy transfers within renewable energy communities;

(d) renewable energy communities are subject to fair, proportionate and transparent procedures, including registration and licensing procedures, and cost-reflective network charges, as well as relevant charges, levies and taxes, ensuring that they contribute, in an adequate, fair and balanced way, to the overall cost sharing of the system in line with a transparent cost-benefit analysis of distributed energy sources developed by the national competent authorities;

(e) renewable energy communities are not subject to discriminatory treatment with regard to their activities, rights and obligations as final customers, producers, suppliers, distribution system operators, or as other market participants;

(f) the participation in the renewable energy communities is accessible to all consumers, including those in low-income or vulnerable households;

(g) tools to facilitate access to finance and information are available;

(h) regulatory and capacity-building support is provided to public authorities in enabling and setting up renewable energy communities, and in helping authorities to participate directly;

(i) rules to secure the equal and non-discriminatory treatment of consumers that participate in the renewable energy community are in place.

5. The main elements of the enabling framework referred to in paragraph 4, and of its implementation, shall be part of the updates of the Member States' integrated national energy and climate plans and progress reports pursuant to Regulation (EU) 2018/1999.

6. Member States may provide for renewable energy communities to be open to cross-border participation.

7. Without prejudice to Articles 107 and 108 TFEU, Member States shall take into account specificities of renewable energy communities when designing support schemes in order to allow them to compete for support on an equal footing with other market participants.

Article 23

Mainstreaming renewable energy in heating and cooling

1. In order to promote the use of renewable energy in the heating and cooling sector, each Member State shall endeavour to increase the share of renewable energy in that sector by an indicative 1,3 percentage points as an annual average calculated for the periods 2021 to 2025 and 2026 to 2030, starting from the share of renewable energy in the heating and cooling sector in 2020, expressed in terms of national share of final energy consumption and calculated in accordance with the methodology set out in Article 7, without prejudice to paragraph 2 of this Article. That increase shall be limited to an indicative 1,1 percentage points for Member States where waste heat and cold is not used. Member States shall, where appropriate, prioritise the best available technologies.

2. For the purposes of paragraph 1, when calculating its share of renewable energy in the heating and cooling sector and its average annual increase in accordance with that paragraph, each Member State:

(a) may count waste heat and cold, subject to a limit of 40 % of the average annual increase;

(b) where its share of renewable energy in the heating and cooling sector is above 60 %, may count any such share as fulfilling the average annual increase; and

(c) where its share of renewable energy in the heating and cooling sector is above 50 % and up to 60 %, may count any such share as fulfilling half of the average annual increase.

When deciding which measures to adopt for the purposes of deploying energy from renewable sources in the heating and cooling sector, Member States may take into account cost-effectiveness reflecting structural barriers arising from the high share of natural gas or cooling, or from a dispersed settlement structure with low population density.

Where those measures would result in a lower average annual increase than that referred to in paragraph 1 of this Article, Member States shall make it public, for instance by the means of their integrated national energy and climate progress reports pursuant to Article 20 of Regulation (EU) 2018/1999, and provide the Commission with reasons, including of choice of measures as referred to the second subparagraph of this paragraph.

3. On the basis of objective and non-discriminatory criteria, Member States may establish and make public a list of measures and may designate and make public the implementing entities, such as fuel suppliers, public or professional bodies, which are to contribute to the average annual increase referred to in paragraph 1.

4. Member States may implement the average annual increase referred to in paragraph 1 by means, *inter alia*, of one or more of the following options:

(a) physical incorporation of renewable energy or waste heat and cold in the energy and energy fuel supplied for heating and cooling;

(b) direct mitigation measures such as the installation of highly efficient renewable heating and cooling systems in buildings, or the use of renewable energy or waste heat and cold in industrial heating and cooling processes;

(c) indirect mitigation measures covered by tradable certificates proving compliance with the obligation laid down in paragraph 1 through support to indirect mitigation measures, carried out by another economic operator such as an independent renewable technology installer or energy service company providing renewable installation services;

(d) other policy measures, with an equivalent effect, to reach the average annual increase referred to in paragraph 1, including fiscal measures or other financial incentives.

When adopting and implementing the measures referred to in the first subparagraph, Member States shall aim to ensure the accessibility of measures to all consumers, in particular those in low-income or vulnerable households, who would not otherwise possess sufficient up-front capital to benefit.

5. Member States may use the structures established under the national energy savings obligations set out in Article 7 of Directive 2012/27/EU to implement and monitor the measures referred to in paragraph 3 of this Article.

6. Where entities are designated under paragraph 3, Member States shall ensure that the contribution by those designated entities is measurable and verifiable and that the designated entities report annually on:

(a) the total amount of energy supplied for heating and cooling;

(b) the total amount of renewable energy supplied for heating and cooling;

(c) the amount of waste heat and cold supplied for heating and cooling;

(d) the share of renewable energy and waste heat and cold in the total amount of energy supplied for heating and cooling; and

(e) the type of renewable energy source.

Article 24

District heating and cooling

1. Member States shall ensure that information on the energy performance and the share of renewable energy in their district heating and cooling systems is provided to final consumers in an easily accessible manner, such as on the suppliers' websites, on annual bills or upon request.

2. Member States shall lay down the necessary measures and conditions to allow customers of district heating or cooling systems which are not efficient district heating and cooling systems, or which are not such a system by 31 December 2025 on the basis of a plan approved by the competent authority, to disconnect by terminating or modifying their contract in order to produce heating or cooling from renewable sources themselves.

Where the termination of a contract is linked to physical disconnection, such a termination may be made conditional on compensation for the costs directly incurred as a result of the physical disconnection and for the undepreciated portion of assets needed to provide heat and cold to that customer.

3. Member States may restrict the right to disconnect by terminating or modifying a contract in accordance with paragraph 2 to customers who can demonstrate that the planned alternative supply solution for heating or cooling results in a significantly better energy performance. The energy-performance assessment of the alternative supply solution may be based on the energy performance certificate.

4. Member States shall lay down the necessary measures to ensure that district heating and cooling systems contribute to the increase referred to in Article 23(1) of this Directive by implementing at least one of the two following options:

(a) Endeavour to increase the share of energy from renewable sources and from waste heat and cold in district heating and cooling by at least one percentage point as an annual average calculated for the period 2021 to 2025 and for the period 2026 to 2030, starting from the share of energy from renewable sources and from waste heat and cold in district heating and cooling in 2020, expressed in terms of share of final energy consumption in district heating and cooling, by implementing measures that can be expected to trigger that average annual increase in years with normal climatic conditions.

Member States with a share of energy from renewable sources and from waste heat and cold in district heating and cooling above 60 % may count any such share as fulfilling the average annual increase referred to in the first subparagraph of this point.

Member States shall lay down the necessary measures to implement the average annual increase referred to in the first subparagraph of this point in their integrated national energy and climate plans pursuant to Annex I to Regulation (EU) 2018/1999.

(b) Ensure that operators of district heating or cooling systems are obliged to connect suppliers of energy from renewable sources and from waste heat and cold or are obliged to offer to connect and purchase heat or cold from renewable sources and from waste heat and cold from third-party suppliers based on non-discriminatory criteria set by the competent authority of the Member State concerned, where they need to do one or more of the following:

(i) meet demand from new customers;

(ii) replace existing heat or cold generation capacity;

(iii) expand existing heat or cold generation capacity.

5. Where a Member State exercises the option referred to in point (b) of paragraph 4, an operator of a district heating or cooling system may refuse to connect and to purchase heat or cold from a third-party supplier where:

(a) the system lacks the necessary capacity due to other supplies of waste heat and cold, of heat or cold from renewable sources or of heat or cold produced by high-efficiency cogeneration;

(b) the heat or cold from the third-party supplier does not meet the technical parameters necessary to connect and ensure the reliable and safe operation of the district heating and cooling system; or

(c) the operator can demonstrate that providing access would lead to an excessive heat or cold cost increase for final customers compared to the cost of using the main local heat or cold supply with which the renewable source or waste heat and cold would compete.

Member States shall ensure that, when an operator of a district heating or cooling system refuses to connect a supplier of heating or cooling pursuant to the first subparagraph, information on the reasons for the refusal, as well as the conditions to be met and measures to be taken in the system in order to enable the connection, is provided by that operator to the competent authority in accordance with paragraph 9.

6. Where a Member State exercises the option referred to in point (b) of paragraph 4, it may exempt operators of the following district heating and cooling systems from the application of that point:

(a) efficient district heating and cooling;

(b) efficient district heating and cooling that exploits high-efficiency cogeneration;

(c) district heating and cooling that, on the basis of a plan approved by the competent authority, is efficient district heating and cooling by 31 December 2025;

(d) district heating and cooling with a total rated thermal input below 20 MW.

7. The right to disconnect by terminating or modifying a contract in accordance with paragraph 2 may be exercised by individual customers, by joint undertakings formed by customers or by parties acting on behalf of customers. For multi-apartment blocks, such disconnection may be exercised only at a whole building level in accordance with the applicable housing law.

8. Member States shall require electricity distribution system operators to assess at least every four years, in cooperation with the operators of district heating or cooling systems in their respective area, the potential for district heating or cooling systems to provide balancing and other system services, including demand response and storing of excess electricity from renewable sources, and whether the use of the identified potential would be more resource- and cost-efficient than alternative solutions.

9. Member States shall ensure that the rights of consumers and the rules for operating district heating and cooling systems in accordance with this Article are clearly defined and enforced by the competent authority.

10. A Member State shall not be required to apply paragraphs 2 to 9 of this Article where:

(a) its share of district heating and cooling is less than or equal to 2 % of the overall consumption of energy in heating and cooling on 24 December 2018;

(b) its share of district heating and cooling is increased above 2 % by developing new efficient district heating and cooling based on its integrated national energy and climate plan pursuant to Annex I to Regulation (EU) 2018/1999 or the assessment referred to in Article 15(7) of this Directive; or

(c) its share of systems referred to in paragraph 6 of this Article constitutes over 90 % of total sales of its district heating and cooling.

Article 25

Mainstreaming renewable energy in the transport sector

1. In order to mainstream the use of renewable energy in the transport sector, each Member State shall set an obligation on fuel suppliers to ensure that the share of renewable energy within the final consumption of energy in the transport sector is at least 14 % by 2030 (minimum share) in accordance with an indicative trajectory set by the Member State and calculated in accordance with the methodology set out in this Article and in Articles 26 and 27. The Commission shall assess that obligation, with a view to submitting, by 2023, a legislative proposal to increase it in the event of further substantial costs reductions in the production of renewable energy, where necessary to meet the Union's international commitments for decarbonisation, or where justified on the grounds of a significant decrease in energy consumption in the Union.

Member States may exempt, or distinguish between, different fuel suppliers and different energy carriers when setting the obligation on the fuel suppliers, ensuring that the varying degrees of maturity and the cost of different technologies are taken into account.

For the calculation of the minimum share referred to in the first subparagraph, Member States:

(a) shall take into account renewable liquid and gaseous transport fuels of non-biological origin also when they are used as intermediate products for the production of conventional fuels; and

(b) may take into account recycled carbon fuels.

Within the minimum share referred to in the first subparagraph, the contribution of advanced biofuels and biogas produced from the feedstock listed in Part A of Annex IX as a share of final consumption of energy in the transport sector shall be at least 0,2 % in 2022, at least 1 % in 2025 and at least 3,5 % in 2030.

Member States may exempt fuel suppliers supplying fuel in the form of electricity or renewable liquid and gaseous transport fuels of non-biological origin from the requirement to comply with the minimum share of advanced biofuels and biogas produced from the feedstock listed in Part A of Annex IX with respect to those fuels.

When setting the obligation referred to in the first and fourth subparagraphs to ensure the achievement of the share set out therein, Member States may do so, *inter alia*, by means of measures targeting volumes, energy content or greenhouse gas emissions, provided that it is demonstrated that the minimum shares referred to in the first and fourth sub-paragraphs are achieved.

2. The greenhouse gas emissions savings from the use of renewable liquid and gaseous transport fuels of non-biological origin shall be at least 70 % from 1 January 2021.

By 1 January 2021, the Commission shall adopt a delegated act in accordance with Article 35 to supplement this Directive by establishing appropriate minimum thresholds for greenhouse gas emissions savings of recycled carbon fuels through a life-cycle assessment that takes into account the specificities of each fuel.

Article 26

Specific rules for biofuels, bioliquids and biomass fuels produced from food and feed crops

1. For the calculation of a Member State's gross final consumption of energy from renewable sources referred to in Article 7 and the minimum share referred to in the first subparagraph of Article 25(1), the share of biofuels and bioliquids, as well as of biomass fuels consumed in transport, where produced from food and feed crops, shall be no more than one percentage point higher than the share of such fuels in the final consumption of energy in the road and rail transport sectors in 2020 in that Member State, with a maximum of 7 % of final consumption of energy in the road and rail transport sectors in that Member State.

Where that share is below 1 % in a Member State, it may be increased to a maximum of 2 % of the final consumption of energy in the road and rail transport sectors.

Member States may set a lower limit and may distinguish, for the purposes of Article 29(1), between different biofuels, bioliquids and biomass fuels produced from food and feed crops, taking into account best available evidence on indirect land-use change impact. Member States may, for example, set a lower limit for the share of biofuels, bioliquids and biomass fuels produced from oil crops.

