RSB – ROUNDTABLE ON SUSTAINABLE BIOMATERIALS

RSB Standard for Advanced Fuels

Version 2.6

Publication Date: 01 December 2023

Type of document: RSB Standard

Status: Approved

RSB reference code: RSB-STD-01-010 (Version 2.6)

Contact Details:

RSB – The Roundtable on Sustainable Biomaterials
International Environment House 2
Chemin de Balexert 7-9
1219 Châtelaine
Switzerland
web: http://www.rsb.org
email: info@rsb.org

Introduction

This standard describes the requirements for the production of advanced fuels, including:

- Biofuels from biogenic end-of-life products and production residues;
- Recycled carbon fuels from non-biogenic end-of-life products and production residues;
- Renewable liquid and gaseous fuels of non-biological origin (RFNBOs);
- Renewable hydrogen;
- Electrofuels (e-fuels)

End-of-life products are a specific type of feedstock generated at the end of the life of products that were not primarily produced or intended for the production of biofuel or biomaterial. In this way, they have reached the end of their intended supply chain, as they have been consumed, used, spoiled etc. These end-of-life materials are diverted from disposal, thus reducing potentially harmful environmental and social impacts. Examples of end-of-life-products include municipal solid waste (MSW), used cooking oil (UCO) and wastewater.

Production residues are secondary products derived from agricultural, forestry, food or industrial production and processing chains, among others. Secondary products can be defined as "products of a process that have inelastic supply with demand where even if the market value of a secondary product increases one would not expect more of it to be produced from the process"[1]. Secondary products are therefore not purposefully generated for their potential use as an advanced fuel feedstock. These production residues can be discarded or disposed of, but they can also be sold to specific markets (e.g. animal fats are often sold to the oleo-chemical industry), in order to increase the revenue of the production process.

The main goal of using end-of-life-products and production residues as feedstock is to use a sustainable source of material to produce advanced fuels, and minimise the pressure on lands and natural resources by reducing the use of agricultural crops that are purposefully grown to produce biofuels. Feedstocks that are purposefully produced are primary (co-)products, and differ from secondary products as they are elastic in their supply, meaning that more of this material is likely to be produced if the market value increases. In addition, using production residues can increase the overall system efficiency (e.g. use of water, energy) by reducing processes and costs related to treatment and disposal. The distinction between primary products and secondary products is crucial to adequately allocate environmental impacts.

However, this standard does not intend to systematically divert end-of-life products and production residues towards advanced fuel production if other recycling, re-use or disposal options with a higher energy-efficiency or social/environmental benefits exist.

Note: Operators intending to produce biofuels eligible under the Renewable Energy Directive (2009/28/EC) need to be certified against the *RSB EU RED Standard for Certification of Biofuels based on Waste and Residues* (RSB-STD-11-001-01-010).

[1] ICF International. 2015. "Waste, Residue and By-Product Definitions for the California Low Carbon Fuel Standard".

Main changes from version 2.5 to version 2.6

Addition of vinasse and filter cake as accepted feedstocks under Annex I, Category 2.

Addition of feedstock-specific requirement for vinasse and filter cake, to include displacement emissions assessment.

Main changes from version 2.4 to version 2.5

RSB Standard Amendment on sustainability and specific requirements for RFNBOs and electrofuels:

a. Definitions of Direct air carbon dioxide capture (F.10), Electrofuels (F.11), Geological sources of carbon (f.14), Geothermal energy (F.15), Industrial waste gas (F.16), Renewable electricity (F.20), Renewable hydrogen (F.22), Renewable power purchase agreement (F.23) were added.
b. Definition of Renewable fuels of non-biological origin (F. 21) was amended.
c. Feedstock-specific requirements for non-biogenic CO_2 and precursors contained in waste gas were amended at 3.11.
d. Feedstock-specific requirements for CO_2 captured from the atmosphere and geological sources were added at 3.12.
e. Pathway-specific requirements for electrofuels, renewable hydrogen and renewable fuels of non-biological origin were added at 5.1; 5.2; 5.3 and 5.4.
f. Term flue gas was replaced by waste gas at 3.10; 3.11 and Annex I.
g. Types of captured CO2 were added in Category 4 in Annex I.
h. The term electrofuels was added to fuels described in Annex II.
i. Types of biogenic CO_2 were added in Category 2 in Annex I.

RSB Standard Amendment on flexible allocation:

a. Clarification at 2.1.3 that the RSB Methodology for Displacement Emissions is a voluntary add-on.
b. A flexible attribution approach was added at Section 2.4 and 2.5 for documenting biogenic and non-biogenic fractions when blending and/or co-processing fossil and biogenic fuels,
c. A methodology for flexible attribution approach was added in Annex IV.

Table of Contents

A. Intent of this Standard

The intent of this standard is to ensure that the production and trading of advanced fuels and their intermediates are appropriately addressed within the RSB certification system, by ensuring that negative environmental, social and economic impacts related to their production are minimised and that the requirements upon Participating Operators are appropriate.

B. Scope of this standard

This standard and the RSB standards mentioned in this document apply to any operation and operator:

- using end-of-life-products and production residues from agriculture, forestry, livestock, fishery or industrial production, and/or
- processing and/or any product generated from the processing, transformation or treatment of end-of-life-products and production residues, and/or
- using renewable electricity.

for the purpose of producing advanced fuels.

C. Status and effective date

Version 2.5 of this RSB Standard shall be effective from 15 December 2022.

Any party can make comments on this document by writing to the RSB Secretariat. The Secretariat will undertake a regular review of this document every five years, or earlier if deemed necessary by the Secretariat or RSB Board of Directors. The review shall follow the Procedure for the Development and Modification of RSB Standards (RSB-PRO-15-001).

D. Note on use of this standard

All aspects of this standard are considered to be normative, including the intent, scope, effective date, note on the use of this standard, references, terms and definitions, and requirements, unless otherwise stated. Users implementing this standard shall ensure that the intent of this standard is met. To ensure that the intent of this standard is met, users shall implement all of the requirements specified in this standard, and all additional measures necessary to achieve the intent of this standard.

E. RSB List of documents and corresponding references

Please see RSB List of Documents and References (RSB-DOC-10-001)

F. Terms and definitions

For the purposes of this standard, the terms and definitions given in the RSB Glossary of Terms (RSB-STD-01-002) shall apply. Relevant terms as defined in RSB-STD-01-002 are:

F. 1. Biofuel

Fuel derived from biomass (adapted from ISO 13065).

F. 2. Biomass

Raw material of biological origin excluding material embedded in geological formations or transformed to fossilised material (Source: ISO 13065).

F. 3. Bio-based carbon / biogenic carbon

Carbon derived from biomass (Source: EN 16575:2014 Bio-based products – Vocabulary)

F. 4. Biomaterial

A product wholly or partly derived from biomass. Also known as bioproduct or bio-based product.

F. 5. First collector

Operator that receives end-of-life-products or production residues from points of origin.

F. 6. Point of origin

The generator, such as companies, farms, forest areas, residences, industries and commercial facilities of end-of-life-products, production residues or other waste materials.

F. 7. Raw material

Primary or secondary material that is used to produce a product (Source: ISO 13065) Also known as feedstock.

The following additional specific definitions apply:

F. 8. Agricultural Processing Residues

Residues that are directly generated by first processors of agricultural crops (e.g. husks, shells), and that do not include residues produced on-farm (defined instead as agricultural residues) or from further downstream processing (defined instead as industrial processing residues).

F. 9. Animal fats, oils and other animal processing residues

Secondary products derived from livestock (e.g. cattle, swine, sheep) and poultry (e.g. chickens, turkeys, geese) processing, e.g. tallow, lard, poultry fat. These are usually collected out of the slaughtering and/or rendering processes. These fats can be used to produce biofuels or biomaterials. Can include other residues from animal processing e.g. bone meal or offal.

F. 10. Biogenic municipal solid waste (BMSW)

The biogenic fraction of municipal solid waste, i.e. materials derived from renewable biomass resources, including but not limited to crop residues, food residues, wood residues, paper, cardboard, textiles, grasses, and aquatic plants. The BMSW does not include materials derived from petrochemical resources (e.g. plastics).

F. 11. Direct air carbon dioxide capture

Chemical process by which CO_2 is captured directly from the ambient air.

(Adapted from IPCC report, 2018)

F. 12. Electrofuels (e-fuels)

Liquid or gaseous fuels and intermediates produced from renewable hydrogen together with carbon monoxide or carbon dioxide or nitrogen. Carbon and nitrogen can have biological as well as non-biological origins. The energy content stems from the hydrogen molecule in the fuel and hydrogen component must be produced in an electrolyser that uses renewable electricity or be obtained from renewable

fuels reforming. Hydrogen from fossil hydrocarbon reforming is not accepted for the production of electrofuels.

F. 13. End-of-life product

Material with low economic value that the holder discards or intends or is required to discard and that was not primarily produced or intended for the production of advanced fuels or advanced products and has reached the end of its intended supply chain, as it has been consumed, used, spoiled etc. End-of-life products eligible under this standard are specified in Annex I.

F. 14 Exhausted molasses

As sucrose crystallisation from final molasses progresses, the rate of crystallisation becomes progressively slower until, at a given temperature, no more sucrose can crystallise. Consequently, the final molasses is termed exhausted molasses. (Adapated from Sugar Series volume 4: Unit Operations in Cane Sugar Production – 1982).