Where the share of biofuels and bioliquids, as well as of biomass fuels consumed in transport, produced from food and feed crops in a Member State is limited to a share lower than 7 % or a Member State decides to limit the share further, that Member State may reduce the minimum share referred to in the first subparagraph of Article 25(1) accordingly, by a maximum of 7 percentage points.

2. For the calculation of a Member State's gross final consumption of energy from renewable sources referred to in Article 7 and the minimum share referred to in the first subparagraph of Article 25(1), the share of high indirect land-use change-risk biofuels, bioliquids or biomass fuels produced from food and feed crops for which a significant expansion of the production area into land with high-carbon stock is observed shall not exceed the level of consumption of such fuels in that Member State in 2019, unless they are certified to be low indirect land-use change-risk biofuels, bioliquids or biomass fuels pursuant to this paragraph.

From 31 December 2023 until 31 December 2030 at the latest, that limit shall gradually decrease to 0 %.

By 1 February 2019, the Commission shall submit to the European Parliament and to the Council a report on the status of worldwide production expansion of the relevant food and feed crops.

By 1 February 2019, the Commission shall adopt a delegated act in accordance with Article 35 to supplement this Directive by setting out the criteria for certification of low indirect land-use change-risk biofuels, bioliquids and biomass fuels and for determining the high indirect land-use change-risk feedstock for which a significant expansion of the production area into land with high-carbon stock is observed. The report and the accompanying delegated act shall be based on the best available scientific data.

By 1 September 2023, the Commission shall review the criteria laid down in the delegated act referred to in the fourth subparagraph based on the best available scientific data and shall adopt delegated acts in accordance with Article 35 to amend such criteria, where appropriate, and to include a trajectory to gradually decrease the contribution to the Union target set in Article 3(1) and to the minimum share referred to in the first subparagraph of Article 25(1), of high indirect land-use change-risk biofuels, bioliquids and biomass fuels produced from feedstock for which a significant expansion of the production into land with high-carbon stock is observed.

Article 27

Calculation rules with regard to the minimum shares of renewable energy in the transport sector

1. For the calculation of the minimum shares referred to in the first and fourth subparagraphs of Article 25(1), the following provisions shall apply:

(a) for the calculation of the denominator, that is the energy content of road- and rail- transport fuels supplied for consumption or use on the market, petrol, diesel, natural gas, biofuels, biogas, renewable liquid and gaseous transport fuels of non-biological origin, recycled carbon fuels and electricity supplied to the road and rail transport sectors, shall be taken into account;

(b) for the calculation of the numerator, that is the amount of energy from renewable sources consumed in the transport sector for the purposes of the first subparagraph of Article 25(1), the energy content of all types of energy from renewable sources supplied to all transport sectors, including renewable electricity supplied to the road and rail transport sectors, shall be taken into account. Member States may also take into account recycled carbon fuels.

For the calculation of the numerator, the share of biofuels and biogas produced from the feedstock listed in Part B of Annex IX shall, except for in Cyprus and Malta, be limited to 1,7 % of the energy content of transport fuels supplied for consumption or use on the market. Member States may, where justified, modify that limit, taking into account the availability of feedstock. Any such modification shall be subject to approval by the Commission;

(c) for the calculation of both numerator and denominator, the values regarding the energy content of transport fuels set out in Annex III shall be used. For the determination of the energy content of transport fuels not included in Annex III, the Member States shall use the relevant ESO standards for the determination of the calorific values of fuels. Where no ESO standard has been adopted for that purpose, the relevant ISO standards shall be used. The Commission is empowered to adopt delegated acts in accordance with Article 35 to amend this Directive by adapting the energy content of transport fuels, as set out in Annex III, in accordance with scientific and technical progress.

2. For the purposes of demonstrating compliance with the minimum shares referred to in Article 25(1):

(a) the share of biofuels and biogas for transport produced from the feedstock listed in Annex IX may be considered to be twice its energy content;

(b) the share of renewable electricity shall be considered to be four times its energy content when supplied to road vehicles and may be considered to be 1,5 times its energy content when supplied to rail transport;

(c) with the exception of fuels produced from food and feed crops, the share of fuels supplied in the aviation and maritime sectors shall be considered to be 1,2 times their energy content.

3. For the calculation of the share of renewable electricity in the electricity supplied to road and rail vehicles for the purposes of paragraph 1 of this Article, Member States shall refer to the two-year period before the year in which the electricity is supplied in their territory.

By way of derogation from the first subparagraph of this paragraph, to determine the share of electricity for the purposes of paragraph 1 of this Article, in the case of electricity obtained from a direct connection to an installation generating renewable electricity and supplied to road vehicles, that electricity shall be fully counted as renewable.

In order to ensure that the expected increase in demand for electricity in the transport sector beyond the current baseline is met with additional renewable energy generation capacity, the Commission shall develop a framework on additionality in the transport sector and shall develop different options with a view to determining the baseline of Member States and measuring additionality.

For the purposes of this paragraph, where electricity is used for the production of renewable liquid and gaseous transport fuels of non-biological origin, either directly or for the production of intermediate products, the average share of electricity from renewable sources in the country of production, as measured two years before the year in question, shall be used to determine the share of renewable energy.

However, electricity obtained from direct connection to an installation generating renewable electricity may be fully counted as renewable electricity where it is used for the production of renewable liquid and gaseous transport fuels of non-biological origin, provided that the installation:

(a) comes into operation after, or at the same time as, the installation producing the renewable liquid and gaseous transport fuels of non-biological origin; and

(b) is not connected to the grid or is connected to the grid but evidence can be provided that the electricity concerned has been supplied without taking electricity from the grid.

Electricity that has been taken from the grid may be counted as fully renewable provided that it is produced exclusively from renewable sources and the renewable properties and other appropriate criteria have been demonstrated, ensuring that the renewable properties of that electricity are claimed only once and only in one end-use sector.

By 31 December 2021, the Commission shall adopt a delegated act in accordance with Article 35 to supplement this Directive by establishing a Union methodology setting out detailed rules by which economic operators are to comply with the requirements laid down in the fifth and sixth subparagraphs of this paragraph.

Article 28

Other provisions on renewable energy in the transport sector

1. With a view to minimising the risk of single consignments being claimed more than once in the Union, Member States and the Commission shall strengthen cooperation among national systems and between national systems and voluntary schemes and verifiers established pursuant to Article 30, including, where appropriate, the exchange of data. Where the competent authority of one Member State suspects or detects a fraud, it shall, where appropriate, inform the other Member States.

2. The Commission shall ensure that a Union database is put in place to enable the tracing of liquid and gaseous transport fuels that are eligible for being counted towards the numerator referred to in point (b) of Article 27(1) or that are taken into account for the purposes referred to in points (a), (b), and (c) of the first subparagraph of Article 29(1). Member States shall require the relevant economic operators to enter into that database information on the transactions made and the sustainability characteristics of those fuels, including their life-cycle greenhouse gas emissions, starting from their point of production to the fuel supplier that places the fuel on the market. A Member State may set up a national database that is linked to the Union database ensuring that information entered is instantly transferred between the databases.

Fuel suppliers shall enter the information necessary to verify compliance with the requirements laid down in the first and fourth subparagraphs of Article 25(1) into the relevant database.

3. By 31 December 2021, Member States shall take measures to ensure the availability of fuels from renewable sources for transport including with regard to publicly accessible high-power recharging points and other refuelling infrastructure as provided for in their national policy frameworks in accordance with Directive 2014/94/EU.

4. Member States shall have access to the Union database referred to in paragraph 2 of this Article. They shall take measures to ensure that economic operators enter accurate information into the relevant database. The Commission shall require the schemes that are the subject of a decision pursuant to Article 30(4) of this Directive to verify compliance with that requirement when checking compliance with the sustainability criteria for biofuels, bioliquids and biomass fuels. It shall publish, every two years, aggregated information from the Union database pursuant to Annex VIII to Regulation (EU) 2018/1999.

5. By 31 December 2021, the Commission shall adopt delegated acts in accordance with Article 35 to supplement this Directive by specifying the methodology to determine the share of biofuel, and biogas for transport, resulting from biomass being processed with fossil fuels in a common process, and by specifying the methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels, which shall ensure that credit for avoided emissions is not given for CO_2 the capture of which has already received an emission credit under other provisions of law.

6. By 25 June 2019 and every two years thereafter, the Commission shall review the list of feedstock set out in Parts A and B of Annex IX with a view to adding feedstock in accordance with the principles set out in the third subparagraph.

The Commission is empowered to adopt delegated acts in accordance with Article 35 to amend the list of feedstock set out in Parts A and B of Annex IX by adding, but not removing, feedstock. Feedstock that can be processed only with advanced technologies shall be added to Part A of Annex IX. Feedstock that can be processed into biofuels, or biogas for transport, with mature technologies shall be added to Part B of Annex IX.

Such delegated acts shall be based on an analysis of the potential of the raw material as feedstock for the production of biofuels and biogas for transport, taking into account all of the following:

(a) the principles of the circular economy and of the waste hierarchy established in Directive 2008/98/EC;

(b) the Union sustainability criteria laid down in Article 29(2) to (7);

(c) the need to avoid significant distortive effects on markets for (by-)products, wastes or residues;

(d) the potential for delivering substantial greenhouse gas emissions savings compared to fossil fuels based on a life-cycle assessment of emissions;

(e) the need to avoid negative impacts on the environment and biodiversity;

(f) the need to avoid creating an additional demand for land.

7. By 31 December 2025, in the context of the biennial assessment of progress made pursuant to Regulation (EU) 2018/1999, the Commission shall assess whether the obligation relating to advanced biofuels and biogas produced from feedstock listed in Part A of Annex IX laid down in the fourth subparagraph of Article 25(1) effectively stimulates innovation and ensures greenhouse gas emissions savings in the transport sector. The Commission shall analyse in that assessment whether the application of this Article effectively avoids double accounting of renewable energy.

The Commission shall, if appropriate, submit a proposal to amend the obligation relating to advanced biofuels and biogas produced from feedstock listed in Part A of Annex IX laid down in the fourth subparagraph of Article 25(1).

Article 29

Sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass fuels

1. Energy from biofuels, bioliquids and biomass fuels shall be taken into account for the purposes referred to in points (a), (b) and (c) of this subparagraph only if they fulfil the sustainability and the greenhouse gas emissions saving criteria laid down in paragraphs 2 to 7 and 10:

(a) contributing towards the Union target set in Article 3(1) and the renewable energy shares of Member States;

(b) measuring compliance with renewable energy obligations, including the obligation laid down in Article 25;

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

However, biofuels, bioliquids and biomass fuels 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 paragraph 10 in order to be taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph. This subparagraph shall also apply to waste and residues that are first processed into a product before being further processed into biofuels, bioliquids and biomass fuels.

Electricity, heating and cooling produced from municipal solid waste shall not be subject to the greenhouse gas emissions saving criteria laid down in paragraph 10.

Biomass fuels shall fulfil the sustainability and greenhouse gas emissions saving criteria laid down in paragraphs 2 to 7 and 10 if used in installations producing electricity, heating and cooling or fuels with a total rated thermal input equal to or exceeding 20 MW in the case of solid biomass fuels, and with a total rated thermal input equal to or exceeding 2 MW in the case of gaseous biomass fuels. Member States may apply the sustainability and greenhouse gas emissions saving criteria to installations with lower total rated thermal input.

The sustainability and the greenhouse gas emissions saving criteria laid down in paragraphs 2 to 7 and 10 shall apply irrespective of the geographical origin of the biomass.

2. Biofuels, bioliquids and biomass fuels produced from waste and residues derived not from forestry but from agricultural land shall be taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 1 only where operators or national authorities have monitoring or management plans in place in order to address the impacts on soil quality and soil carbon. Information about how those impacts are monitored and managed shall be reported pursuant to Article 30(3).

3. Biofuels, bioliquids and biomass fuels produced from agricultural biomass taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 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;

(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;

(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 subparagraph of Article 30(4),

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

(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.

The Commission may adopt implementing acts further specifying the criteria by which to determine which grassland are to be covered by point (d) of the first subparagraph of this paragraph. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 34(3).

4. Biofuels, bioliquids and biomass fuels produced from agricultural biomass taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 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;

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

(c) land spanning more than one hectare with trees higher than five metres and a canopy cover of between 10 % and 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 Annex V is applied, the conditions laid down in paragraph 10 of this Article would be fulfilled.

This paragraph shall not apply if, at the time the raw material was obtained, the land had the same status as it had in January 2008.

5. Biofuels, bioliquids and biomass fuels produced from agricultural biomass taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 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.

6. Biofuels, bioliquids and biomass fuels produced from forest biomass taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 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;

(b) when evidence referred to in point (a) of this paragraph is not available, the biofuels, bioliquids and biomass fuels produced from forest biomass shall be taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 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.

7. Biofuels, bioliquids and biomass fuels produced from forest biomass taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 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:

(i) is a Party to the Paris Agreement;

(ii) 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 NDC; or

(iii) 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 evidence referred to in point (a) of this paragraph is not available, the biofuels, bioliquids and biomass fuels produced from forest biomass shall be taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 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.

8. By 31 January 2021, the Commission shall adopt implementing acts establishing the operational guidance on the evidence for demonstrating compliance with the criteria laid down in paragraphs 6 and 7 of this Article. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 34(3).

9. By 31 December 2026, the Commission shall assess whether the criteria laid down in paragraphs 6 and 7 effectively minimise the risk of using forest biomass derived from unsustainable production and address LULUCF criteria, on the basis of the available data.