F. 15. Fish residues

Secondary products derived from the aquaculture, fishing and processing of fish. Oil can be extracted from the fish residues and it can be used to produce biodiesel among other uses.

F. 16. Geological sources of carbon

Captured CO_2 from a geological source such as volcanoes, gases escaping from the Earth's mantle and erosion of carbon-rich rocks (e.g. limestone).

F. 17. Geothermal energy

Energy stored in the form of heat beneath the surface of solid earth.

(Adapted from Directive (EU) 2018/2001)

F. 18. Industrial waste gas

Waste gases produced by manufacturing and other industrial processes that can be treated and released, reused, or released untreated.

(Source: International Society for Environmental Protection)

F. 19. Municipal solid waste (MSW)

For the purpose of this standard, municipal solid waste is an end-of-life product and includes:

- Waste materials originating from households and waste that is similar in nature and composition, originating from commerce and trade, small businesses, office buildings and institutions, including but not limited to materials such as paper, food scraps, yard trimmings, plastics, metals, rubber, leather, textiles, wood, and glass.
- Waste materials from selected municipal services, including but not limited to waste from park and garden maintenance, waste from street cleaning services (street sweepings, the content of litter containers, market cleansing waste), if managed as waste.
- Construction and demolition waste including but not limited to wood (from buildings), plastics, salvaged building components (doors, windows, and plumbing fixtures), and trees, stumps and earth from clearing sites.

For the purpose of this standard, municipal solid waste excludes:

- Waste sludge from sewage network and treatment
- Industrial waste
- Special waste requiring separate disposal by law
- Hazardous waste requiring separate disposal by law

F. 20. Production residues

Material that is a secondary product of a process which is inelastic in supply and that has an economic value ratio of ≤ 5% with respect to the sum of primary product(s), co-products and other by-products generated from the same production process.
Please note: The methodology to assess if production residues are eligible under this standard is defined in Section G.1.

F. 21. Recyclable material

Material such as glass, paper, metal, plastic, textiles and electronics that

a) can be diverted from the waste stream through regionally established recycling programmes that are

available to a significant portion of the consumers or communities in the region of operation, and

b) are cost-effectively collected, processed, and returned to use in the form of raw materials and products.

(Adapted from ISO 14021 and FTC Green Guides, 260.12).

F. 22. Renewable electricity

Electricity obtained or produced 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.

(Adapted from Directive (EU) 2018/2001)

F. 23. Renewable fuels of non-biological origin (RFNBO)

Liquid or gaseous fuels and intermediates whose energy content comes from renewable energy sources other than biomass. Carbon, hydrogen and electricity which contribute to the energy content of the fuel shall have a non-biological origin. The hydrogen component must be produced in an electrolyser that uses renewable electricity, excluding biomass and biogas electricity. Hydrogen from renewable fuel reforming is not accepted under this definition, but could be classified as an Electrofuel (see definition F.11). Hydrogen from fossil hydrocarbon reforming is not accepted for the production of RFNBOs.

(Adapted from COM (2016) 767 final/2 and DA XX).

Please note: RFNBOs can also be classified as electrofuels, however the opposite is not true. A hydrocarbon produced from non-biogenic carbon and hydrogen obtained from water electrolysis using renewable electricity is both an RFNBO and an electrofuel.

F. 24. Renewable hydrogen

Hydrogen produced in a process using renewable electricity or produced from biomass or obtained from renewable fuel reforming.

F. 25. Renewables power purchases agreement

Contract under which a natural or legal person agrees to purchase renewable electricity directly from an electricity producer.

(Adapted from Directive (EU) 2018/2001)

F. 26. Used cooking oil (UCO)

Any type of vegetable and animal oils and fats used for cooking purposes and collected from food processing activities after being used, including but not limited to restaurants, food manufacturers, households, industrial deep fryers, etc.

F. 27. Recycled carbon fuels

Liquid or gaseous fuels produced from waste, residue streams of non-biogenic origin, including waste-processing gases and exhaust gases of non-biogenic origin which are produced as unavoidable and unintentional consequence of the production process (adapted from: EU 2016/0382 (COD)).

Please note that waste-processing gases also refer to waste gases from industrial processes.

F. 28. Wastewater

Includes domestic wastewater, industrial wastewater and sludge.

F. 29. 1. Domestic wastewater

Wastewater from residential settlements and services, which originates predominantly from the human metabolism and from household activities (Source: European Union (91/271/ECC)[2]).

F. 29. 2. Industrial wastewater

Wastewater which is discharged from premises used for carrying on any trade or industry, other than domestic wastewater and run-off rain water, and which does not contain any co-product, by-product or residue with market value (Source: European Union (91/271/ECC)).

F. 29. 3. Sludge

[2] Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991L0271:EN:HTML

Residual sludge, whether treated or untreated, from wastewater treatment plants (Source: European Union (91/271/ECC)).

G. Requirements

1. Eligibility Requirements

1. 1. Feedstocks listed in
   - Annex I, Category 1 (End-of-life products of biogenic origin)
   - Annex I Category 3 (End-of-life products of non-biogenic origin), and
   - Annex I Category 4 (types of captured CO_2)

   are eligible for certification.

   Please note: Notwithstanding the eligibility of materials, auditors are required to verify the material type and conduct a plausibility check of the amount. See RSB Procedure for Certification Bodies and Auditors (RSB-PRO-70) for further information on the auditing and certification process.

1. 2. Feedstock listed in Annex I, Category 2 (Production residues of biogenic or non-biogenic origin) shall be eligible under this standard if it meets the following eligibility requirements:

   a) It is a secondary product of a process which is inelastic in supply where even if the market value of the product increases one would not expect more of it to be produced from the process, i.e. the percentage change in the quantity supplied divided by the percentage change in price is less than one.

   AND

   b) It has an economic value ratio of ≤5% with respect to the primary product(s), co-products and other by-products generated from the same production process, after covering additional production costs occurring at the point of origin after its production (see Annex III for the calculation of the economic value ratio).

   Operators shall provide evidence that the requirements G.1.2.a) and G.1.2.b) are met either at the level of the point of origin, at the regional level, or at the global level.

Feedstock that is certified as eligible at the time of the certification audit, and changes its status because of price increases, shall be eligible for the certified operator for a further ten years from the date of the status change. In the case that a certified operator expands the supplier base beyond the scope of the initial eligibility assessment (e.g. by adding a region that was not covered by the initial assessment), a new eligibility assessment shall be conducted to verify that the eligibility requirements are met.

Please note: Auditors are required to verify the information provided on a sample basis at the point of origin. See RSB Procedure for Certification Bodies and Auditors (RSB-PRO-70) for further information on the auditing and certification process.

1. 3. Feedstock that is not included in Annex I-II can be added subject to the approval by the RSB Board of Directors.

1. 4. Fuels listed in Annex II (Electrofuels and Renewable fuels of non-biological origin) are eligible for certification.

2. General Requirements (for all feedstocks and pathways)

2. 1. Sustainability Requirements

2. 1. 1. With the exception of Principle 6 and Principle 8, the RSB Principles & Criteria (RSB-STD-01-001) and related documents (i.e. guidelines, glossary, guidance and indicators) shall apply to any processing facility from the first collector onwards.

Please note: Operators only conducting mechanical processing are not considered a processing facility.

2. 1. 2. Principle 3 (Greenhouse Gas Calculation) applies to any operator in the chain of custody starting with the collection at the point of origin onwards.

Operators shall calculate lifecycle cradle-to-gate GHG emissions of the feedstock/intermediate product/fuel, i.e. the emission value shall include the emissions of all inputs and raw materials including the emissions of the previous step in the supply chain. The operators along the chain of custody shall add the additional emissions from transport and /or processing.

The GHG emission calculation shall cover the feedstock/intermediate product/fuel that the RSB claim is referring to.

Please note: Cradle-to-gate refers to the boundary of the certification scope and, under this Standard requires that all emissions related to the material collection at the point of origin ("cradle") up to the factory gate are included in the assessment.

The following elements shall be included in the GHG emission calculation:

- Emissions from the collection or capture of the materials, emissions from waste and leakage including field and processing emissions, and emissions from the production of chemicals or products used in the extraction or processing;

- Emissions from processing shall include emissions from converting the material into fuel, from waste and leakage, from the production of chemicals or products used in processing;

- Emissions from transport and distribution shall include emissions from transport of raw materials, intermediates and fuel from storage of materials as well as distribution: All relevant transport and distribution steps shall be taken into account.

Activity data shall be measured or based on technical specifications (e.g. for processing facilities). Emission factors shall be drawn from established databases, e.g. Ecoinvent or GaBi.

2. 1. 3. For all calculations of GHG emissions, the operator shall adhere to all requirements of this standard RSB-STD-01-010. In the case of any inconsistencies between this standard RSB-STD-01-010 and the GHG methodology chosen, this standard RSB-STD-01-010 shall prevail.

2. 1. 4. In addition, advanced fuel producers may voluntarily report on indirect emissions that may have been created by the diversion of end-of-life-products or residual feedstocks to the eligible product.

The reporting shall be separate from the Greenhouse Gas Calculation. The operator shall either

a) report that the feedstock meets the requirements of the RSB Low iLUC Risk Biomass Criteria and

Compliance Indicators (RSB-STD-04-001), category “Waste and Residues”

or

b) report on the estimated displacement emissions risk level by following the RSB methodology for estimating displacement emissions (RSB-STD-04-002).