The Commission shall, if appropriate, submit a legislative proposal to amend the criteria laid down in paragraphs 6 and 7 for the period after 2030.

10. The greenhouse gas emission savings from the use of biofuels, bioliquids and biomass fuels taken into account for the purposes referred to in paragraph 1 shall be:

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

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

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

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

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.

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 Article 31(1).

11. Electricity from biomass fuels shall be taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 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 50 MW;

(b) for installations with a total rated thermal input from 50 to 100 MW, 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 ([1]);

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

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

For the purposes of points (a), (b) and (c) of the first subparagraph of paragraph 1 of this Article, 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 in accordance with Article 14 of Directive 2012/27/EU.

For the purposes of points (a) and (b) of the first subparagraph of paragraph 1 of this Article, this paragraph shall apply only to installations starting operation or converted to the use of biomass fuels after 25 December 2021. For the purposes of point (c) of the first subparagraph of paragraph 1 of this Article, this paragraph shall be without prejudice to support granted under support schemes in accordance with Article 4 approved by 25 December 2021.

Member States may apply higher energy efficiency requirements than those referred in the first subparagraph to installations with lower rated thermal input.

The first subparagraph shall not apply to electricity from installations which are the object of a specific notification by a Member State to the Commission based on the duly substantiated existence of risks for the security of supply of electricity. Upon assessment of the notification, the Commission shall adopt a decision taking into account the elements included therein.

12. For the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 1 of this Article, and without prejudice to Articles 25 and 26, Member States shall not refuse to take into account, on other sustainability grounds, biofuels and bioliquids obtained in compliance with this Article. This paragraph shall be without prejudice to public support granted under support schemes approved before 24 December 2018.

13. For the purposes referred to in point (c) of the first subparagraph of paragraph 1 of this Article, Member States may derogate, for a limited period of time, from the criteria laid down in paragraphs 2 to 7 and 10 and 11 of this Article by adopting different criteria for:

(a) installations located in an outermost region as referred to in Article 349 TFEU to the extent that such facilities produce electricity or heating or cooling from biomass fuels; and

(b) biomass fuels used in the installations referred to in point (a) of this subparagraph, irrespective of the place of origin of that biomass, provided that such criteria are objectively justified on the grounds that their aim is to ensure, for that outermost region, a smooth phase-in of the criteria laid down in paragraphs 2 to 7 and 10 and 11 of this Article and thereby incentivise the transition from fossil fuels to sustainable biomass fuels.

The different criteria referred to in this paragraph shall be subject to a specific notification by the relevant Member State to the Commission.

14. For the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 1, Member States may establish additional sustainability criteria for biomass fuels.

By 31 December 2026, the Commission shall assess the impact of such additional criteria on the internal market, accompanied, if necessary, by a proposal to ensure harmonisation thereof.

([1]) Commission Implementing Decision (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants (OJ L 212, 17.8.2017, p. 1).

Article 30

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

1. Where biofuels, bioliquids and biomass fuels, or other fuels that are eligible for counting towards the numerator referred to in point (b) of Article 27(1), are to be taken into account for the purposes referred to in Articles 23 and 25 and in points (a), (b) and (c) of the first subparagraph of Article 29(1), Member States shall require economic operators to show that the sustainability and greenhouse gas emissions saving criteria laid down in Article 29(2) to (7) and (10) have been fulfilled. For those purposes, they shall require economic operators 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 point (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.

The mass balance system shall ensure that each consignment is counted only once in point (a), (b) or (c) of the first subparagraph of Article 7(1) 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.

2. 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.

3. Member States shall take measures to ensure that economic operators submit reliable information regarding the compliance with the greenhouse gas emissions savings thresholds set in, and adopted pursuant to, Article 25(2), and with the sustainability and greenhouse gas emissions saving criteria laid down in Article 29(2) to (7) and (10), and that economic operators make available to the relevant Member State, upon request, the data that were used to develop the information. Member States shall require economic operators to arrange for an adequate standard of independent auditing of the information submitted, and to provide evidence that this has been done. In order to comply with point (a) of Article 29(6) and point (a) of Article 29(7), the first or second party auditing may be used up to the first gathering point of the forest biomass. The auditing 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.

The obligations laid down in this paragraph 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.

Member States shall submit to the Commission, in aggregated form, the information referred to in the first subparagraph of this paragraph. The Commission shall publish that information on the e-reporting platform referred to in Article 28 of Regulation (EU) 2018/1999 in summary form preserving the confidentiality of commercially sensitive information.

4. The Commission may decide that voluntary national or international schemes setting standards for the production of biofuels, bioliquids or biomass fuels, or other fuels that are eligible for counting towards the numerator referred to in point (b) of Article 27(1), provide accurate data on greenhouse gas emission savings for the purposes of Article 25(2) and Article 29(10), demonstrate compliance with Article 27(3) and Article 28(2) and (4), or demonstrate that consignments of biofuels, bioliquids or biomass fuels comply with the sustainability criteria laid down in Article 29(2) to (7). When demonstrating that the criteria laid down in Article 29(6) and (7) are met, the operators may provide the required evidence directly at sourcing area level. The Commission may recognise areas 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 for the purposes of point (c)(ii) of the first subparagraph of Article 29(3).

The Commission may decide that those schemes contain accurate information on measures taken for soil, water and air protection, for the restoration of degraded land, for the avoidance of excessive water consumption in areas where water is scarce, and for certification of biofuels, bioliquids and biomass fuels with low indirect land-use change-risk.

5. The Commission shall adopt decisions under paragraph 4 of this Article by means of implementing acts. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 34(3). Such decisions shall be valid for a period of no more than five years.

The Commission shall require that each voluntary scheme on which a decision has been adopted under paragraph 4 submit annually by 30 April a report to the Commission covering each of the points set out in Annex IX to Regulation (EU) 2018/1999. The report shall cover the preceding calendar year. The requirement to submit a report shall apply only to voluntary schemes that have operated for at least 12 months.

The Commission shall make the reports drawn up by the voluntary schemes available, in an aggregated form or in full if appropriate, on the e-reporting platform referred to in Article 28 of Regulation (EU) 2018/1999.

6. Member States may set up national schemes where compliance with the sustainability and greenhouse gas emissions saving criteria laid down in Article 29(2) to (7) and (10) and with the greenhouse gas emissions savings thresholds for renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels set in, and adopted pursuant to, Article 25(2) and in accordance with Article 28(5) is verified throughout the entire chain of custody involving competent national authorities.

A Member State may notify such a national scheme to the Commission. The Commission shall give priority to the assessment of such a scheme in order to facilitate mutual bilateral and multilateral recognition of schemes for verification of compliance with the sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass fuels and with the greenhouse gas emissions savings thresholds for other fuels that are eligible for counting towards the numerator referred to in point (b) of Article 27(1). The Commission may decide, by means of implementing acts, whether such a notified national scheme complies with the conditions laid down in this Directive. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 34(3).

Where the decision is positive, schemes established in accordance with this Article shall not refuse mutual recognition with that Member State's scheme, as regards verification of compliance with the sustainability and greenhouse gas emissions saving criteria laid down in Article 29(2) to (7) and (10) and the greenhouse gas emissions savings thresholds set in, and adopted pursuant to, Article 25(2).

7. The Commission shall adopt decisions under paragraph 4 of this Article only if the scheme in question meets adequate standards of reliability, transparency and independent auditing and provides adequate assurances that no

materials have been intentionally modified or discarded so that the consignment or part thereof would fall under Annex IX. In the case of schemes to measure greenhouse gas emissions savings, such schemes shall also comply with the methodological requirements set out in Annex V or VI. Lists of areas of high biodiversity value as referred to in point (c)(ii) of the first subparagraph of Article 29(3) shall meet adequate standards of objectivity and coherence with internationally recognised standards and provide for appropriate appeal procedures.

The voluntary schemes referred to in paragraph 4 shall, at least annually, publish a list of their certification bodies used for independent auditing, indicating for each certification body by which entity or national public authority it was recognised and which entity or national public authority is monitoring it.

8. In order to ensure that compliance with the sustainability and greenhouse gas emissions saving criteria as well as with the provisions on low or high direct and indirect land-use change-risk biofuels, bioliquids and biomass fuels is verified in an efficient and harmonised manner and in particular to prevent fraud, the Commission shall adopt implementing acts specifying detailed implementing rules, including adequate standards of reliability, transparency and independent auditing and require all voluntary schemes to apply those standards. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 34(3).

In those implementing acts, the Commission shall pay particular attention to the need to minimise administrative burden. The implementing acts shall set a time frame by which voluntary schemes are required to implement the standards. The Commission may repeal decisions recognising voluntary schemes pursuant to paragraph 4 in the event that those schemes fail to implement such standards in the time frame provided for. Where a Member State raises concerns that a voluntary scheme does not operate in accordance with the standards of reliability, transparency and independent auditing that constitute the basis for decisions under paragraph 4, the Commission shall investigate the matter and take appropriate action.

9. Where an economic operator provides evidence or data obtained in accordance with a scheme that has been the subject of a decision pursuant to paragraph 4 or 6 of this Article, to the extent covered by that decision, a Member State shall not require the supplier to provide further evidence of compliance with the sustainability and greenhouse gas emissions saving criteria laid down in Article 29(2) to (7) and (10).

Competent authorities of the Member States shall supervise the operation of certification bodies that are conducting independent auditing under a voluntary scheme. Certification bodies shall submit, upon the request of competent authorities, all relevant information necessary to supervise the operation, including the exact date, time and location of audits. Where Member States find issues of non-conformity, they shall inform the voluntary scheme without delay.

10. At the request of a Member State, which may be based on the request of an economic operator, the Commission shall, on the basis of all available evidence, examine whether the sustainability and greenhouse gas emissions saving criteria laid down in Article 29(2) to (7) and (10) in relation to a source of biofuels, bioliquids and biomass fuels, and the greenhouse gas emissions savings thresholds set in, and adopted pursuant to, Article 25(2), have been met.

Within six months of receipt of such a request and in accordance with the examination procedure referred to in Article 34(3), the Commission shall, by means of implementing acts, decide whether the Member State concerned may either:

(a) take into account biofuels, bioliquids, biomass fuels and other fuels that are eligible for counting towards the numerator referred to in point (b) of Article 27(1) from that source for the purposes referred to in points (a), (b) and (c) of the first subparagraph of Article 29(1); or

(b) by way of derogation from paragraph 9 of this Article, require suppliers of the source of biofuels, bioliquids, biomass fuels and other fuels that are eligible for counting towards the numerator referred to in point (b) of Article 27(1) to provide further evidence of compliance with those sustainability and greenhouse gas emissions saving criteria and those greenhouse gas emissions savings thresholds.

Article 31

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

1. For the purposes of Article 29(10), 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 Annex V for biofuels and bioliquids and in Part A of Annex VI for biomass fuels where the e_l value for those biofuels or bioliquids calculated in accordance with point 7 of Part C of Annex V and for those biomass fuels calculated in accordance with point 7 of Part B of Annex VI 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 Annex V for biofuels and bioliquids and in Part B of Annex VI for biomass fuels;

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

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

2. Member States may submit to the Commission reports including information on the typical greenhouse gas emissions from the cultivation of agricultural raw materials of the areas on their territory 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 ([1]). 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.

3. In the case of territories outside the Union, reports equivalent to those referred to in paragraph 2 and drawn up by competent bodies may be submitted to the Commission.

4. The Commission may, by means of implementing acts, decide that the reports referred to in paragraphs 2 and 3 of this Article contain accurate data for the purposes of measuring the greenhouse gas emissions associated with the cultivation of agriculture biomass feedstock produced in the areas included in such reports for the purposes of Article 29(10). Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 34(3).

Those data may, pursuant to such decisions, be used instead of the disaggregated default values for cultivation laid down in Part D or E of Annex V for biofuels and bioliquids and in Part C of Annex VI for biomass fuels.

5. The Commission shall review Annexes V and VI with a view, where justified, to adding or revising values for biofuel, bioliquid and biomass fuel production pathways. Those reviews shall also consider modifying the methodology laid down in Part C of Annex V and in Part B of Annex VI.

The Commission is empowered to adopt delegated acts pursuant to Article 35 to amend, where appropriate, Annexes V and VI by adding or revising the default values or modifying the methodology.

In the case of an adaptation of, or addition to, the list of default values in Annexes V and VI:

(a) where the contribution of a factor to overall emissions is small, where there is limited variation, or where the cost or difficulty of establishing actual values is high, the default values shall be typical of normal production processes;

(b) in all other cases, the default values shall be conservative compared to normal production processes.

([1]) Regulation (EC) No 1059/2003 of the European Parliament and of the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS) (OJ L 154, 21.6.2003, p. 1).

6. Where necessary in order to ensure the uniform application of Part C of Annex V and Part B of Annex VI, the Commission may adopt implementing acts setting out detailed technical specifications including definitions, conversion factors, the calculation of annual cultivation emissions or emission savings caused by changes above and below-ground carbon stocks on already cultivated land, the calculation of emission savings from CO_2 capture, CO_2 replacement and CO_2 geological storage. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 34(3).

Article 32

Implementing acts

The implementing acts referred to in the second subparagraph of Article 29(3), Article 29(8), the first subparagraph of Article 30(5), the second subparagraph of Article 30(6), the first subparagraph of Article 30(8), the first subparagraph of Article 31(4) and Article 31(6) of this Directive, shall take full account of the provisions relating to greenhouse gas emissions reductions in accordance with Article 7a of Directive 98/70/EC of the European Parliament and of the Council ([1]).

Article 33

Monitoring by the Commission

1. The Commission shall monitor the origin of biofuels, bioliquids and biomass fuels consumed in the Union and the impact of their production, including the impact as a result of displacement, on land use in the Union and in the main third countries of supply. Such monitoring shall be based on Member States' integrated national energy and climate plans and corresponding progress reports pursuant to Articles 3, 17 and 20 of Regulation (EU) 2018/1999, and those of relevant third countries, intergovernmental organisations, scientific studies and any other relevant pieces of information. The Commission shall also monitor the commodity price changes associated with the use of biomass for energy and any associated positive and negative effects on food security.

2. The Commission shall maintain a dialogue and exchange information with third countries and biofuel, bioliquid and biomass fuel producers, consumer organisations and civil society concerning the general implementation of the measures in this Directive relating to biofuels, bioliquids and biomass fuels. It shall, within that framework, pay particular attention to the impact that biofuel, bioliquid and biomass fuel production may have on food prices.

3. In 2026, the Commission shall submit, if appropriate, a legislative proposal on the regulatory framework for the promotion of energy from renewable sources for the period after 2030.

That proposal shall take into account the experience of the implementation of this Directive, including its sustainability and greenhouse gas emissions saving criteria, and technological developments in energy from renewable sources.

4. In 2032, the Commission shall publish a report reviewing the application of this Directive.

Article 34

Committee procedure

1. The Commission shall be assisted by the Energy Union Committee established by Article 44 of Regulation (EU) 2018/1999.

2. Notwithstanding paragraph 1, for matters relating to the sustainability of biofuels, bioliquids and biomass fuels, the Commission shall be assisted by the Committee on the Sustainability of Biofuels, Bioliquids and Biomass fuels. That committee shall be a committee within the meaning of Regulation (EU) No 182/2011.

3. Where reference is made to this paragraph, Article 5 of Regulation (EU) No 182/2011 shall apply.

([1]) Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC (OJ L 350, 28.12.1998, p. 58).

Where the Committee delivers no opinion, the Commission shall not adopt the draft implementing act and the third subparagraph of Article 5(4) of Regulation (EU) No 182/2011 shall apply.

Article 35

Exercise of the delegation

1. The power to adopt delegated acts is conferred on the Commission subject to the conditions laid down in this Article.

2. The power to adopt delegated acts referred to in the second subparagraph of Article 8(3), the second subparagraph of Article 25(2), the fourth subparagraph of Article 26(2), the fifth subparagraph of Article 26(2), point (c) of Article 27(1), the seventh subparagraph of Article 27(3), Article 28(5), the second subparagraph of Article 28(6), and the second subparagraph of Article 31(5) shall be conferred on the Commission for a period of five years from 24 December 2018. The Commission shall draw up a report in respect of the delegation of power not later than nine months before the end of the five-year period. The delegation of power shall be tacitly extended for periods of an identical duration, unless the European Parliament or the Council opposes such extension not later than three months before the end of each period.

3. The power to adopt delegated acts referred to in the fifth subparagraph of Article 7(3) shall be conferred on the Commission for a period of two years from 24 December 2018.

4. The delegation of power referred to in the fifth subparagraph of Article 7(3), the second subparagraph of Article 8(3), the second subparagraph of Article 25(2), the fourth subparagraph of Article 26(2), the fifth subparagraph of Article 26(2), point (c) of Article 27(1), the seventh subparagraph of Article 27(3), Article 28(5), the second subparagraph of Article 28(6), and the second subparagraph of Article 31(5) may be revoked at any time by the European Parliament or by the Council. A decision to revoke shall put an end to the delegation of the power specified in that decision. It shall take effect the day following the publication of the decision in the *Official Journal of the European Union* or at a later date specified therein. It shall not affect the validity of any delegated acts already in force.

5. Before adopting a delegated act, the Commission shall consult experts designated by each Member State in accordance with the principles laid down in the Interinstitutional Agreement of 13 April 2016 on Better Law-Making.

6. As soon as it adopts a delegated act, the Commission shall notify it simultaneously to the European Parliament and to the Council.

7. A delegated act adopted pursuant to the fifth subparagraph of Article 7(3), the second subparagraph of Article 8(3), the second subparagraph of Article 25(2), the fourth subparagraph of Article 26(2), the fifth subparagraph of Article 26(2), point (c) of Article 27(1), the seventh subparagraph of Article 27(3), Article 28(5), the second subparagraph of Article 28(6), and the second subparagraph of Article 31(5) shall enter into force only if no objection has been expressed either by the European Parliament or the Council within a period of two months of notification of that act to the European Parliament and to the Council or if, before the expiry of that period, the European Parliament and the Council have both informed the Commission that they will not object. That period shall be extended by two months at the initiative of the European Parliament or of the Council.

Article 36

Transposition

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with Articles 2 to 13, 15 to 31 and 37 and Annexes II, III and V to IX, by 30 June 2021. They shall immediately communicate the text of those measures to the Commission.

When Member States adopt those measures, they shall contain a reference to this Directive or be accompanied by such a reference on the occasion of their official publication. They shall also include a statement that references in existing laws, regulations and administrative provisions to the Directive repealed by this Directive shall be construed as references to this Directive. Member States shall determine how such reference is to be made and how that statement is to be formulated.

2. Member States shall communicate to the Commission the text of the main provisions of national law which they adopt in the field covered by this Directive.

3. This Directive shall not affect the application of the derogations pursuant to Union law on the internal market for electricity.

Article 37

Repeal

Directive 2009/28/EC, as amended by the Directives listed in Part A of Annex X, is repealed with effect from 1 July 2021, without prejudice to the obligations of the Member States relating to the time-limits for the transposition into national law of the Directives set out in Part B of Annex X and without prejudice to the obligations of Member States in 2020 as laid down in Article 3(1) and set out in Part A of Annex I to Directive 2009/28/EC.

References to the repealed Directive shall be construed as references to this Directive and shall be read in accordance with the correlation table set out in Annex XI.

Article 38

Entry into force

This Directive shall enter into force on the third day following that of its publication in the *Official Journal of the European Union*.

Article 39

Addressees

This Directive is addressed to the Member States.

Done at Strasbourg, 11 December 2018.

For the European Parliament	*For the Council*
The President	*The President*
A. TAJANI	J. BOGNER-STRAUSS

ANNEX I

NATIONAL OVERALL TARGETS FOR THE SHARE OF ENERGY FROM RENEWABLE SOURCES IN GROSS FINAL CONSUMPTION OF ENERGY IN 2020 ([1])

A. National overall targets

	Share of energy from renewable sources in gross final consumption of energy, 2005 (S_{2005})	Target for share of energy from renewable sources in gross final consumption of energy, 2020 (S_{2020})
Belgium	2,2 %	13 %
Bulgaria	9,4 %	16 %
Czech Republic	6,1 %	13 %
Denmark	17,0 %	30 %
Germany	5,8 %	18 %
Estonia	18,0 %	25 %
Ireland	3,1 %	16 %
Greece	6,9 %	18 %
Spain	8,7 %	20 %
France	10,3 %	23 %
Croatia	12,6 %	20 %
Italy	5,2 %	17 %
Cyprus	2,9 %	13 %
Latvia	32,6 %	40 %
Lithuania	15,0 %	23 %
Luxembourg	0,9 %	11 %
Hungary	4,3 %	13 %
Malta	0,0 %	10 %
Netherlands	2,4 %	14 %
Austria	23,3 %	34 %
Poland	7,2 %	15 %
Portugal	20,5 %	31 %
Romania	17,8 %	24 %
Slovenia	16,0 %	25 %
Slovak Republic	6,7 %	14 %
Finland	28,5 %	38 %
Sweden	39,8 %	49 %
United Kingdom	1,3 %	15 %

([1]) In order to be able to achieve the national objectives set out in this Annex, it is underlined that the State aid guidelines for environmental protection recognise the continued need for national mechanisms of support for the promotion of energy from renewable sources.

ANNEX II

NORMALISATION RULE FOR ACCOUNTING FOR ELECTRICITY GENERATED FROM HYDROPOWER AND WIND POWER

The following rule shall be applied for the purposes of accounting for electricity generated from hydropower in a given Member State:

$(Q_{N(norm)})(C_N[(/(i)(N\ 14))(Q_iC_i)]\ 15)$ where:

N	=	reference year;
$Q_{N(norm)}$	=	normalised electricity generated by all hydropower plants of the Member State in year N, for accounting purposes;
Q_i	=	the quantity of electricity actually generated in year i by all hydropower plants of the Member State measured in GWh, excluding production from pumped storage units using water that has previously been pumped uphill;
C_i	=	the total installed capacity, net of pumped storage, of all hydropower plants of the Member State at the end of year i, measured in MW.

The following rule shall be applied for the purposes of accounting for electricity generated from onshore wind power in a given Member State:

$(Q_{N(norm)})((C_N\ C_{N\ 1}2)((/(i)(Nn))Q_i(/(j)(Nn))(C_j\ C_{j\ 1}2)))$ where:

N	=	reference year;
$Q_{N(norm)}$	=	normalised electricity generated by all onshore wind power plants of the Member State in year N, for accounting purposes;
Q_i	=	the quantity of electricity actually generated in year i by all onshore wind power plants of the Member State measured in GWh;
C_j	=	the total installed capacity of all the onshore wind power plants of the Member State at the end of year j, measured in MW;
n	=	4 or the number of years preceding year N for which capacity and production data are available for the Member State in question, whichever is lower.

The following rule shall be applied for the purposes of accounting for electricity generated from offshore wind power in a given Member State:

$(Q_{N(norm)})((C_N\ C_{N\ 1}2)((/(i)(Nn))Q_i(/(j)(Nn))(C_j\ C_{j\ 1}2)))$ where:

N	=	reference year;
$Q_{N(norm)}$	=	normalised electricity generated by all offshore wind power plants of the Member State in year N, for accounting purposes;
Q_i	=	the quantity of electricity actually generated in year i by all offshore wind power plants of the Member State measured in GWh;
C_j	=	the total installed capacity of all the offshore wind power plants of the Member State at the end of year j, measured in MW;
n	=	4 or the number of years preceding year N for which capacity and production data are available for the Member State in question, whichever is lower.

ANNEX III

ENERGY CONTENT OF FUELS

Fuel	Energy content by weight (lower calorific value, MJ/kg)	Energy content by volume (lower calorific value, MJ/l)
FUELS FROM BIOMASS AND/OR BIOMASS PROCESSING OPERATIONS		
Bio-Propane	46	24
Pure vegetable oil (oil produced from oil plants through pressing, extraction or comparable procedures, crude or refined but chemically unmodified)	37	34
Biodiesel - fatty acid methyl ester (methyl-ester produced from oil of biomass origin)	37	33
Biodiesel - fatty acid ethyl ester (ethyl-ester produced from oil of biomass origin)	38	34
Biogas that can be purified to natural gas quality	50	—
Hydrotreated (thermochemically treated with hydrogen) oil of biomass origin, to be used for replacement of diesel	44	34
Hydrotreated (thermochemically treated with hydrogen) oil of biomass origin, to be used for replacement of petrol	45	30
Hydrotreated (thermochemically treated with hydrogen) oil of biomass origin, to be used for replacement of jet fuel	44	34
Hydrotreated oil (thermochemically treated with hydrogen) of biomass origin, to be used for replacement of liquefied petroleum gas	46	24
Co-processed oil (processed in a refinery simultaneously with fossil fuel) of biomass or pyrolysed biomass origin to be used for replacement of diesel	43	36
Co-processed oil (processed in a refinery simultaneously with fossil fuel) of biomass or pyrolysed biomass origin, to be used to replace petrol	44	32
Co-processed oil (processed in a refinery simultaneously with fossil fuel) of biomass or pyrolysed biomass origin, to be used to replace jet fuel	43	33
Co-processed oil (processed in a refinery simultaneously with fossil fuel) of biomass or pyrolysed biomass origin, to be used to replace liquefied petroleum gas	46	23
RENEWABLE FUELS THAT CAN BE PRODUCED FROM VARIOUS RENEWABLE SOURCES, INCLUDING BIOMASS		
Methanol from renewable sources	20	16
Ethanol from renewable sources	27	21
Propanol from renewable sources	31	25
Butanol from renewable sources	33	27

Fuel	Energy content by weight (lower calorific value, MJ/kg)	Energy content by volume (lower calorific value, MJ/l)
Fischer-Tropsch diesel (a synthetic hydrocarbon or mixture of synthetic hydrocarbons to be used for replacement of diesel)	44	34
Fischer-Tropsch petrol (a synthetic hydrocarbon or mixture of synthetic hydrocarbons produced from biomass, to be used for replacement of petrol)	44	33
Fischer-Tropsch jet fuel (a synthetic hydrocarbon or mixture of synthetic hydrocarbons produced from biomass, to be used for replacement of jet fuel)	44	33
Fischer-Tropsch liquefied petroleum gas (a synthetic hydrocarbon or mixture of synthetic hydrocarbons, to be used for replacement of liquefied petroleum gas	46	24
DME (dimethylether)	28	19
Hydrogen from renewable sources	120	—
ETBE (ethyl-tertio-butyl-ether produced on the basis of ethanol)	36 (of which 37 % from renewable sources)	27 (of which 37 % from renewable sources)
MTBE (methyl-tertio-butyl-ether produced on the basis of methanol)	35 (of which 22 % from renewable sources)	26 (of which 22 % from renewable sources)
TAEE (tertiary-amyl-ethyl-ether produced on the basis of ethanol)	38 (of which 29 % from renewable sources)	29 (of which 29 % from renewable sources)
TAME (tertiary-amyl-methyl-ether produced on the basis of methanol)	36 (of which 18 % from renewable sources)	28 (of which 18 % from renewable sources)
THxEE (tertiary-hexyl-ethyl-ether produced on the basis of ethanol)	38 (of which 25 % from renewable sources)	30 (of which 25 % from renewable sources)
THxME (tertiary-hexyl-methyl-ether produced on the basis of methanol)	38 of which 14 % from renewable sources)	30 (of which 14 % from renewable sources)
FOSSIL FUELS		
Petrol	43	32
Diesel	43	36

ANNEX IV

CERTIFICATION OF INSTALLERS

The certification schemes or equivalent qualification schemes referred to in Article 18(3) shall be based on the following criteria:

1. The certification or qualification process shall be transparent and clearly defined by the Member States or by the administrative body that they appoint.