Please note: RSB aims to support fuels with significant GHG emissions reduction potential. Displacement emissions may occur when a feedstock is diverted from an existing use to advanced fuel production and therefore must be considered. The RSB offers a voluntary add-on certification for estimating displacement effects, the RSB Methodology for Displacement Emissions (RSB-STD-04-001).

2. 1. 5. Whenever operators who use fossil or bio-based end-of-life products or production residues can demonstrate that the carbon stored in those waste- or residue-based materials would ultimately be emitted into the atmosphere as local GHG emissions (e.g. incineration of MSW) in the absence of utilisation (i.e.in the baseline scenario), the operator may

a) calculate the GHG emissions that will be avoided compared to the baseline scenario, and
b) deduct the avoided emissions from the GHG value of the final product.
c) Add the GHG emissions associated with the fuel in use.

For simplification reasons, the operator may also set the emissions of the fuel in use at zero instead of calculating and deducting avoided emissions from the final GHG value.

Operators who account for avoided GHG emissions shall:

a) Disclose that avoided emissions outside of the production process were considered;
b) Specify the baseline scenario;
c) Not state or imply that the GHG calculation was done in accordance with ISO 14067 or any other carbon footprint standard that does not include the option to account for avoided emissions.

d) Ensure that the avoided GHG emissions were not accounted in any other voluntary or regulatory scheme (i.e. Avoid double-counting).

2. 1. 6. Principles 6 and 8 do not apply to processing facilities.

2. 1. 7. Feedstock-specific requirements apply (see section "Feedstock-specific requirements").

2. 2. Traceability requirements

2. 2. 1. The RSB Chain of Custody Standard (RSB-STD-20-001) applies to any operator in the supply chain from the first collector onward.

2. 2. 2. RSB Participating Operators (POs) shall ensure that

a) all the collectors and aggregators in their supply chain, including first collectors, maintain a mass balance system, for each individual material included in the scope of certification and
b) all organisations in their supply chain are contractually obliged to provide the information as specified in clause G.2.2.4, for all end-of-life and production residues, which are part of the PO's certification scope.

2. 2. 3. First collectors shall have supporting evidence back to the point of origin of the material, which shall be available for the auditors to verify. Supporting evidence may include, for example, evidence of collection from specific restaurants or renders. The name of the specific feedstock shall be on all documentation.

2. 2. 4. Organisations in the supply chain aggregating and/or forwarding end-of-life products and production residues, shall maintain both procurement management and mass balance systems, including the following:

1. A list of all end-of-life products and production residues suppliers with whom the organisation is currently engaged. The list of suppliers shall be updated regularly and contain the following information:
   - Legal name of the supplier;
   - Physical address and phone number of supplier;

- Contact name.

2. Acquisition data, on a physical volume or weight basis, associated with each individual listed supplier, by quarter. This may include both purchased and otherwise collected/acquired end-of-life product, and production residues
3. A contractual requirement that all suppliers shall provide the necessary information on type of material, country of origin on a physical volume or weight basis for all consignments.
4. Sales data on a physical volume or weight basis for the end-of-life products and production residues for the previous 12-month period.
5. A procedure for demonstrating that end-of-life products and production residues acquired are in mass balance with end-of-life products and production residues sold, or kept in stock, every quarter, over the course of the preceding year, for all categories of material handled by the organisation.
6. Where the organisation aggregates or forwards end-of-life products and production residues, the nationally compliant documentation, stating the type of material and the country of origin, shall be passed on with each consignment sold.

2. 3. Other Requirements

The following RSB Standards apply to any operator in the supply chain from the first collector onward:

2. 3. 1. RSB Chain of Custody Standard (RSB-STD-20-001)

2. 3. 2. RSB Standard on Communication and Claims (RSB-STD-50-001)

2. 3. 3. RSB Standard for Participating Operators (RSB-STD-30-001)

2. 3. 4. RSB Standard for Risk Management (RSB-STD-60-001)

2. 3. 5. RSB GHG Calculation Methodology (RSB-STD-01-003-01)

2. 3. 6. RSB Fossil Fuel Baseline Calculation Methodology (RSB-STD-01-003-02)

2. 3. 7. RSB Procedure for Certification Bodies and Auditors (RSB-PRO-70-001) for auditing and certifying operators

2. 4. Requirements for blending and/or co-processing virgin fossil sources with biogenic sources

Please note: For blending virgin fossil and biogenic substance in the context of the processing or production of bioproducts (non-energy use), the specific requirements of the RSB Standard for Advanced Products (RSB-STD-02-001) shall apply.

2. 4. 1. If fuels or intermediates from biogenic sources are blended or co-processed with virgin fossil materials, the operator shall document quantities from biogenic sources separately from quantities from virgin fossil sources.

Please note: Instead of documenting biogenic and eligible non-biogenic fractions separately (for example in the case of MSW), the alternative claim "RSB-Compliant Low Carbon Fuel" or "RSB-Compliant Advanced Fuel" can be made for fuel that is derived partly from biogenic material and partly from eligible fossil material.

2. 4. 2. For documenting biogenic and virgin fossil fractions, the operator shall follow one of the following methods:

a) determine the bio-based proportion of the product by using a mass balance, as described in section 2.4.3, or

b) determine the biogenic carbon content using the radiocarbon method, as described in section 2.4.4, or

c) attribute the bio-based portions of the input(s) or feedstock(s) to specific product(s) or output(s) using flexible attribution, as described in section 2.4.5.

Please note*:* for requirements related to eligible non-biogenic feedstocks see section 2.5.4.

In the event that the location where the product is intended to be marketed has defined deviating requirements, these locally-specific requirements shall apply to ensure the acceptance of the product in the final market. RSB certification does not guarantee market access as different legal requirements might apply. The operator is responsible for verifying locally-specific requirements.

2. 4. 3. Operators determining the bio-based proportion of the product by using a mass balance shall:

1. Determine the quantity of the blended or co-processed output with a biogenic sustainability characteristic by accounting for the following:
   a) the quantity of biogenic feedstock (processing) or fuel (trading/distributing), and
   b) the material-specific conversion factor of the process or process sequences.

   Please note: Biogenic and non-biogenic feedstocks might have different conversion efficiencies. The material-specific conversion factors do have to take these differences into account.

2. Keep the mass balance material specific. It is not permitted to transfer the sustainability characteristic from one type of material to another type of material.

3. Keep the mass balance site specific or specific to a network of interconnected plants and sites.

4. Ensure that balance is achieved at the end of the balancing period. The operator may apply a balancing period of up to 3 months. Within the balancing period, a deficit of a sustainability characteristic might occur. A positive balance may be reported into the next balancing period if the corresponding amount of material in still in stock.

   Note: For operators using mass balance, it is not permitted to assign the sustainability characteristic of inputs to specific outputs. The sustainability characteristic shall be assigned according to actual material specific yields. For operators choosing to flexibly assign the sustainability characteristic to specific outputs, see requirements at Section 2.4.5.

2. 4. 4. Determine the bio-based content by using one of the following options:

   a. Determination of the bio-based carbon content through $_{14}C$ measurement according to EN 16640, ASTM D6866, CEN/TS 16137:2011 or ISO 16620-1:2015.

      The bio-based carbon content shall be expressed as percentage of mass of the total

organic carbon, or the total carbon of the certified fuel.

Documented sampling procedures shall be used to ensure that the samples are representative for the fuel under consideration.

b. Determination of the bio-based mass content using the radiocarbon analysis and elemental analysis according to EN 16785-1 or ISO 16620-4.

Documented sampling procedures shall be used to ensure that the samples are representative for the fuel under consideration.

The bio-based mass content shall be expressed as the percentage of the total mass of the fuel.

c. Determination of the bio-based content by using the material balance method according to EN 16785-2.

As required in EN 16785-2 the operator shall establish a traceability system capable of providing the necessary information and to ensure the validity of all needed data required by this method and the representativeness of the product batch considered.

The bio-based content shall be expressed as the percentage of the total mass of the fuel.

In all cases, the operator shall implement a sampling procedure that is adequate to ensure that samples are representative of the material or the product.

2. 4. 5. Operators that opt to allocate the bio-based portions of the input(s) or feedstock(s) to specific product(s) or output(s) using flexible attribution shall:

1. Document the following:

- the amount of bio-based or eligible non-biogenic feedstock that is used as material in the system.

- the carbon content (%, w/w) of the biogenic or eligible non-biogenic feedstock entering the industrial process.

- the quantification of losses, by mass, in the production unit, for each lost material.

Note: Feedstock that is used for internal energy production or other auxiliaries, which will not be present in a final product, shall not be considered in balance.

2. Have a documented book-keeping system in place to monitor the balance of bio-based or eligible non-biogenic feedstock that have been added to the system and advanced fuel withdrawn from the system (i.e. sold to customers).

3. Ensure that bio-based or eligible non-biogenic feedstock and advanced fuel claims are balanced within a 3-month period. Within the balancing period, a deficit may occur, as long as a non-negative balance is achieved over the 3-months-period. A positive balance may be reported into the next reporting period.

4. Ensure that the boundary of the assessment is:

• one site, or
• several sites at the same geographic location which are connected with pipelines or other means of transport,

or

• sites at different geographic locations if the operator can ensure and demonstrate for all sites that double- booking does not occur, e.g. by limiting the boundary to one legal entity or by having specific contractual relationships in place.

Note: Operators may use Annex IV for calculation guidance.

2. 5. Requirements for blending and/or co-processing virgin fossil sources with non-biogenic sources

2. 5. 1. If fuels or intermediate products from eligible fossil sources (see Annex I, Category 3) are blended or co-processed with fuels or intermediate products from virgin fossil sources, the operator shall document quantities of products from eligible sources separately from products from virgin fossil sources.

2. 5. 2. For documenting eligible and non-eligible fossil fractions, the operator shall determine the attributed eligible fossil proportion of the product by either:

a) Using a mass balance, or
b) Attributing the eligible non-biogenic portion of the input(s) or feedstock(s) to one or more output following requirements in section 2.4.5.

2. 5. 3. Operators determining the eligible non-biogenic proportion of the product by using a mass balance shall:

1. Determine the quantity of the blended or co-processed eligible output by accounting for the following:

- the quantity of eligible feedstock (processing) or product (trading / distributing), and

- the material-specific conversion factor of the process or the process sequences in the case of chemical processes.

Please note: Eligible and non-eligible fossil feedstocks might have different conversion efficiencies. The material specific conversion factors shall take these differences in conversion efficiencies into account.

2. Keep the mass balance material specific. It is not permitted to transfer the eligible characteristic from one type of material to another type of material.

3. Keep the mass balance site specific or specific to a network of interconnected plants and sites.

Ensure that a non-negative balance is achieved at the end of the balancing period. The operator may apply a balancing period of up to three months. Within the balancing period, a deficit of an “eligible” characteristic might occur. A positive balance may be reported into the next balancing period if the corresponding amount of material in still in stock.

2. 5. 4. Operators that opt to attribute the eligible non-biogenic portion of the input(s) or feedstock(s) to specific product(s) or output(s) using flexible attribution shall follow the requirements of 2.4.5.

Note: Claims may not refer to a physical sustainable content of the output product. Alternative claims such as “RSB-Compliant Low Carbon Fuel” or “RSB-Compliant

Advanced Fuel" may be used. Other claims must be approved by the RSB Secretariat on a case-by-case basis.

3. Feedstock-specific requirements

3. 1. Biogenic fraction of municipal solid waste (MSW)

The operator shall ensure that:

(a) Only the biogenic fraction of municipal solid waste is considered to produce RSB Biofuel or RSB Bio-based product, based on representative sampling done at least once every year.
(b) The municipal solid waste is processed into a feedstock consistent with the scope of the operator's certification, removing to the extent that it is economically and physically practical: recyclable material, hazardous material, infectious material or pollutants.

Please note: Materials derived from the waste stream, which is or can be composted, are not considered recyclable in this context.

Should the alternative fate of the MSW be landfill if not used for the production of certified products, operators may calculate avoided landfill greenhouse gas emissions. Avoided landfill greenhouse gas emissions may be subtracted from the total greenhouse gas emissions of the fuel, and shall be calculated following one of the following methodologies:

- California Environmental Protection Agency: Air Resources Board: Proposed Low Carbon Fuel Standard (LCFS) Pathway for the Production of Biomethane from High Solids Anaerobic Digestion (HSAD) of Organic (Food and Green) Wastes. Staff Report. June 28, 2012, Version 1.0. Chapter VIII a. Carbon Credit for Avoided Emissions.
- United States Environmental Protection Agency: ENVIA Energy, LLC Request for Fuel Pathway Determination under the RFS Program. May 8, 2015.
- Intergovernmental Panel on Climate Change (IPCC): 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5 Waste, Chapter 3: Methodology for estimating landfill emissions.

Avoided landfill emissions shall not apply in the case that the MSW is displaced from any other use for the production of fuels or materials (e.g. incineration for electricity production purposes).

Guidance

It is not necessary for households, commerce and any other operators generating MSW to demonstrate compliance with the RSB standards. Compliance with the RSB standards must be demonstrated (through a third-party audit process) from the first collector onward.

Examples of first collectors include, but are not limited to:

- A private or a municipal landfill
- A mechanical biological treatment (MBT) plant where recyclable and organic elements (BMSW), wastewater and refuses are separated from bulk MSW.
- A warehouse or equivalent site where MSW or BMSW is aggregated, either formally by or on behalf of municipal authorities, or informally by trash and refuse collectors, retailers or wholesalers.

3. 2. Wastewater

The RSB standard and related documents referred to in G.2. apply to wastewater from the processing, transformation or treatment of wastewater onward.

Guidance

It is not necessary for households, commerce or any other operators generating wastewater to demonstrate compliance with the RSB standards. Compliance with the RSB standards must be demonstrated as soon as wastewater, and/or any product generated from the processing, transformation or treatment of wastewater, begin to be treated or processed for the purpose of producing biofuels.

Examples of wastewater and product generated from the processing, transformation or treatment of wastewater for the purpose of producing biofuels include, but are not limited to:

- Starchy wastewater, e.g., from grain milling operations
- Effluents from industrial premises, which do not contain any economically recoverable co-product, by-product or residue
- Primary or secondary sludge collected out of a wastewater treatment plant
- Greases or fats collected from a wastewater treatment plant

3 3. Feedstock-specific requirements for woody materials from orchards or plantations

The operator shall provide evidence

- that the point of origin of the material is an orchard, or a plantation dominated by agricultural species (for example palm);
- documenting the tree species that was collected at the point of origin;
- about the frequency at which re-planting activities are conducted as well as information about regional - and species-specific practices;
- documenting that the trees were not left on the ground for soil health or contributing to biodiversity preceding their use for bioenergy purposes;
- that the plantation/orchard has been in operation before 1 January 2008.

Whenever there is any indication that the material is diverted from previous use in other non-energy markets (for example previous use to produce high quality timber products) the material is not eligible for certification.

3. 4. Feedstock-specific requirements for harvesting residues from agriculture

The operator who supplies harvesting residues shall comply with the criteria of RSB Principle 7 (Conservation), 8 (Soil), 9 (Water) and 10 (Air Quality) that are applicable to biomass producers.

Please note: This requirement only applies to residues that originate directly from a farm. It does not apply to agricultural processing residues.

3. 5. Feedstock-specific requirements for forestry residues

Operators shall provide evidence that forestry harvesting residues derive from forests/wood that is certified by the RSB, Forest Stewardship Council (FSC[3]) or any verification/certification scheme with equivalent sustainability requirements as approved by the RSB.

[3] http://www.fsc.org

3. 6. Feedstock-specific requirements for agricultural processing residues

Whenever agricultural processing residues are derived from palm (e.g. palm kernel shells), the material shall be certified back to plantation by RSB or RSPO[4] (EU market and non-EU market), or equivalent, as approved by the RSB Board of Directors following a consultation with the RSB Membership.

3. 7. Feedstock-specific requirements for animal fats, oils and other animal processing residues

Operators shall demonstrate that animal fats, oils and other animal processing residues used as a feedstock to produce biofuels are produced in slaughterhouses and/or rendering units for which a regulation exists and is locally enforced, with regards to:

a) Environmental impacts, in particular waste management practices, and
b) Animal welfare

Whenever animal fats, oils and other animal processing residues used as a feedstock to produce biofuels are produced in slaughterhouses and/or rendering units, for which no regulation exists or the existing regulation is not locally enforced, operators shall demonstrate that environmental impacts, in particular waste management practices, are addressed through voluntary certification of their operations (e.g. ISO 14000, Eco-Management and Audit Scheme etc.).

Guidance:

Important impacts may occur across the supply chain before animal fats are processed into biofuels. This standard addresses the impacts related to the processing of animal fats, oils and other animal processing by-products in biofuel production plants.

The impacts related to the production of animal fats, oils and other animal processing by-products in slaughterhouses and rendering units shall primarily be

[4] Roundtable on Sustainable Palm Oil (RSPO): www.rspo.org

covered by the existing regulation in the country/region. The Participating Operator using animal fats, oils and other animal processing by-products as a feedstock to produce biofuels shall demonstrate that animal fats, oils and other animal processing by-products come from a country/region where regulation exists and is locally enforced on environmental impacts of slaughterhouses and rendering units and on animal welfare. Examples of regulations include:

United States of America:

- Federal Meat Inspection Act (1906)
- Code of Federal Regulations on Animals and Animal Products (9 CFR 313)
- Humane Methods of Livestock Slaughter Act (7 USC, 1901 - 1907)
- Clean Water Act (1972, 1977) and Water Quality Act (1987)
- EPA Factsheet (Final Rule) for wastewater discharge standard EPA 821-F-04-004

European Union

- Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control)
- Directive 93/119/EC on the protection of animals at the time of slaughter or killing
- Council Directive 98/58/EC on the protection of animals kept for farming purposes
- Regulation (EC) No 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety
- Directive 2002/99/EC laying down the animal health rules governing the production, processing, distribution and introduction of products of animal origin for human consumption, 16 December 2002

Canada

- Meat Inspection Act (R.S.C., 1985, c. 25 (1st Supp.))
- Meat and Poultry Products Plant Liquid Effluent Regulations (C.R.C., c. 818)

Auditors evaluate on a case-by-case basis if regional/national regulations on the environmental impacts of slaughterhouses and rendering units and on animal welfare exist and are enforced in the region(s) from which the animal fats used by a participating operator originate, e.g. demonstrated implementation.