2. Installers of biomass, heat pump, shallow geothermal and solar photovoltaic and solar thermal energy shall be certified by an accredited training programme or training provider.

3. The accreditation of the training programme or provider shall be effected by Member States or by the administrative body that they appoint. The accrediting body shall ensure that the training programme offered by the training provider has continuity and regional or national coverage. The training provider shall have adequate technical facilities to provide practical training, including some laboratory equipment or corresponding facilities to provide practical training. The training provider shall also offer in addition to the basic training, shorter refresher courses on topical issues, including on new technologies, to enable life-long learning in installations. The training provider may be the manufacturer of the equipment or system, institutes or associations.

4. The training leading to certification or qualification of an installer shall include theoretical and practical parts. At the end of the training, the installer must have the skills required to install the relevant equipment and systems to meet the performance and reliability needs of the customer, incorporate quality craftsmanship, and comply with all applicable codes and standards, including energy and eco-labelling.

5. The training course shall end with an examination leading to a certificate or qualification. The examination shall include a practical assessment of successfully installing biomass boilers or stoves, heat pumps, shallow geothermal installations, solar photovoltaic or solar thermal installations.

6. The certification schemes or equivalent qualification schemes referred to in Article 18(3) shall take due account of the following guidelines:

   (a) Accredited training programmes should be offered to installers with work experience, who have undergone, or are undergoing, the following types of training:

      (i) in the case of biomass boiler and stove installers: training as a plumber, pipe fitter, heating engineer or technician of sanitary and heating or cooling equipment as a prerequisite;

      (ii) in the case of heat pump installers: training as a plumber or refrigeration engineer and have basic electrical and plumbing skills (cutting pipe, soldering pipe joints, gluing pipe joints, lagging, sealing fittings, testing for leaks and installation of heating or cooling systems) as a prerequisite;

      (iii) in the case of a solar photovoltaic or solar thermal installer: training as a plumber or electrician and have plumbing, electrical and roofing skills, including knowledge of soldering pipe joints, gluing pipe joints, sealing fittings, testing for plumbing leaks, ability to connect wiring, familiar with basic roof materials, flashing and sealing methods as a prerequisite; or

      (iv) a vocational training scheme to provide an installer with adequate skills corresponding to a three years education in the skills referred to in point (a), (b) or (c), including both classroom and workplace learning.

   (b) The theoretical part of the biomass stove and boiler installer training should give an overview of the market situation of biomass and cover ecological aspects, biomass fuels, logistics, fire protection, related subsidies, combustion techniques, firing systems, optimal hydraulic solutions, cost and profitability comparison as well as the design, installation and maintenance of biomass boilers and stoves. The training should also provide good knowledge of any European standards for technology and biomass fuels, such as pellets, and biomass related national and Union law.

(c) The theoretical part of the heat pump installer training should give an overview of the market situation for heat pumps and cover geothermal resources and ground source temperatures of different regions, soil and rock identification for thermal conductivity, regulations on using geothermal resources, feasibility of using heat pumps in buildings and determining the most suitable heat pump system, and knowledge about their technical requirements, safety, air filtering, connection with the heat source and system layout. The training should also provide good knowledge of any European standards for heat pumps, and of relevant national and Union law. The installer should demonstrate the following key competences:

(i) a basic understanding of the physical and operation principles of a heat pump, including characteristics of the heat pump circle: context between low temperatures of the heat sink, high temperatures of the heat source, and the efficiency of the system, determination of the coefficient of performance and seasonal performance factor (SPF);

(ii) an understanding of the components and their function within a heat pump circle, including the compressor, expansion valve, evaporator, condenser, fixtures and fittings, lubricating oil, refrigerant, superheating and sub-cooling and cooling possibilities with heat pumps; and

(iii) the ability to choose and size the components in typical installation situations, including determining the typical values of the heat load of different buildings and for hot water production based on energy consumption, determining the capacity of the heat pump on the heat load for hot water production, on the storage mass of the building and on interruptible current supply; determine the buffer tank component and its volume and integration of a second heating system.

(d) The theoretical part of the solar photovoltaic and solar thermal installer training should give an overview of the market situation of solar products and cost and profitability comparisons, and cover ecological aspects, components, characteristics and dimensioning of solar systems, selection of accurate systems and dimensioning of components, determination of the heat demand, fire protection, related subsidies, as well as the design, installation and maintenance of solar photovoltaic and solar thermal installations. The training should also provide good knowledge of any European standards for technology, and certification such as Solar Keymark, and related national and Union law. The installer should demonstrate the following key competences:

(i) the ability to work safely using the required tools and equipment and implementing safety codes and standards and to identify plumbing, electrical and other hazards associated with solar installations;

(ii) the ability to identify systems and their components specific to active and passive systems, including the mechanical design, and to determine the components' location and system layout and configuration;

(iii) the ability to determine the required installation area, orientation and tilt for the solar photovoltaic and solar water heater, taking account of shading, solar access, structural integrity, the appropriateness of the installation for the building or the climate and to identify different installation methods suitable for roof types and the balance of system equipment required for the installation; and

(iv) for solar photovoltaic systems in particular, the ability to adapt the electrical design, including determining design currents, selecting appropriate conductor types and ratings for each electrical circuit, determining appropriate size, ratings and locations for all associated equipment and subsystems and selecting an appropriate interconnection point.

(e) The installer certification should be time restricted, so that a refresher seminar or event would be necessary for continued certification.

ANNEX V

RULES FOR CALCULATING THE GREENHOUSE GAS IMPACT OF BIOFUELS, BIOLIQUIDS AND THEIR FOSSIL FUEL COMPARATORS

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 %

Biofuel production pathway	Greenhouse gas emissions saving – typical value	Greenhouse gas emissions saving – default value
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)	32 %	19 %
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 %

Biofuel production pathway	Greenhouse gas emissions saving – typical value	Greenhouse gas emissions saving – default value
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.

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	85 %	85 %
farmed wood Fischer-Tropsch diesel in free-standing plant	82 %	82 %
waste wood Fischer-Tropsch petrol in free-standing plant	85 %	85 %
farmed wood Fischer-Tropsch petrol in free-standing plant	82 %	82 %
waste wood dimethylether (DME) in free-standing plant	86 %	86 %
farmed wood dimethylether (DME) in free-standing plant	83 %	83 %
waste wood methanol in free-standing plant	86 %	86 %
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	

[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).

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 ([1]).

([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.

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 ([1]):

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

where

$$Allocation\,factor\,fuel_a = \left[\frac{Energy\,in\,fuel}{Energy\,fuel + Energy\,in\,co\text{-}products}\right]$$

$$Fuel\,feedstock\,factor_a = \left[Ratio\,of\,MJ\,feedstock\,required\,to\,make\,1\,MJ\,fuel\right]$$

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 point 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

([1]) 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.

the use of regional averages for cultivation emissions included in the reports referred to in Article 31(4) or the information on the disaggregated default values for cultivation emissions included in this Annex, 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 point 1(a), 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 ([1]).

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

$e_l = (CS_R - CS_A) \times 3{,}664 \times 1/20 \times 1/P - e_B$, ([2])

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' ([3]) and 'perennial cropland' ([4]) 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 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 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 point 8.

8. The bonus of 29 g 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 29 g CO_2eq/MJ shall apply for a period of up to 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.

([1]) 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.

([2]) 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.

([3]) Cropland as defined by IPCC.

([4]) 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.

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 ([1]) 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 ([2]). The Commission guidelines shall serve as the basis for the calculation of land carbon stocks for the purposes of this 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 point 5 shall not be covered by this point.

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 ([3]).

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)

([1]) 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 (OJ L 151, 17.6.2010, p. 19).

([2]) 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 (OJ L 156, 19.6.2018, p. 1).

([3]) 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 (OJ L 140, 5.6.2009, p. 114).

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 point 16.

18. For the purposes of the calculation referred to in point 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 point 17 shall be the refinery.

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

For bioliquids used for the production of electricity, for the purposes of the calculation referred to in point 3, the fossil fuel comparator $EC_{F(e)}$ shall be 183 g 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 point 3, the fossil fuel comparator $EC_{F(h\&c)}$ shall be 80 g CO_2eq/MJ.

D. DISAGGREGATED DEFAULT VALUES FOR BIOFUELS AND BIOLIQUIDS

Disaggregated default values for cultivation: 'e_{ec}' as defined in Part C of this Annex, 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	26,2	26,2
waste cooking oil biodiesel	0	0
animal fats from rendering biodiesel (**)	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	27,4	27,4
hydrotreated oil from waste cooking oil	0	0
hydrotreated oil from animal fats from rendering (**)	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

(**) 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 (**)	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 (**)	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

(**) 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 Annex

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 (*))	13,2	18,5
sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*))	7,6	10,6
sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*))	27,4	38,3
sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*))	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 (*))	14,8	20,8
corn (maize) ethanol (lignite as process fuel in CHP plant (*))	28,6	40,1
corn (maize) ethanol (forest residues as process fuel in CHP plant (*))	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 (*))	15,1	21,1
other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*))	30,3	42,5
other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*))	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	

Biofuel and bioliquid production pathway	Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$)	Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$)
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 (**)	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 (**)	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

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

(**) 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 Annex

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 (*))	2,3	2,3
sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*))	2,3	2,3
sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*))	2,3	2,3
sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*))	2,3	2,3
corn (maize) ethanol (natural gas as process fuel in CHP plant (*))	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 (*))	2,2	2,2
corn (maize) ethanol (forest residues as process fuel in CHP plant (*))	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 (*))	2,2	2,2
other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*))	2,2	2,2
other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*))	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	

Biofuel and bioliquid production pathway	Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$)	Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$)
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 (**)	1,7	1,7
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 (**)	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

(*) Default values for processes using CHP are valid only if all the process heat is supplied by CHP.
(**) 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 Annex, 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 (*))	1,6	1,6
sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*))	1,6	1,6
sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*))	1,6	1,6
sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*))	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 (*))	1,6	1,6
corn (maize) ethanol (lignite as process fuel in CHP plant (*))	1,6	1,6
corn (maize) ethanol (forest residues as process fuel in CHP plant (*))	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 (*))	1,6	1,6
other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*))	1,6	1,6
other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*))	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	

Biofuel and bioliquid production pathway	Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$)	Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$)
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 (**)	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 (**)	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

(*) Default values for processes using CHP are valid only if all the process heat is supplied by CHP.
(**) 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 (*))	25,1	30,4
sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*))	19,5	22,5
sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*))	39,3	50,2
sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*))	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 (*))	42,5	48,5
corn (maize) ethanol (lignite as process fuel in CHP plant (*))	56,3	67,8
corn (maize) ethanol (forest residues as process fuel in CHP plant (*))	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 (*))	44,3	50,3
other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*))	59,5	71,7
other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*))	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	

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	45,5	50,1
sunflower biodiesel	40,0	44,7
soybean biodiesel	42,2	47,0
palm oil biodiesel (open effluent pond)	63,5	75,7
palm oil biodiesel (process with methane capture at oil mill)	46,3	51,6
waste cooking oil biodiesel	11,2	14,9
animals fats from rendering biodiesel (**)	15,3	20,8
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)	62,2	73,3
hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	44,1	48,0
hydrotreated oil from waste cooking oil	11,9	16,0
hydrotreated oil from animal fats from rendering (**)	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)	56,3	65,4
pure vegetable oil from palm oil (process with methane capture at oil mill)	38,4	57,2
pure oil from waste cooking oil	2,0	2,2

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

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 Annex, 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	8,2	8,2
farmed wood Fischer-Tropsch petrol in free-standing plant	12,4	12,4
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

Biofuel and bioliquid production pathway	Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$)	Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$)
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 Annex

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

Biofuel and bioliquid production pathway	Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$)	Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$)
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 Annex

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	10,3	10,3
farmed wood Fischer-Tropsch diesel in free-standing plant	8,4	8,4
waste wood Fischer-Tropsch petrol in free-standing plant	10,3	10,3
farmed wood Fischer-Tropsch petrol in free-standing plant	8,4	8,4
waste wood dimethylether (DME) in free-standing plant	10,4	10,4
farmed wood dimethylether (DME) in free-standing plant	8,6	8,6
waste wood methanol in free-standing plant	10,4	10,4
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

Biofuel and bioliquid production pathway	Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$)	Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$)
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 Annex, 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

Biofuel and bioliquid production pathway	Greenhouse gas emissions – typical value ($g CO_2eq/MJ$)	Greenhouse gas emissions – default value ($g CO_2eq/MJ$)
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	13,7	13,7
farmed wood Fischer-Tropsch diesel in free-standing plant	16,7	16,7
waste wood Fischer-Tropsch petrol in free-standing plant	13,7	13,7
farmed wood Fischer-Tropsch petrol in free-standing plant	16,7	16,7
waste wood dimethylether (DME) in free-standing plant	13,5	13,5
farmed wood dimethylether (DME) in free-standing plant	16,2	16,2
waste wood methanol in free-standing plant	13,5	13,5
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	

ANNEX VI

RULES FOR CALCULATING THE GREENHOUSE GAS IMPACT OF BIOMASS FUELS AND THEIR FOSSIL FUEL COMPARATORS

A. Typical and default values of greenhouse gas emissions savings for biomass fuels 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 2 500 km	89 %	84 %	87 %	81 %
	2 500 to 10 000 km	82 %	73 %	78 %	67 %
	Above 10 000 km	67 %	51 %	60 %	41 %
Woodchips from short rotation coppice (Eucalyptus)	2 500 to 10 000 km	77 %	65 %	73 %	60 %
Woodchips from short rotation coppice (Poplar – Fertilised)	1 to 500 km	89 %	83 %	87 %	81 %
	500 to 2 500 km	85 %	78 %	84 %	76 %
	2 500 to 10 000 km	78 %	67 %	74 %	62 %
	Above 10 000 km	63 %	45 %	57 %	35 %
Woodchips from short rotation coppice (Poplar – No fertilisation)	1 to 500 km	91 %	87 %	90 %	85 %
	500 to 2 500 km	88 %	82 %	86 %	79 %
	2 500 to 10 000 km	80 %	70 %	77 %	65 %
	Above 10 000 km	65 %	48 %	59 %	39 %
Woodchips from stemwood	1 to 500 km	93 %	89 %	92 %	88 %
	500 to 2 500 km	90 %	85 %	88 %	82 %
	2 500 to 10 000 km	82 %	73 %	79 %	68 %
	Above 10 000 km	67 %	51 %	61 %	42 %
Woodchips from industry residues	1 to 500 km	94 %	92 %	93 %	90 %
	500 to 2 500 km	91 %	87 %	90 %	85 %
	2 500 to 10 000 km	83 %	75 %	80 %	71 %
	Above 10 000 km	69 %	54 %	63 %	44 %

WOOD PELLETS (*)						
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 2 500 km	58 %	37 %	49 %	25 %
		2 500 to 10 000 km	55 %	34 %	47 %	21 %
		Above 10 000 km	50 %	26 %	40 %	11 %
	Case 2a	1 to 500 km	77 %	66 %	72 %	59 %
		500 to 2 500 km	77 %	66 %	72 %	59 %
		2 500 to 10 000 km	75 %	62 %	70 %	55 %
		Above 10 000 km	69 %	54 %	63 %	45 %
	Case 3a	1 to 500 km	92 %	88 %	90 %	85 %
		500 to 2 500 km	92 %	88 %	90 %	86 %
		2 500 to 10 000 km	90 %	85 %	88 %	81 %
		Above 10 000 km	84 %	76 %	81 %	72 %
Wood briquettes or pellets from short rotation coppice (Eucalyptus)	Case 1	2 500 to 10 000 km	52 %	28 %	43 %	15 %
	Case 2a	2 500 to 10 000 km	70 %	56 %	66 %	49 %
	Case 3a	2 500 to 10 000 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 10 000 km	52 %	29 %	44 %	16 %
		Above 10 000 km	47 %	21 %	37 %	7 %
	Case 2a	1 to 500 km	73 %	60 %	69 %	54 %
		500 to 10 000 km	71 %	57 %	67 %	50 %
		Above 10 000 km	66 %	49 %	60 %	41 %
	Case 3a	1 to 500 km	88 %	82 %	87 %	81 %
		500 to 10 000 km	86 %	79 %	84 %	77 %
		Above 10 000 km	80 %	71 %	78 %	67 %

WOOD PELLETS (*)						
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 short rotation coppice (Poplar – No fertilisation)	Case 1	1 to 500 km	56 %	35 %	48 %	23 %
		500 to 10 000 km	54 %	32 %	46 %	20 %
		Above 10 000 km	49 %	24 %	40 %	10 %
	Case 2a	1 to 500 km	76 %	64 %	72 %	58 %
		500 to 10 000 km	74 %	61 %	69 %	54 %
		Above 10 000 km	68 %	53 %	63 %	45 %
	Case 3a	1 to 500 km	91 %	86 %	90 %	85 %
		500 to 10 000 km	89 %	83 %	87 %	81 %
		Above 10 000 km	83 %	75 %	81 %	71 %
Stemwood	Case 1	1 to 500 km	57 %	37 %	49 %	24 %
		500 to 2 500 km	58 %	37 %	49 %	25 %
		2 500 to 10 000 km	55 %	34 %	47 %	21 %
		Above 10 000 km	50 %	26 %	40 %	11 %
	Case 2a	1 to 500 km	77 %	66 %	73 %	60 %
		500 to 2 500 km	77 %	66 %	73 %	60 %
		2 500 to 10 000 km	75 %	63 %	70 %	56 %
		Above 10 000 km	70 %	55 %	64 %	46 %
	Case 3a	1 to 500 km	92 %	88 %	91 %	86 %
		500 to 2 500 km	92 %	88 %	91 %	87 %
		2 500 to 10 000 km	90 %	85 %	88 %	83 %
		Above 10 000 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 2 500 km	75 %	62 %	70 %	55 %
		2 500 to 10 000 km	72 %	59 %	67 %	51 %
		Above 10 000 km	67 %	51 %	61 %	42 %
	Case 2a	1 to 500 km	87 %	80 %	84 %	76 %
		500 to 2 500 km	87 %	80 %	84 %	77 %
		2 500 to 10 000 km	85 %	77 %	82 %	73 %
		Above 10 000 km	79 %	69 %	75 %	63 %

WOOD PELLETS (*)						
Biomass fuel production system		Transport distance	Greenhouse gas emissions savings – typical value		Greenhouse gas emissions savings – default value	
			Heat	Electricity	Heat	Electricity
	Case 3a	1 to 500 km	95 %	93 %	94 %	91 %
		500 to 2 500 km	95 %	93 %	94 %	92 %
		2 500 to 10 000 km	93 %	90 %	92 %	88 %
		Above 10 000 km	88 %	82 %	85 %	78 %

(*) 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/m³ (*)	1 to 500 km	95 %	92 %	93 %	90 %
	500 to 2 500 km	89 %	83 %	86 %	80 %
	2 500 to 10 000 km	77 %	66 %	73 %	60 %
	Above 10 000 km	57 %	36 %	48 %	23 %
Agricultural Residues with density > 0,2 t/m³ (**)	1 to 500 km	95 %	92 %	93 %	90 %
	500 to 2 500 km	93 %	89 %	92 %	87 %
	2 500 to 10 000 km	88 %	82 %	85 %	78 %
	Above 10 000 km	78 %	68 %	74 %	61 %
Straw pellets	1 to 500 km	88 %	82 %	85 %	78 %
	500 to 10 000 km	86 %	79 %	83 %	74 %
	Above 10 000 km	80 %	70 %	76 %	64 %
Bagasse briquettes	500 to 10 000 km	93 %	89 %	91 %	87 %
	Above 10 000 km	87 %	81 %	85 %	77 %
Palm Kernel Meal	Above 10 000 km	20 %	-18 %	11 %	-33 %

AGRICULTURE PATHWAYS					
Biomass fuel production system	Transport distance	Greenhouse gas emissions savings – typical value		Greenhouse gas emissions savings – default value	
		Heat	Electricity	Heat	Electricity
Palm Kernel Meal (no CH_4 emissions from oil mill)	Above 10 000 km	46 %	20 %	42 %	14 %

(*) 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).
(**) 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 (*)				
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 %

([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 (*)				
Biogas production system		Technological option	Greenhouse gas emissions savings – typical value	Greenhouse gas emissions savings – default value
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 %

(*) 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).

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 %

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 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 (*)			
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 %

(*) 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 (*)			
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 %

(*) 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.

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;

([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).

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:

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

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 Annex (*)

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

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 45 g CO_2eq/MJ manure (– 54 kg 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:

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

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 45 g 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 point 1(d)), irrespective if the heat is used for actual heating purposes or for cooling. ([1])

([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.

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 ([1]):

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

Where

$$Allocation\,factor\,fuel_a = \left[\frac{Energy\,in\,fuel}{Energy\,fuel + Energy\,in\,co\text{-}products}\right]$$

$$Fuel\,feedstock\,factor_a = \left[Ratio\,of\,MJ\,feedstock\,required\,to\,make\,1\,MJ\,fuel\right]$$

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 point 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, 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 this Directive or the information on the disaggregated default values for cultivation emissions included in this Annex, 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.

([1]) The formula for calculating greenhouse gas emissions from the extraction or cultivation of raw materials eec 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 eec for intermediate products.

6. For the purposes of the calculation referred to in point 1(a), 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 ([1]).

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

$e_l = (CS_R - CS_A) \times 3{,}664 \times 1/20 \times 1/P - e_B$, ([2])

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' ([3]) and 'perennial cropland' ([4]) 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 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 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 29 g CO_2eq/MJ biomass fuel if biomass is obtained from restored degraded land under the conditions laid down in point 8.

8. The bonus of 29 g 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 29 g CO_2eq/MJ shall apply for a period of up to 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 point 10 of Part C of Annex V to this Directive, Commission Decision 2010/335/EU ([5]), which provides for guidelines for the calculation of land carbon stocks in relation to this 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.

([1]) 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.

([2]) The quotient obtained by dividing the molecular weight of CO2 (44,010 g/mol) by the molecular weight of carbon (12,011 g/mol) is equal to 3,664.

([3]) Cropland as defined by IPCC.

([4]) 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.

([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 (OJ L 151, 17.6.2010, p. 19).

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 point 5 shall not be covered by this point.

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 point 16.

18. For the purposes of the calculations referred to in point 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 that do not fall under the scope of point 7 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 point 17 shall be the refinery.

19. For biomass fuels used for the production of electricity, for the purposes of the calculation referred to in point 3, the fossil fuel comparator $EC_{F(el)}$ shall be 183 g CO_2eq/MJ electricity or 212 g 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 point 3, the fossil fuel comparator $EC_{F(h)}$ shall be 80 g 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 point 3, the fossil fuel comparator $EC_{F(h)}$ shall be 124 g CO_2eq/MJ heat.

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

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 2 500 km	0,0	1,6	5,2	0,4	0,0	1,9	6,2	0,5
	2 500 to 10 000 km	0,0	1,6	10,5	0,4	0,0	1,9	12,6	0,5
	Above 10 000 km	0,0	1,6	20,5	0,4	0,0	1,9	24,6	0,5
Wood chips from SRC (Eucalyptus)	2 500 to 10 000 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 2 500 km	3,9	0,0	5,6	0,4	3,9	0,0	6,8	0,5
	2 500 to 10 000 km	3,9	0,0	11,0	0,4	3,9	0,0	13,2	0,5
	Above 10 000 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 2 500 km	2,2	0,0	5,6	0,4	2,2	0,0	6,8	0,5
	2 500 to 10 000 km	2,2	0,0	11,0	0,4	2,2	0,0	13,2	0,5
	Above 10 000 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 2 500 km	1,1	0,3	5,2	0,4	1,1	0,4	6,2	0,5
	2 500 to 10 000 km	1,1	0,3	10,5	0,4	1,1	0,4	12,6	0,5
	Above 10 000 km	1,1	0,3	20,5	0,4	1,1	0,4	24,6	0,5

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 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 2 500 km	0,0	0,3	5,2	0,4	0,0	0,4	6,2	0,5
	2 500 to 10 000 km	0,0	0,3	10,5	0,4	0,0	0,4	12,6	0,5
	Above 10 000 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 2 500 km	0,0	25,8	2,8	0,3	0,0	30,9	3,3	0,3
	2 500 to 10 000 km	0,0	25,8	4,3	0,3	0,0	30,9	5,2	0,3
	Above 10 000 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 2 500 km	0,0	12,5	2,9	0,3	0,0	15,0	3,5	0,3
	2 500 to 10 000 km	0,0	12,5	4,4	0,3	0,0	15,0	5,3	0,3
	Above 10 000 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 2 500 km	0,0	2,4	2,9	0,3	0,0	2,8	3,5	0,3
	2 500 to 10 000 km	0,0	2,4	4,4	0,3	0,0	2,8	5,3	0,3
	Above 10 000 km	0,0	2,4	8,2	0,3	0,0	2,8	9,8	0,3

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 from short rotation coppice (Eucalyptus – case 1)	2 500 to 10 000 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)	2 500 to 10 000 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)	2 500 to 10 000 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 10 000 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 10 000 km	4,4	10,6	4,4	0,3	4,4	12,7	5,3	0,3
	Above 10 000 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 10 000 km	4,6	0,3	4,4	0,3	4,6	0,4	5,3	0,3
	Above 10 000 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 2 500 km	2,0	24,5	4,3	0,3	2,0	29,4	5,2	0,3
	2 500 to 10 000 km	2,0	24,5	7,9	0,3	2,0	29,4	9,5	0,3