3. 8. Feedstock-specific requirements for production residues from industrial processing

3. 8. 1. Whenever production residues are derived from palm oil (e.g. palm fatty acid distillate or palm glycerin), the material shall be certified by RSB or RSPO[5] (EU market and non-EU market), or equivalent, as approved by the RSB Board of Directors following a consultation with the RSB Membership.

3. 8. 2. Whenever exhausted molasses, vinasse or filter cake are used as a feedstock, the operator shall demonstrate that the risk for displacement emissions is low by assessing displacement emissions and determining the risk level following the RSB Methodology for Displacement Emissions.[6]

3. 8. 3. Whenever exhausted molasses is used as a feedstock, the amount of molasses that is eligible for certification shall be calculated according to requirements set out in Annex L.

3. 9. Feedstock-specific requirements for fish residues

The operator shall provide evidence that the fish residues are not suitable for human or animal consumption (food and feed).

3. 10. Feedstock-specific requirements for biogenic CO_2 and precursors contained in waste gas

3. 10. 1. The operator shall provide evidence that the CO_2 and/or precursors is biomass derived.

[5] Roundtable on Sustainable Palm Oil (RSPO): www.rspo.org

[6] RSB-STD-004-002

3. 10. 2. The operator shall provide evidence that the unit which generates the waste gas does not consider the captured greenhouse gas as a credit in an LCA for any other purpose (e.g. voluntary disclosure, obligatory calculation etc.).

Please note: biomass shall not be deliberately combusted for the specific purpose of producing CO_2 or CO.

3. 11. Feedstock-specific requirements for non-biogenic CO2 and precursors contained in waste gas

3. 11. 1. The operator shall provide evidence that CO_2 or CO originates from a waste gas stream, whose inputs have already seen a primary use (such as coal and limestone for steel production or limestone and petroleum-coke for cement production).

Please note: fuels shall not be deliberately combusted or gasified for the specific purpose of producing CO_2 or CO.

3. 11. 2. The operator shall provide evidence that the unit that generates the waste gas does not consider the captured greenhouse gas as a credit in a LCA for any other purpose (e.g. voluntary disclosure, obligatory calculation, provisions of law).

3. 12. Feedstock-specific requirements for CO_2 captured from the atmosphere and geological sources

3. 12. 1. The operator shall provide evidence that the captured CO_2 has not received a credit under other provisions of law, obligatory calculation or voluntary disclosure.

3. 12. 2. The operator shall provide evidence that the energy required for the CO_2 capture has been derived from renewable sources (see definition F. 20 for renewable electricity).

4. Pathway-specific requirements for recycled carbon fuels

4. 1. General requirements for all pathways using fossil end-of-life product, residue or by-product materials

4. 1. 1. The operator shall not use on-product claims that refer to biofuels or biomaterials (for example: “RSB-

Compliant Low Carbon Fuel" or "RSB-Compliant Advanced Fuel" would be allowed).[7]

Please note: Fuels or materials derived partly from biogenic material and partly from eligible fossil material (e.g. MSW) may be claimed in total as "RSB-Compliant Low Carbon Fuel" or "RSB-Compliant Advanced Fuel" instead of tracking biogenic and non-biogenic fractions separately.

4. 1. 2. The operator shall provide evidence that the fossil carbon stored in the end-of-life product or production residue-based materials would ultimately be emitted into the atmosphere as local CO_2 emissions (e.g. incineration of fossil MSW) or other greenhouse gases (e.g. methane) in the absence of the utilisation.

4. 1. 3. The operator shall provide evidence that all practical and cost-effective efforts to remove recyclable material (see definition in F.12) have been made or that recycling would result in poor product properties or in a higher environmental impact.

4. 1. 4. For compliance with Principle 3, the following greenhouse gas emissions are considered:

If the evidence in G.4.1.2 is provided: emissions resulting from capturing or collecting the end-of-life products, or production residues, emissions resulting from the processing into fuel, emissions from transport from the point of capture/collection to fuel station/final distributor.

If the evidence in G.4.1.2 is not provided: all emissions above as well as emissions from combustion/use of the fuel.

4. 2. Feedstock-specific requirements for CO_2 and precursors contained in flue gas

4. 2. 1. The operator shall provide evidence that CO_2 or CO originates from a waste gas stream, whose inputs have already seen a primary use (such as steel or cement production).

4. 2. 2. The operator shall provide evidence that the unit that generates the flue gas does not consider the captured

[7] This deviates from the RSB Procedure on Communication and Claims that requires the short claim to be "RSB-compliant Biofuel"

greenhouse gas as a credit in a LCA for any other purpose (e.g. voluntary disclosure, obligatory calculation)

5. Pathway-specific requirements for electrofuels, renewable hydrogen and renewable fuels of non-biological origin

5. 1. The operator shall not use on-product claims that refer to biofuels or biomaterials whenever using carbon sources from non-biological origin or CO_2 captured from atmospheric and geological sources (for example: “RSB-Compliant Low Carbon Fuel”, “RSB-Compliant Renewable Fuel” or “RSB-Compliant Advanced Fuel” would be allowed).[8]

5. 2. Specific requirements related to the production and use of renewable electricity.

5. 2. 1. The operator shall demonstrate that only renewable electricity is used for the production of electrofuels, renewable hydrogen and renewable fuels of non-biological origin.

Whenever renewable electricity is produced from biomass, biomass residues or biogas, the feedstock and/or fermentation processes shall be certified by RSB or equivalent, as approved by the RSB Board of Directors following a consultation with the RSB Membership.

5. 2. 2. The operator shall provide evidence that renewable electricity is supplied by an installation that is directly connected to the facility that produces electrofuels, renewable hydrogen or renewable fuels of non-biological origin, or comes from the grid/bidding zones, or a combination thereof.

5. 2. 2. 1. If an installation is supplying electricity through a **direct connection**, the operator shall demonstrate that:

- the installations generating renewable electricity always supply renewable electricity;
- the installations generating renewable electricity are connected to the facility that produces electrofuels, renewable hydrogen or renewable fuels of non-biological origin via a direct line, or the production of renewable fuels

[8] This deviates from the RSB Procedure on Communication and Claims that requires the short claim to be “RSB-compliant Biofuel”

and renewable electricity take place within the same installation;

- the installation generating renewable electricity is not connected to the grid, or if it is connected to the grid, no electricity has been taken from the grid to produce electrofuels, renewable hydrogen or renewable fuels of non-biological origin;
- the installations generating renewable electricity began operation no earlier than 36 months before the facility that produces electrofuels, renewable hydrogen or renewable fuels of non-biological origin began operation;
- If an existing industrial facility producing electrofuels, renewable hydrogen or renewable fuels of non-biological origin increases the fuels production capacity, the added capacity shall be considered to have come into operation simultaneously with the initial installation, as long as the capacity is added at the same site and no later than 36 months after the initial facility came into operation;

5. 2. 2. 2. If renewable electricity is supplied by the **grid or bidding zones**, the operator shall demonstrate that:

- in the preceding calendar year, more than 90% of electricity received by the grid or bidding zones was renewable or power purchase agreements with operators producing renewable electricity for an amount at least equivalent to the amount claimed as fully renewable;
- the risk of grid congestion between the industrial facility producing electrofuels, renewable hydrogen or renewable fuels of non-biological origin and the installation generating renewable electricity is avoided;
- from 1 January 2027, for power purchase agreements, the operator shall provide evidence that:
    - the installation generating renewable electricity came into operation not earlier than 36 months before the facility producing electrofuels, renewable hydrogen or renewable

fuels of non-biological origin came into operation;

- if additional production capacity is added to an existing industrial facility producing electrofuels, renewable hydrogen or renewable fuels of non-biological origin, the added capacity shall be considered to have come into operation simultaneously with the initial installation, as long as the capacity is added at the same site and no later than 36 months after the initial facility came into operation.

5. 2. 3. The operator shall demonstrate that the production of renewable electricity occurs during the same calendar month as the consumption of electricity by the industrial facility producing electrofuels, renewable hydrogen or renewable fuels of non-biological origin, or that renewable electricity that has been locally stored for a longer time period is used.

The following information shall be documented monthly for renewable electricity production as well as electrofuels, renewable hydrogen or renewable fuels of non-biological origin:

- The amount of renewable electricity used to produce electrofuels, renewable hydrogen or renewable fuels of non-biological origin, being distinguished the amount of electricity sourced from the grid and/or direct connection as well as the amount of electricity sourced from the grid that does not count as fully renewable

  Note that non-renewable electricity shall not contribute to the production of RSB certified electrofuels, renewable hydrogen and renewable fuels of non-biological origin, as per 5.2.1 ;
- The amount of renewable electricity generated by the installations generating renewable electricity;
- The amount of renewable electricity stored in local assets and used to produce electrofuels, renewable hydrogen or renewable fuels of non-biological origin;

The amounts of produced renewable and non-renewable electrofuels, hydrogen and fuels of non-biological origin.

5. 2. 4. Operators shall demonstrate that the risk of double booking of the renewable electricity is avoided.