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 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 10 000 km	2,5	10,6	4,4	0,3	2,5	12,7	5,3	0,3
	Above 10 000 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 10 000 km	2,6	0,3	4,4	0,3	2,6	0,4	5,3	0,3
	Above 10 000 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 2 500 km	1,1	24,8	2,8	0,3	1,1	29,8	3,3	0,3
	2 500 to 10 000 km	1,1	24,8	4,3	0,3	1,1	29,8	5,2	0,3
	Above 10 000 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 2 500 km	1,4	11,0	2,9	0,3	1,4	13,2	3,5	0,3
	2 500 to 10 000 km	1,4	11,0	4,4	0,3	1,4	13,2	5,3	0,3
	Above 10 000 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 2 500 km	1,4	0,8	2,9	0,3	1,4	0,9	3,5	0,3
	2 500 to 10 000 km	1,4	0,8	4,4	0,3	1,4	0,9	5,3	0,3
	Above 10 000 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 2 500 km	0,0	14,3	2,7	0,3	0,0	17,2	3,2	0,3
	2 500 to 10 000 km	0,0	14,3	4,2	0,3	0,0	17,2	5,0	0,3
	Above 10 000 km	0,0	14,3	7,7	0,3	0,0	17,2	9,2	0,3

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 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 2 500 km	0,0	6,0	2,7	0,3	0,0	7,2	3,3	0,3
	2 500 to 10 000 km	0,0	6,0	4,2	0,3	0,0	7,2	5,1	0,3
	Above 10 000 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 2 500 km	0,0	0,2	2,7	0,3	0,0	0,3	3,3	0,3
	2 500 to 10 000 km	0,0	0,2	4,2	0,3	0,0	0,3	5,1	0,3
	Above 10 000 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 2 500 km	0,0	0,9	6,5	0,2	0,0	1,1	7,8	0,3
	2 500 to 10 000 km	0,0	0,9	14,2	0,2	0,0	1,1	17,0	0,3
	Above 10 000 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 2 500 km	0,0	0,9	3,6	0,2	0,0	1,1	4,4	0,3
	2 500 to 10 000 km	0,0	0,9	7,1	0,2	0,0	1,1	8,5	0,3
	Above 10 000 km	0,0	0,9	13,6	0,2	0,0	1,1	16,3	0,3

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
Straw pellets	1 to 500 km	0,0	5,0	3,0	0,2	0,0	6,0	3,6	0,3
	500 to 10 000 km	0,0	5,0	4,6	0,2	0,0	6,0	5,5	0,3
	Above 10 000 km	0,0	5,0	8,3	0,2	0,0	6,0	10,0	0,3
Bagasse briquettes	500 to 10 000 km	0,0	0,3	4,3	0,4	0,0	0,4	5,2	0,5
	Above 10 000 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 10 000 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

([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.

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
Maize whole plant [1]	case 1	Open digestate	15,6	13,5	8,9	0,0 [2]	—	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] Maize whole plant means maize harvested as fodder and ensiled for preservation.
[2] 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	—

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 2 500 km	7	9
	2 500 to 10 000 km	12	15
	Above 10 000 km	22	27
Woodchips from short rotation coppice (Eucalyptus)	2 500 to 10 000 km	16	18
Woodchips from short rotation coppice (Poplar – Fertilised)	1 to 500 km	8	9
	500 to 2 500 km	10	11
	2 500 to 10 000 km	15	18
	Above 10 000 km	25	30
Woodchips from short rotation coppice (Poplar – No fertilisation)	1 to 500 km	6	7
	500 to 2 500 km	8	10
	2 500 to 10 000 km	14	16
	Above 10 000 km	24	28
Woodchips from stemwood	1 to 500 km	5	6
	500 to 2 500 km	7	8
	2 500 to 10 000 km	12	15
	Above 10 000 km	22	27
Woodchips from industry residues	1 to 500 km	4	5
	500 to 2 500 km	6	7
	2 500 to 10 000 km	11	13
	Above 10 000 km	21	25
Wood briquettes or pellets from forest residues (case 1)	1 to 500 km	29	35
	500 to 2 500 km	29	35
	2 500 to 10 000 km	30	36
	Above 10 000 km	34	41
Wood briquettes or pellets from forest residues (case 2a)	1 to 500 km	16	19
	500 to 2 500 km	16	19
	2 500 to 10 000 km	17	21
	Above 10 000 km	21	25

Biomass fuel production system	Transport distance	Greenhouse gas emissions – typical value (g CO_2eq/MJ)	Greenhouse gas emissions – default value (g CO_2eq/MJ)
Wood briquettes or pellets from forest residues (case 3a)	1 to 500 km	6	7
	500 to 2 500 km	6	7
	2 500 to 10 000 km	7	8
	Above 10 000 km	11	13
Wood briquettes or pellets from short rotation coppice (Eucalyptus – case 1)	2 500 to 10 000 km	33	39
Wood briquettes or pellets from short rotation coppice (Eucalyptus – case 2a)	2 500 to 10 000 km	20	23
Wood briquettes or pellets from short rotation coppice (Eucalyptus – case 3a)	2 500 to 10 000 km	10	11
Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised – case 1)	1 to 500 km	31	37
	500 to 10 000 km	32	38
	Above 10 000 km	36	43
Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised – case 2a)	1 to 500 km	18	21
	500 to 10 000 km	20	23
	Above 10 000 km	23	27
Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised – case 3a)	1 to 500 km	8	9
	500 to 10 000 km	10	11
	Above 10 000 km	13	15
Wood briquettes or pellets from short rotation coppice (Poplar – no fertilisation – case 1)	1 to 500 km	30	35
	500 to 10 000 km	31	37
	Above 10 000 km	35	41
Wood briquettes or pellets from short rotation coppice (Poplar – no fertilisation – case 2a)	1 to 500 km	16	19
	500 to 10 000 km	18	21
	Above 10 000 km	21	25
Wood briquettes or pellets from short rotation coppice (Poplar – no fertilisation – case 3a)	1 to 500 km	6	7
	500 to 10 000 km	8	9
	Above 10 000 km	11	13

Biomass fuel production system	Transport distance	Greenhouse gas emissions – typical value (g CO_2eq/MJ)	Greenhouse gas emissions – default value (g CO_2eq/MJ)
Wood briquettes or pellets from stemwood (case 1)	1 to 500 km	29	35
	500 to 2 500 km	29	34
	2 500 to 10 000 km	30	36
	Above 10 000 km	34	41
Wood briquettes or pellets from stemwood (case 2a)	1 to 500 km	16	18
	500 to 2 500 km	15	18
	2 500 to 10 000 km	17	20
	Above 10 000 km	21	25
Wood briquettes or pellets from stemwood (case 3a)	1 to 500 km	5	6
	500 to 2 500 km	5	6
	2 500 to 10 000 km	7	8
	Above 10 000 km	11	12
Wood briquettes or pellets from wood industry residues (case 1)	1 to 500 km	17	21
	500 to 2 500 km	17	21
	2 500 to 10 000 km	19	23
	Above 10 000 km	22	27
Wood briquettes or pellets from wood industry residues (case 2a)	1 to 500 km	9	11
	500 to 2 500 km	9	11
	2 500 to 10 000 km	10	13
	Above 10 000 km	14	17
Wood briquettes or pellets from wood industry residues (case 3a)	1 to 500 km	3	4
	500 to 2 500 km	3	4
	2 500 to 10 000	5	6
	Above 10 000 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/m³ ([1])	1 to 500 km	4	4
	500 to 2 500 km	8	9
	2 500 to 10 000 km	15	18
	Above 10 000 km	29	35
Agricultural Residues with density > 0,2 t/m³ ([2])	1 to 500 km	4	4
	500 to 2 500 km	5	6
	2 500 to 10 000 km	8	10
	Above 10 000 km	15	18
Straw pellets	1 to 500 km	8	10
	500 to 10 000 km	10	12
	Above 10 000 km	14	16
Bagasse briquettes	500 to 10 000 km	5	6
	Above 10 000 km	9	10
Palm Kernel Meal	Above 10 000 km	54	61
Palm Kernel Meal (no CH_4 emissions from oil mill)	Above 10 000 km	37	40

Typical and default values – biogas for electricity

Biogas production system	Technological option		Typical value	Default value
			Greenhouse gas emissions (g CO_2eq/MJ)	Greenhouse gas emissions (g CO_2eq/MJ)
Biogas for electricity from wet manure	Case 1	Open digestate ([3])	– 28	3
		Close digestate ([4])	– 88	– 84
	Case 2	Open digestate	– 23	10
		Close digestate	– 84	– 78
	Case 3	Open digestate	– 28	9
		Close digestate	– 94	– 89

([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).
([3]) 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.
([4]) 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.

Biogas production system	Technological option		Typical value	Default value
			Greenhouse gas emissions (g CO_2eq/MJ)	Greenhouse gas emissions (g CO_2eq/MJ)
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

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

([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).

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 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

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	Default value
		(g CO_2eq/MJ)	(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 3,3 g CO_2eq/MJ biomethane needs to be added to the typical values and a value of 4,6 g CO_2eq/MJ biomethane to the default values.

ANNEX VII

ACCOUNTING OF ENERGY FROM HEAT PUMPS

The amount of aerothermal, geothermal or hydrothermal energy captured by heat pumps to be considered to be energy from renewable sources for the purposes of this Directive, E_{RES}, shall be calculated in accordance with the following formula:

$E_{RES} = Q_{usable} * (1 - 1/SPF)$

where

— Q_{usable} = the estimated total usable heat delivered by heat pumps fulfilling the criteria referred to in Article 7(4), implemented as follows: Only heat pumps for which SPF > 1,15 * 1/η shall be taken into account,

— SPF = the estimated average seasonal performance factor for those heat pumps,

— η = the ratio between total gross production of electricity and the primary energy consumption for the production of electricity and shall be calculated as an EU average based on Eurostat data.

ANNEX VIII

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

Feedstock group	Mean ([2])	Interpercentile range derived from the sensitivity analysis ([3])
Cereals and other starch-rich crops	12	8 to 16
Sugars	13	4 to 17
Oil crops	55	33 to 66

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 Annex.

(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 ([4]). In such a case a direct land-use change emission value (e_l) should have been calculated in accordance with point 7 of part C of Annex V.

([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.

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

([3]) 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 33 g 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 66 g CO_2eq/MJ).

([4]) 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.

ANNEX IX

Part A. Feedstocks for the production of biogas for transport and advanced biofuels, the contribution of which towards the minimum shares referred to in the first and fourth subparagraphs of Article 25(1) may be considered to be twice their energy content:

(a) Algae if cultivated on land in ponds or photobioreactors;

(b) Biomass fraction of mixed municipal waste, but not separated household waste subject to recycling targets under point (a) of Article 11(2) of Directive 2008/98/EC;

(c) Biowaste as defined in point (4) of Article 3 of Directive 2008/98/EC from private households subject to separate collection as defined in point (11) of Article 3 of that Directive;

(d) Biomass fraction of industrial waste not fit for use in the food or feed chain, including material from retail and wholesale and the agro-food and fish and aquaculture industry, and excluding feedstocks listed in part B of this Annex;

(e) Straw;

(f) Animal manure and sewage sludge;

(g) Palm oil mill effluent and empty palm fruit bunches;

(h) Tall oil pitch;

(i) Crude glycerine;

(j) Bagasse;

(k) Grape marcs and wine lees;

(l) Nut shells;

(m) Husks;

(n) Cobs cleaned of kernels of corn;

(o) Biomass fraction of wastes and residues from forestry and forest-based industries, namely, bark, branches, pre-commercial thinnings, leaves, needles, tree tops, saw dust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil;

(p) Other non-food cellulosic material;

(q) Other ligno-cellulosic material except saw logs and veneer logs.

Part B. Feedstocks for the production of biofuels and biogas for transport, the contribution of which towards the minimum share established in the first subparagraph of Article 25(1) shall be limited and may be considered to be twice their energy content:

(a) Used cooking oil;

(b) Animal fats classified as categories 1 and 2 in accordance with Regulation (EC) No 1069/2009.