- In the European Union, Guarantees of Origin (GoOs)[9] shall be provided for the total electricity consumption of the fuel production. Other regions shall use a similar approach, such as Renewable Energy Certificates (REC and I-REC)[10].

Please note: whenever possible, the operator should purchase renewable energy certificates from the same renewable energy plant to which the PPA is linked.

5. 2. 5. The operator shall demonstrate that areas identified as "no-go areas" or areas that contain identified conservation values, according to the RSB Principle 7, were not used for the production of renewable electricity after the 1st of January 2008.

5. 3. Specific requirements on feedstocks for renewable hydrogen production:

5. 3. 1. The operator shall demonstrate that renewable hydrogen production via electrolysis is in compliance with the RSB Principles and Criteria.

5. 3. 2. Whenever desalination plants are used for water obtention, the operator must comply with renewable electricity requirements described in section 5.2 and RSB Principle 11 on waste management.

5. 3. 3. Whenever renewable hydrogen is obtained from renewable fuel reforming, such as biomethane or ethanol, the entire supply chain for biofuel production shall be certified by RSB or equivalent, as approved by the RSB Board of Directors following a consultation with the RSB Membership

5. 4. The operator shall provide evidence on the following requirements for compliance with Principle 3 on greenhouse gas emissions:

[9] Guarantees of Origin is a type of certificate to provide information to a costumer on electricity produced from a renewable source. More information can be found in Article 19 of Directive (EU) 2018/2001.

[10] Renewable Energy Certificates (REC) are a type of certificate that demonstrates the environmental attributes of producing one megawatt hour (MWh) of energy from renewable sources. More information can be found at The International REC Standard website.

5. 4. 1. Lifecycle greenhouse gas emissions of electrofuels, renewable hydrogen or renewable fuels of non-biological origin shall be calculated following the RSB GHG methodology or the EU RED calculation methodology and shall be minimum 70% lower than the fossil fuel comparator.

5. 4. 2. The following emission sources shall be considered in the greenhouse gas emission calculation:

- emissions from the production of the electricity,
- emissions from water capturing and processing (e.g., desalination, deionization) used in the electrolysis processes,
- emissions from the production of the fuel,
- emissions from compression of the gas,
- emissions from transport from the production of the fuel up to the fuel station/final distributor (including grid losses) and,
- emission from the combustion of the fuel in use.

For all electrofuels, renewable hydrogen or renewable fuels of non-biological origin, the total emissions from the fossil fuel comparator shall be 94 gCO_{2eq}/MJ.

Emissions associated with the electricity and heat and consumable materials used in the capture process of CO2 shall also be included in the calculation of emissions.

Emissions from processing shall include direct atmospheric emissions from the processing itself, from waste treatment and leakages.

Please note: The emissions from the construction and decommissioning and waste management of electricity producing facilities are not considered. The carbon equivalent emissions associated with the renewable electricity (wind, solar, hydro and geothermal) production are considered to be equal to zero.

5. 4. 3. The operator using non-biogenic carbon sources shall provide evidence that the carbon would ultimately be emitted into the atmosphere as local CO_2 emissions or other greenhouse gases in the absence of the utilisation.

If the evidence is provided, the following greenhouse gas emissions shall be considered**:**

- emissions resulting from capturing or collecting the end-of-life products, or production residues,
- emissions resulting from the processing into fuel,
- emissions from transport from the point of capture/collection to fuel station/final distributor.

If the evidence is not provided, all emissions above as well as emissions from combustion/use of the fuel shall be considered.

Please note: Capturing of emissions from non-sustainable sources should only be considered as avoiding emissions until 2035.

H. Annex I: List of materials for advanced fuel production

This list may be amended by the RSB Board of Directors following a consultation with the RSB Membership.

Category 1: End-of-life-products of biogenic origin

1) End-of-life-products
   - Biogenic fraction of municipal solid waste (BMSW)
   - Biogenic fraction of end-of-life tyres
   - Used cooking oil
   - Wastewater
   - Woody material from trees that are removed from orchards (e.g. mango trees) or plantations dominated by agricultural species (e.g. palm) as part of re-planting when old trees are replaced by new trees
     Please note: Woody material from short rotation woody crops is not included in this definition
2) Animal excrement and run-offs from farms
   - Liquid manure
   - Manure and manure streams
   - Silage effluent and similar run-offs from farms with animal husbandry
3) Biogenic CO_2 and precursors contained in waste gas

Category 2: Production residues of biogenic or non-biogenic origin

1) Agricultural residues
   - Harvesting residues: Straw, husks, cobs, leaves and stems
   - Processing residues: Bagasse, nutshells, bran, gums, soap stocks, pomace and palm kernel shells (PKS)
   - Spoiled or contaminated grain or other commodities that no longer meet quality specification for food or other intended uses
2) Forestry harvesting residues
   - Tops, limbs (branches) and saplings (trees with a diameter at a breast height below 5 inches/12.7 cm [11])
3) Forestry industry processing residues
   - Sawdust, shavings, bark, tall oil, tall oil pitch, and black and brown liquor
4) Animal fats, oils and other animal processing by-products
5) Production Residues from industrial processes (of biogenic or non-biogenic origin)
   - Fatty acids from distillation (volatiles, bottoms, deodorized fraction and other fractions)
   - Fatty alcohols from light ends, distillation residues or ester residues
   - Recovered fats and oils from pipeline flushing or fat trap/residues
   - Inedible oil from corn ethanol production

[11] Based on US Dept of Agriculture and Energy.

- Fats, oils and grease (FOG) separated from wastewater treatment; or FOG diverted upstream of wastewater collection
- Vegetable acid oils from physical refining, chemical neutralisation or other residues
- Lipids from food wastes
- Production residues from chemical production processes other than petroleum refining processes
- Biogenic CO_2 and precursors from fermentation processes
- Biogenic CO_2 and precursors from gasification processes
- Exhausted sugarcane molasses
- Vinasse
- Filter cake

6) Fish residues
7) Crude glycerin from processing
    - Waste animal fats
    - Waste oils
    - Vegetable oils

Category 3: End-of-life products of non-biogenic origin

- CO_2 and precursors contained in waste gas
- End-of-life tyres of non-biogenic origin
- Non-biogenic fraction of municipal solid waste
- Waste plastics (e.g. polyethylene, polypropylene)
- Used solvents
- Off-spec material from production processes that would otherwise be landfilled or incinerated
- Other end-of-life products of fossil origin

Category 4: Natural carbon sources

- CO_2 captured from the atmosphere
- Geological sources of CO_2 previously released naturally

I. Annex II: List of eligible electrofuels and renewable fuels of non-biological origin

- Hydrogen
- Synthesis gas
- Synthetic liquid fuels

J. Annex III: Determination of Economic Value Ratio for determination of production residues

The Economic Value Ratio (EVR) of residues is calculated as the relative value of the residue compared to the primary product(s), co-products and other by-products generated from the same production process. The market value of a given residue and the primary product (as listed on a stock exchange or other aggregate market source), is used in combination with the quantity used for advanced fuels relative to how much of that same product is used for other purposes. This indicates the economic influence between advanced fuels production and feedstock production. The value U should be sought at the national/regional level or for each supplier of the by-product, whichever is the highest. Wherever possible, market value data shall be obtained from the same market and for the same calculation period. The calculation period shall not exceed five years and weighted average values shall be used for the calculation. During the calculation period, the EVR may exceed 5% as long as it is equal or less than 5% for the total calculation period. The calculation shall be performed as follows:

$$economic\ value\ ratio\ = \left(\frac{M_1 - C_1}{M1 + M_2 + M_3 + \cdots + M_n}\right) \times F_1 \times U_1 \qquad (1)$$

Where:

- M_1 is the market value of the residue (in USD[12]/metric ton)
- C_1 is the additional processing costs occurring at the point of origin related to M_1 after its production (e.g. costs of baling straw, transport, etc.)
- $M_2, M_3, \ldots M_n$ is the market value of other product(s), incl. primary product, co-products and other by-products (in USD[13]/metric ton)
- F_1 is the fraction of the by-product on primary product, co-products and other by-products out of the original raw material (in % by mass or volume)
- U_1 is the fraction of the residue utilised for advanced fuel production on other usages (in % by mass or volume) to be calculated as maximum consumption fraction that is intended to be used for this purpose
- *n* is the total number of products, incl. primary product, co-products and by-products from the original raw material.

Example:

The crop X produces 1 primary product (A) and 2 co-products (B)(C). For each ton of crop, 580kg of (A), 300kg of (B) and 100kg of (C) are obtained. Their respective market values are USD 15/MT, USD 8/MT and USD 2/MT (after covering additional production costs). Out of the second residue (C), 60% is sold to a feed producer and 40% to a biofuel producer.

The EVR is calculated as:

$$economic\ value\ ratio\ = \left(\frac{2}{15+8+2}\right) \times \left(\frac{100}{580+300+100}\right) \times 0.4 = 0.0033 \qquad (2)$$

The EVR is therefore of 0.33%. This residue qualifies under this standard.

[12] Or applicable currency. The same currency must be used consistently in all calculations.
[13] Or applicable currency. The same currency must be used consistently in all calculations.

K. Annex IV: Optional flexible attribution methodology: attributing the eligible (biogenic and non-biogenic) portion(s) in the output products

Step 1) Identifying the total mass of eligible carbon at the output of the industrial process

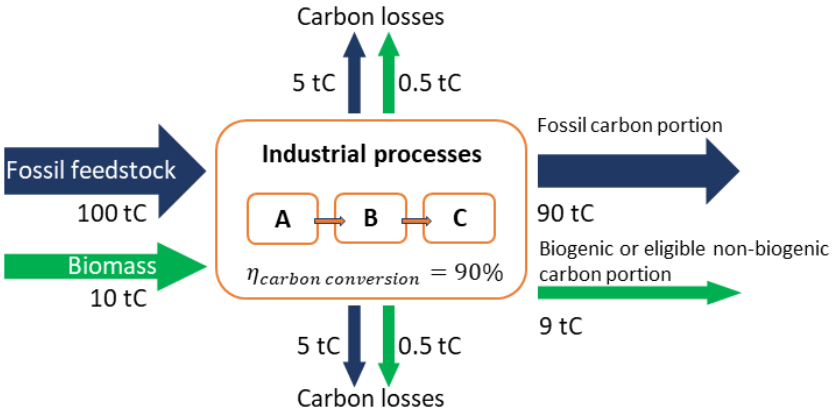
The share of biogenic or eligible non-biogenic products exiting the production unit defines the maximum amount (mass) of product that is eligible as advanced fuel. The following equation shall be applied to identify the maximum availability of bio-based or eligible non-biogenic carbon exiting the production unit:

$$Output_{eligible\ carbon}[t\ C] = m_{eligible\ f}\ [t_{db}] \times\ Carbon\ content_{eligible\ f}\ (\%) \times\ \eta C_i \qquad (1)$$

Where,

- $Output_{eligible\ carbon}$ is the mass of biogenic carbon or eligible non-biogenic carbon exiting the industrial process; given in *t* of C.
- $m_{eligible\ f}$ is the mass of biogenic or eligible non-biogenic feedstock entering the industrial process; given in *t* (dry basis).
- $Carbon\ content_{eligible\ f}$ is the carbon content (%; w/w) of the biogenic or eligible non-biogenic feedstock entering the industrial process.
- ηC_i is the carbon conversion efficiency, i.e., the percentage of carbon in the input ***i*** attached to the final product(s) (%; w/w). The remaining carbon, here called carbon losses, is related to the carbon bonded in the residues (liquid, gaseous, solid) that leave the processes.

For instance, each 10t of biogenic or eligible non-biogenic carbon entering the process produces 9t of within carbon-content outputs, which gives a 90% carbon conversion.



Note 1: The operator shall use the annual average value for the carbon conversion efficiency.

Step 2) Identifying the total supply of advanced fuel

Once the final portion of carbon is identified, the total supply (TS) of advanced fuel is then given by:

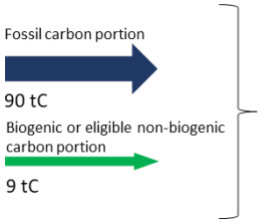
$$TS_{adv.fuel}[t_{adv.fuel\ (db)}] = Output_{eligible\ carbon}[t\ C]\ \times\ Output_{Carbon\ content}\left[\frac{t_{adv.fuel(db)}}{tC}\right] \quad (2)$$

Where,

- $Output_{eligible\ carbon}$ is from equation [1].
- $Output_{Carbon\ content}$ is the carbon content of the advanced fuel; given in *t* of advanced fuel (dry basis) per *t* of carbon content in the advanced fuel.

Note 2: The operator shall use the annual average value for the output carbon content.

Continuing the example above, a carbon content for jet fuel of 0.88 tC/t fuel and 9 t of available eligible biogenic or non-biogenic carbon would lead to 10.2 t of fuel eligible as advanced fuel.



$$9\ [t\ C] \times \frac{1\ [t_{adv.fuel(db)}]}{0.88\ [tC]} = 10.2\ t_{adv.fuel\ (db)}$$

Note 3: whenever the operator intends to attribute the biogenic or eligible non-biogenic feedstock portion to more than one product, operator shall define the portion of $Output_{eligible\ carbon}$ attributed to each product.

Note 4: The use of renewable inorganic chemicals may also be considered in the flexible attribution approach.

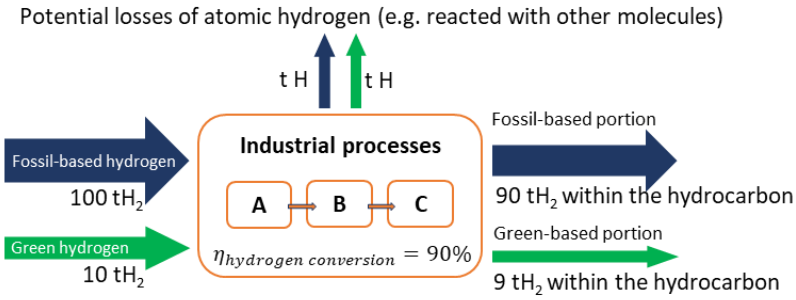
Renewable inorganic chemicals are defined as components that are not carbon-based, produced from renewable source of energy such as wind, solar, and biomass. Examples of renewable inorganic chemicals are green hydrogen and green ammonia produced from Power-to-X technologies.

In this approach, the portion of the renewable inorganic chemical can be attributed to a specific product, or products, by using the same approach, as indicated above, to estimate the maximum supply of advanced fuel, that is, mass of fuel containing the renewable inorganic chemical portion. The equation below uses the hydrogen as example:

$$TS_{adv.fuel}[t_{adv.fuel\ (db)}] = Input_{H_2}[t\ H_2 in]\ \times\ \frac{1}{Output_{H_2\ content}}\left[\frac{t_{adv.fuel(db)}}{tH_2 out}\right] \times \eta H_2 \left[\frac{tH_{2out}}{tH_2 in}\right] \quad (3)$$

Where,

- $Input_{H_2}$ is the mass of hydrogen entering the process; given in *t* of H_2.
- $Output_{H_2\ content}$ is the mass of hydrogen bonded in the advanced fuel, given in *t* of H_2, per *t* of advanced fuel (dry basis).
- ηH_2 is the hydrogen conversion efficiency, i.e., the percentage of hydrogen in the input attached to the final product(s) (%; w/w). The remaining hydrogen is related to the hydrogen bonded in the residues (liquid, gaseous, solid) that leave the processes.



Step 3) Identifying the life-cycle GHG emissions

At the well-to-gate boundary

Once the maximum amount of product with biogenic content and eligible non-biogenic content is defined, the life-cycle GHG emissions for a given advanced fuel shall be calculated as follows:

$$WtG_{adv.fuel}\left[\frac{tCO_2eq}{t_{adv.fuel(db)}}\right] = \left(\left(WtG_{eligible\ f}\left[\frac{tCO_2eq}{t_{db}}\right] \times m_{eligible\ f}\ [t_{db}]\right) + \left(WtG_{inputs}[tCO_2eq]\ \times AF[\%]\right)\right) \times \left(\frac{1}{TS_{adv.fuel}[t_{adv.fuel(db)}]}\right) \quad (4)$$

Where,

- $WtG_{eligible\ f}$ is the well-to-gate life-cycle GHG emission related to the production and transportation of the eligible feedstock; given in *t* CO_{2eq} per *t* (dry basis) of eligible feedstock. Gate here refers to the entrance gate of the industrial unit.

Note 5: for production residues and end-of-life products, the GHG emissions are set as zero at the point of origin. In this case, $WtG_{in_{eligible\ f}}$ shall only include emissions related to the transportation of the eligible feedstock from the point of origin to the processing unit, and

emissions from any further processing required to get the residue/waste into its usable form, which can sometimes occur at the point of origin.

- $m_{eligible\ f}$ is the mass of eligible feedstock entering the industrial process; given in *t* of dry basis.
- WtG_{inputs} is the well-to-gate GHG emission related to the production and transportation of all inputs, excluding the eligible feedstock; given in *t* CO_{2eq}. For instance, the GHG emissions related to the production of fossil fuels, chemicals, among other inputs used in the process.

Note 6: if inorganic renewable chemicals are used (e.g., equation 3), the WtG GHG emissions shall be included in the above WtG_{inputs} emissions.

- $TS_{adv.fuel}$, according to equation 2.
- *AF* is the allocation factor attributed to the advanced fuel portion calculated on an energy-basis as follow:

$$AF\ [\%] = \frac{LHV_{af}\ \left[\frac{MJ}{tfuel}\right]}{Total\ energy\ output\ [MJ]} \quad (5)$$

Where,

- LHV_{af} is the lower heating value for the advanced fuel; given in *MJ* per *t* of fuel (dry basis).
- $Total\ energy\ output$ is the sum of the energy output of all products based on the LHV. The LHV value of the fossil-based share of the output products shall reflect an adequate average for all fossil-based products. When available, the weighted average based on the amount of each type of output product is recommended.

Note 7: Allocation of the GHG emissions among the outputs shall be performed on an energy basis.

At the gate-to-gate boundary

The following step is to calculate the GHG emissions at the industrial unit, the so-called gate-to-gate emissions. The following equation shall be applied:

$$GtG_{adv.fuel}\left[\frac{tCO_2eq}{t_{adv.fuel_{(db)}}}\right] = (GtG_{total}[tCO2eq] \times AF\ [\%]) \times \frac{1}{TS_{adv.fuel}[t_{adv.fuel(db)}]} \quad (6)$$

Where,

- GtG_{total} is the total gate-to-gate life-cycle GHG emission related to the industrial unit; given in *t CO_{2eq}*.
- $TS_{adv.fuel}$, according to equation 2.
- AF, according to equation 5.