ANNEX X

PART A

Repealed Directive with a list of the successive amendments thereto (referred to in Article 37)

Directive 2009/28/EC of the European Parliament and of the Council (OJ L 140, 5.6.2009, p. 16)	
Council Directive 2013/18/EU (OJ L 158, 10.6.2013, p. 230)	
Directive (EU) 2015/1513 of the European Parliament and of the Council (OJ L 239, 15.9.2015, p. 1)	Only Article 2

PART B

Time-limits for transposition into national law

(referred to in Article 36)

Directive	Time-limit for transposition
2009/28/EC	25 June 2009
2013/18/EU	1 July 2013
(EU) 2015/1513	10 September 2017

ANNEX XI

Correlation table

Directive 2009/28/EC	This Directive
Article 1	Article 1
Article 2, first subparagraph	Article 2, first subparagraph
Article 2, second subparagraph, introductory wording	Article 2, second subparagraph, introductory wording
Article 2, second subparagraph, point (a)	Article 2, second subparagraph, point (1)
Article 2, second subparagraph, point (b)	—
—	Article 2, second subparagraph, point (2)
Article 2, second subparagraph, point (c)	Article 2, second subparagraph, point (3)
Article 2, second subparagraph, point (d)	—
Article 2, second subparagraph, points (e), (f), (g), (h), (i), (j), (k), (l), (m), (n), (o), (p), (q), (r), (s), (t), (u), (v) and (w)	Article 2, second subparagraph, points (24), (4), (19), (32), (33), (12), (5), (6), (45), (46), (47), (23), (39), (41), (42), (43), (36), (44) and (37)
—	Article 2, second subparagraph, points (7), (8), (9), (10), (11), (13), (14), (15), (16), (17), (18), (20), (21), (22), (25), (26), (27), (28), (29), (30), (31), (34), (35), (38) and (40)
Article 3	—
—	Article 3
Article 4	—
—	Article 4
—	Article 5
—	Article 6
Article 5(1)	Article 7(1)
Article 5(2)	—
Article 5(3)	Article 7(2)
Article 5(4), first, second, third and fourth subparagraphs	Article 7(3), first, second, third and fourth subparagraphs
—	Article 7(3), fifth and sixth subparagraphs
—	Article 7(4)
Article 5(5),	Article 27(1), first subparagraph, point (c)
Article 5(6) and (7)	Article 7(5) and (6)
Article 6(1)	Article 8(1)
—	Article 8(2) and (3)
Article 6(2) and (3)	Article 8(4) and (5)
Article 7(1), (2), (3), (4) and (5)	Article 9(1), (2), (3), (4) and (5)
—	Article 9(6)
Article 8	Article 10
Article 9(1)	Article 11(1)
Article 9(2), first subparagraph, points (a), (b) and (c)	Article 11(2), first subparagraph, points (a), (b) and (c)
—	Article 11(2), first subparagraph, point (d)
Article 10	Article 12
Article 11(1), (2) and (3)	Article 13(1), (2) and (3)

Directive 2009/28/EC	This Directive
—	Article 13(4)
Article 12	Article 14
Article 13(1), first subparagraph	Article 15(1), first subparagraph
Article 13(1), second subparagraph	Article 15(1), second subparagraph
Article 13(1), second subparagraph, points (a) and (b)	—
Article 13(1), second subparagraph, points (c), (d), (e) and (f)	Article 15(1), second subparagraph, points (a), (b), (c) and (d)
Article 13(2), (3), (4) and (5)	Article 15(2), (3), (4) and (5)
Article 13(6), first subparagraph	Article 15(6), first subparagraph
Article 13(6), second, third, fourth and fifth subparagraphs	—
—	Article 15, (7) and (8)
—	Article 16
—	Article 17
Article 14	Article 18
Article 15(1)	Article 19(1)
Article 15(2), first, second and third subparagraphs	Article 19(2) first, second and third subparagraphs
—	Article 19(2), fourth and fifth subparagraphs
Article 15(2), fourth subparagraph	Article 19(2), sixth subparagraph
Article 15(3)	—
—	Article 19(3) and (4)
Article 15(4) and (5)	Article 19(5) and (6)
Article 15(6), first subparagraph, point (a)	Article 19(7), first subparagraph, point (a)
Article 15(6), first subparagraph, point (b)(i)	Article 19(7), first subparagraph, point (b)(i)
—	Article 19(7), first subparagraph, point (b)(ii)
Article 15(6), first subparagraph, point (b)(ii)	Article 19(7), first subparagraph, point (b)(iii)
Article 15(6), first subparagraph, points (c), (d), (e) and (f)	Article 19(7), first subparagraph, points (c), (d), (e) and (f)
—	Article 19(7), second subparagraph
Article 15(7)	Article 19(8)
Article 15(8)	—
Article 15(9) and (10)	Article 19(9) and (10)
—	Article 19(11)
Article 15(11)	Article 19(12)
Article 15(12)	—
—	Article 19(13)
Article 16(1), (2), (3), (4), (5), (6), (7) and (8)	—
Article 16(9), (10) and (11)	Article 20(1), (2) and (3)
—	Article 21
—	Article 22
—	Article 23
—	Article 24
—	Article 25
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Directive 2009/28/EC	This Directive
—	Article 27
—	Article 28
Article 17(1), first and second subparagraphs	Article 29(1), first and second subparagraphs
—	Article 29(1), third, fourth and fifth subparagraphs
—	Article 29(2)
Article 17(2), first and second subparagraphs	—
Article 17(2), third subparagraph	Article 29(10), third subparagraph
Article 17(3), first subparagraph, point (a)	Article 29(3), first subparagraph, point (a)
—	Article 29(3), first subparagraph, point (b)
Article 17(3), first subparagraph, points (b) and (c)	Article 29(3), first subparagraph, points (c) and (d)
—	Article 29(3), second subparagraph
Article 17(4)	Article 29(4)
Article 17(5)	Article 29(5)
Article 17(6) and (7)	—
—	Article 29(6), (7), (8), (9), (10) and (11)
Article 17(8)	Article 29(12)
Article 17(9)	—
—	Article 29(13) and (14)
Article 18(1), first subparagraph	Article 30(1), first subparagraph
Article 18(1), first subparagraph, points (a), (b) and (c)	Article 30(1), first subparagraph, points (a), (c) and (d)
—	Article 30(1), first subparagraph, point (b)
—	Article 30(1), second subparagraph
Article 18(2)	—
—	Article 30(2)
Article 18(3), first subparagraph	Article 30(3), first subparagraph
Article 18(3), second and third subparagraphs	—
Article 18(3), fourth and fifth subparagraphs	Article 30(3), second and third subparagraphs
Article 18(4), first subparagraph	—
Article 18(4), second and third subparagraphs	Article 30(4), first and second subparagraphs
Article 18(4), fourth subparagraph	—
Article 18(5), first and second subparagraphs	Article 30(7), first and second subparagraphs
Article 18(5), third subparagraph	Article 30(8), first and second subparagraphs
Article 18(5), fourth subparagraph	Article 30(5), third subparagraph
—	Article 30(6), first subparagraph
Article 18(5), fifth subparagraph	Article 30(6), second subparagraph
Article 18(6), first and second subparagraphs	Article 30(5), first and second subparagraphs
Article 18(6), third subparagraph	—
Article 18(6), fourth subparagraph	Article 30(6), third subparagraph
—	Article 30(6), fourth subparagraph
Article 18(6), fifth subparagraph	Article 30(6), fifth subparagraph
Article 18(7)	Article 30(9), first subparagraph

Directive 2009/28/EC	This Directive
—	Article 30(9), second subparagraph
Article 18(8) and (9)	—
—	Article 30(10)
Article 19(1), first subparagraph	Article 31(1), first subparagraph
Article 19(1), first subparagraph, points (a), (b) and (c)	Article 31(1), first subparagraph, points (a), (b) and (c)
—	Article 31(1), first subparagraph, point (d)
Article 19(2), (3) and (4)	Article 31(2), (3) and (4)
Article 19(5)	—
Article 19(7), first subparagraph	Article 31(5), first subparagraph
Article 19(7), first subparagraph, first, second third and fourth indents	—
Article 19(7), second and third subparagraphs	Article 31(5), second and third subparagraphs
Article 19(8)	Article 31(6)
Article 20	Article 32
Article 22	—
Article 23(1) and (2)	Article 33(1) and (2)
Article 23(3), (4), (5), (6), (7) and (8)	—
Article 23(9)	Article 33(3)
Article 23(10)	Article 33(4)
Article 24	—
Article 25(1)	Article 34(1)
Article 25(2)	Article 34(2)
Article 25(3)	Article 34(3)
Article 25a(1)	Article 35(1)
Article 25a(2)	Article 35(2) and (3)
Article 25a(3)	Article 35(4)
—	Article 35(5)
Article 25a(4) and (5)	Article 35(6) and (7)
Article 26	—
Article 27	Article 36
—	Article 37
Article 28	Article 38
Article 29	Article 39
Annex I	Annex I
Annex II	Annex II
Annex III	Annex III
Annex IV	Annex IV
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—	Annex VI
Annex VII	Annex VII
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—	Annex XI

RED1-23-22

IECC: SECTION 202 (New), SECTION 202

Proponents: Diana Burk, representing New Buildings Institute (diana@newbuildings.org)

2024 International Energy Conservation Code [RE Project]

Add new definition as follows:

BIOMASS WASTE. Organic non-fossil material of biological origin that is a byproduct or a discarded product. Biomass waste includes municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural crop byproducts, straw, and other biomass solids, liquids, and biogases; but excludes wood and wood-derived fuels (including black liquor), biofuel, feedstock, biodiesel, and fuel ethanol.

Revise as follows:

RENEWABLE ENERGY RESOURCES. Energy derived from solar radiation, wind, waves, tides, ~~landfill gas, biogas,~~ *biomass waste* or extracted from hot fluid or steam heated within the earth.

Reason: There is currently no definition for biomass in the residential IECC even though biomass was recently listed as a potential renewable energy resource. Because there are many flavors of biomass, it is important for the IECC to clarify which forms of biomass energy count towards reducing a residential buildings' ERI score. The revision limits the biomass sources that count as renewable energy resources to those that are specified as waste products and ensures that virgin material of unknown origin does not count as a steady source of renewable energy. Without an available standard to cite in the IECC for sustainable biomass, it is critical to ensure that biomass used in compliance with the IECC is derived from waste products or byproducts. The definition of *biomass waste* is taken from the glossary of the Energy Information Administration. A similar amendment has been approved by the commercial IECC and is included in the draft code.

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
This code change will not affect the cost of construction.

REPCD1-17-22

Proponents: James Guinan, representing Guinan Associates (GuinanAssociates@gmail.com)

2024 International Energy Conservation Code [RE Project]

BIOMASS WASTE. Organic non-fossil material of biological origin that is a byproduct or a discarded product. Biomass waste includes municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural crop byproducts, straw, and other biomass solids, liquids, and biogases; but excludes wood and wood-derived fuels (including black liquor), biofuel feedstock, biodiesel, and fuel ethanol.

Reason: The US is in a housing crisis. Housing costs are rising, making it difficult for "average" people to pay rent or purchase a house. There is insufficient supply of low income housing. Many people are becoming homeless.
The proposed 2024 IECC will substantially increase the cost of a new home. New requirements will also increase the cost of renovating existing homes. This will result in people living in old, drafty homes since renovations (with new requirements) will not be affordable. The result will be no improvement to the existing homes, and less construction of new homes.

The effect will not be "green", but "brown" since energy usage will increase, not decrease.

I have previously comment on the provisions which increase construction costs. Below are my comments on the NBI proposals to the 2024 IECC.

Comments on Proposed 2024 IECC which were submitted by BNI (New Buildings Institute)
12/15/22

1. Biomass Waste: Residential properties should not collect or compost biomass waste due to odor, rats, and health issues. This should be left to commercial facilities who could have a proper facility and staff qualified to operate it in a sanitary manner.

The IECC applies to Residential and Commercial **BUILDINGS.** It does not regulate processes, such as composting, which may be part of a commercial business. These are regulated by state and local codes, and local Board of Health.

Recommendation: Reject this NBI Recommendation.

2. Appliance Energy Efficiency (R408): These are already regulated by the DOE Energy Star program. Individual appliance energy consumption will vary by the utilization of the appliance.

For example a refrigerator in a un-air conditioned home (like mine) will run more and use more energy. Air conditioning the entire home will use much more energy than would be saved by the refrigeration.

Recommendation: Reject this NBI Recommendation.

3. Energy Efficiency Guidelines for HVAC Equipment (R408): These are already set by the DOE with input from the industry and manufacturers on what is practical and can be manufactured at reasonable cost.

Different standards from different organizations will confuse the industry and the consumers.

Recommendation: Reject this NBI Recommendation

4. Electric Readiness for Space Heating Option in R408:

a. Condensate drainage: Many homes have basement floors which are below the sewer (or septic system) pipe. These cannot be "Naturally Drained" but must be piped. Condensate is usually acidic, and may not be permitted in the sewer or septic system.

b. Dedicated branch circuit for heat pump system #15: The heat pump system will have substantial power requirements (amperage). This will increase the size of the feeders to the house (provided by the electrical utility) and the cost of wiring inside the house. This increases the cost of building a new home or renovating an existing home.

Recommendation: Reject this NBI Recommendation

5. Renewable Energy Contract Length: The building codes regulate building construction, not contracts.

The energy contract is between the supplier and the consumer. Factors include energy cost, reliability, ability of the supplier to provide adequate energy, and service to the consumer. Requiring a 15 year contract allows the energy supplier to provide expensive, unreliable energy, with lousy service.

Also, some towns are now providing town-wide renewable energy plans for the residents. The plan allows residents to cancel (and switch back to a non-renewable supplier) if they are not happy with cost or service. This contract term requirement will discourage consumers from trying renewable energy, and hurt the renewable industry.

Recommendation: Reject this NBI Recommendation

6. RENEWABLE ENERGY RESOURCES and Renewable FUEL:

The building codes regulate **BUILDING COCSTRUCTION**, and not the source of energy supplied to the building.

This section is not appropriate in the Building Code.

In California the definition is in the California Air resource Board, not in the Building Code.

Recommendation: Reject this NBI Recommendation

7. Solar Ready System: These requirements are redundant, and conflict with the purchase of independently supplied renewable power, community solar systems serving low-income housing (which is planned in my community) and/or municipally provided renewable power.

Also, the State building codes regulate what additional building construction information (for example insulation) is posted near the electrical panel. Nothing extra is allowed inside the electrical panel except Panel Directory and Operating Instructions.

Recommendation: Reject this NBI Recommendation

8. Substantial Energy Alteration:

This applies to alterations to EXISTING BUILDINGS, which is addresses in the Existing Building Code, not the Building Code.

It is not appropriate in the Building Code, which applies to New Construction.

Recommendation: Reject this NBI Recommendation

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
No cost information provided

Workgroup Recommendation

Proposal # 1494