Final LCA: from well-to-gate

The total well-to-gate life cycle GHG emission from the production of the feedstocks to the exit gate is:

$$WtG_{adv.fuel_{total}}\left[\frac{tCO_2eq}{t_{adv.fuel(db)}}\right] = WtG_{adv.fuel}[equation\ 5] + GtG_{adv.fuel}[equation\ 6] \quad (7)$$

And in terms of energy, as follows:

$$WtG_{adv.fuel_{final}}\left[\frac{gCO_2eq}{MJ}\right] = \frac{WtG_{adv.fuel_{total}}\ [equation\ 7]}{LHV_{adv.fuel}\left[\frac{MJ}{kg_{adv.fuel\ (db)}}\right]} \times \frac{1}{1000} \quad (8)$$

Example: 1.1t of jet fuel will be sold with 100% bioattributed claim, while the remaining quantity of products will be sold with 0% bioattributed claim. Note that the amount of jet fuel sold with 100% flexible attributed claim is limited by the amount of biogenic carbon content in the biobased feedstock considering the efficiency in converting the feedstock into output (equations 1 and 2).

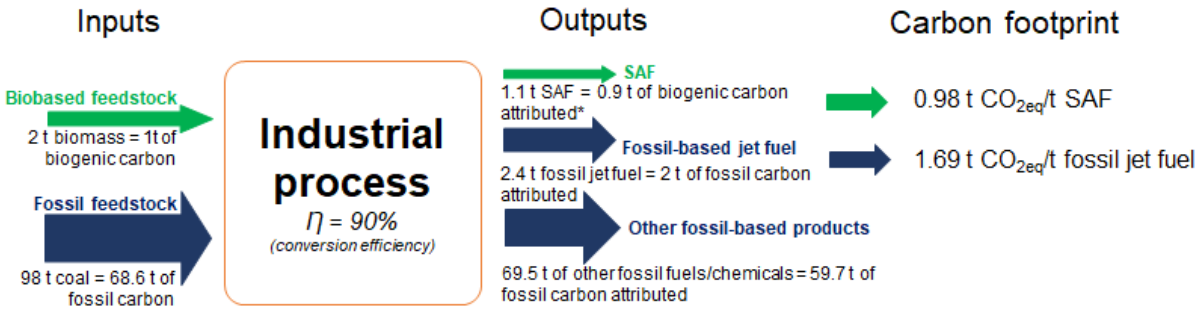


Figure 1. Example of flexible attribution (based on carbon mass balance) applying an energy-based GHG LCA allocation.

L. Quantification of exhausted sugarcane molasses eligible for RSB Certification

1) Definition of ratio between exhausted molasses and produced sugar

Molasses is a substance resulting from the processing of sugarcane into crystallised sugar (sucrose). It is not possible to produce sugar without also producing molasses. In other words, if there is sugar production, there will always be the production of exhausted molasses. The production of exhausted molasses is unavoidable. Consequently, there will always be a ratio (R) of exhausted molasses generated by each kilogramme of sugar produced, regardless of the number of industrial stages in the sugar production process, but always proportional to the amount of sugar produced.

$$R = \frac{Exhausted\ molasses\ (kg)}{produced\ sugar\ \ (kg)}$$

For the purpose of determining and validating the ratio (R) between exhausted molasses and sugar production, data from four major sugar and ethanol producing regions were analysed: Brazil, Australia, India, and South Africa. The ratio was also adjusted based on the minimum sugar concentration in exhausted molasses (49%), as well as the raw sugar polarisation of individual mills. Consequently, the ratio (R) ranges between 0.25 and 0.30, as presented in Table 1.

Table 1: Values for ratio (R) between exhausted molasses and produced sugar.

Mill sugar polarisation	Ratio (R)	Mill sugar polarisation	Ratio (R)	Mill sugar polarisation	Ratio (R)	Mill sugar polarisation	Ratio (R)
96.0	0.25	97.0	0.26	98.0	0.27	99.0	0.28
96.1	0.25	97.1	0.26	98.1	0.27	99.1	0.29
96.2	0.25	97.2	0.26	98.2	0.27	99.2	0.29
96.3	0.25	97.3	0.26	98.3	0.27	99.3	0.29
96.4	0.25	97.4	0.26	98.4	0.28	99.4	0.29
96.5	0.25	97.5	0.26	98.5	0.28	99.5	0.29
96.6	0.25	97.6	0.27	98.6	0.28	99.6	0.29
96.7	0.25	97.7	0.27	98.7	0.28	99.7	0.29
96.8	0.26	97.8	0.27	98.8	0.28	99.8	0.29
96.9	0.26	97.9	0.27	98.9	0.28	99.9	0.30
						100.0	0.30

2) Quantification of exhausted molasses

The total amount of exhausted molasses that is eligible for certification shall be determined by using the following equation:

$$Exhausted\ molasses\ (kg) = R\ \times produced\ sugar\ (kg)$$

Where R is defined according to the values provided in table 1.

M.Annex V: History of changes

Main changes from the previous version (RSB-STD-01-020 version 1.6 and RSB-POL-01-001 version 1.0)

a. This standard is the result of merging *RSB Policy for Certification of Biofuels based on End-of-life Products and Wastewater* (RSB-POL-01-001) and *RSB Standard for Certification of Biofuels based on By-products and Residues* (RSB-STD-01-020).
b. The added section C highlights the fact that EU Member States may set additional requirements regarding the origin of certain feedstock (e.g. used cooking oil). The RSB will provide specific guidance to Participating Operators for each Member State. The flowcharts in the annexes are updated accordingly. It also states that in case of contradiction between this standard and regulation, the latter shall prevail.
c. The term “main product” is replaced by “primary product”, which is the official term in use in the European Union. The definition of primary product is based on the EU definition.
d. Minor language revisions for consistency and an updated table of contents, numbering and other references.

Main changes from Version 1.6 to 1.7

a. Significant restructuring of the whole document with new sections “Terms and Definitions”, “General Requirements”, and “Feedstock-specific Requirements”.
b. Definitions for the terms “point of origin” and “first collector” were added.
c. RSB Standards to be applicable from the first collector onwards (before: after the last collector), including RSB Standards for Traceability, Participating Operators and Communication and Claims.
d. Specific requirements for traceability were added.
e. GHG calculation to start with the collection of the material at the point of origin (before: GHG calculation started at the site of the first collector).
f. Requirement to source Palm Fatty Acid Distillate (PFAD) and Palm Stearin sustainably was extended to all residues derived from palm oil.
g. Auditing requirements as set out in RSB Procedure for Certification Bodies and Auditors (RSB-PRO-70-001) are applicable.

Main changes from Version 1.7 to 2.0

a. The title, scope and language throughout the standard was changed (i.e. “advanced fuels and materials” instead of “biofuels”) to include waste-based fossil fuels used as feedstock and renewable liquid and gaseous fuels/materials of non-biological origin.
b. Definitions were updated.
c. Eligibility requirements were amended and clarified; case-by-case assessments for residues and by-products are now required.
d. A reporting requirement on indirect emissions was included.
e. Requirements for blending or co-processing fossil and biogenic fuels were included.

f. Requirements for blending or co-processing fossil fuels and advanced fuels were included.
g. Feedstock specific requirements for MSW were revised.
h. Feedstock specific requirements for agricultural residues were amended.
i. Feedstock specific requirements for biogenic CO_2 and precursors contained in flue gas were added.
j. Requirements for waste-based fossil pathways and renewable liquid and gaseous fuels of non-biological origin were added.
k. Annex I was amended.
l. Annex II (waste-based fossil fuels) and Annex III (renewable liquid and gaseous fuels of non-biological origin were added.
m. The Economic Value Ratio method was further clarified.

Main changes from Version 2.0 to 2.1

a. The term *by-products and residues* was changed to "*production residues"*.
b. Non-biogenic production residues have been added to the scope throughout the standard (in addition to non-biogenic end-of-life products in the previous version).
c. The term "*waste-based fossil fuels"* was changed to "*recycled carbon fuels".*
d. The reporting on displacement emissions is now voluntary.
e. Avoided incineration emissions are now also applicable for bio-based materials (in addition to fossil waste materials in the previous version).

Main changes from version 2.1 to version 2.2

a) C-grade molasses (reducing sugars content totalling 49% to 52%) was added to Annex I, category 2.
b) A feedstock specific requirement was added for c-grade molasses in section 3.6 that requires operators to demonstrate that the risk for displacement emissions is low.

Main changes from version 2.2 to version 2.3

a) The following was added to Annex I Category 1 (end-of-life products): *Woody material from trees that are removed from orchards (e.g. mango trees) or plantations dominated by agricultural species (e.g. palm) as part of the re-planting where old trees are replaced by new trees*
b) Feedstock specific requirements were added for the new feedstocks described in a)
c) *Palm Kernel Shells (PKS)* was added to the group of agricultural processing residues in Annex I Category 2

Main changes from version 2.3 to version 2.4

a) Definition of agricultural processing residues was added at F.7
b) Sustainability requirements for palm-based agricultural processing residues were added at 3.6
c) Section numbering corrected at Section 2.3