Innovation Fund (InnovFund)

Methodology for GHG Emission Avoidance Calculation

Innovation Fund Small Scale Projects
InnovFund-SSC-2020-single-stage

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HISTORY OF CHANGES		
Version	Publication date	Change
1.0	01.12.2020	Initial version.
2.0	16.02.2021	Updating the information on the EU ETS benchmarks to be used (those from 2011) (section 2); clarifications: reference emission factor for renewable cooling (table 1.1.), calculations for GHG emissions generally excluded (1.3.5.), scope in section 4.1.1.; correction of clerical errors in formulas in 3.3. and 4.2.1.2.

Methodology for calculation of GHG emission avoidance

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1 Introduction

The Innovation Fund (IF) supports projects in energy intensive industries, carbon capture and utilisation (CCU), carbon capture and storage (CCS), energy storage and renewable energy.

The methodologies for the calculation of the GHG emission avoidance are described in the following sections:

1) Energy intensive industries, including carbon capture and use, substitute products and biofuels
2) Carbon capture and storage
3) Renewable energy, including manufacturing plants for components
4) Energy storage, including manufacturing plants for components

Each section details the methodology to be used when:

1) applying for an Innovation Fund grant;
2) reporting performance for the purposes of disbursement of 60% of the grant that is linked to GHG emission avoidance; and
3) reporting performance for the purposes of knowledge-sharing[1].

1.1 Calculation of GHG emission avoidance compared to reference scenario

The calculations of GHG emission avoidance should comprehensively cover the impacts from the changes in inputs, processes, and outputs between the project and the reference scenario.

The reference scenarios should reflect the current state-of-the-art in the different sectors, as shown in Table 1.1 and Table 1.2.

Table 1.1 Reference Scenarios

Sector	GHG emissions are based in the reference scenario (among others) on:
Energy intensive industry	EU ETS benchmark(s) or fossil fuel comparators (FFCs) in some cases or proposed by applicant if the reference cannot be constructed by combination of benchmarks and/or FFCs
Energy intensive industry / Biofuels	Adapted fossil fuel comparators from REDII
CCS	CO_2 is not captured, but released/available in atmosphere
Renewable electricity	Expected 2030 electricity mix
Renewable heat	Natural gas boiler
Renewable cooling	Expected 2030 electricity mix
Electricity storage	Single-cycle natural gas turbine (peaking power)
Electricity grid services	Combined-cycle natural gas turbine (partial load)
Heat / Hydrogen storage	EU ETS benchmark for heat / hydrogen production
Energy storage in vehicles	Diesel-fuelled internal combustion engine

[1] These parameters will be reported through a dedicated knowledge-sharing report template once projects enter into operation. The detailed knowledge-sharing requirements are spelled out in the Model Grant Agreement, call text and knowledge-sharing reporting template.

Table 1.2 Emission factors for projects involving production, use and/or storage of grid electricity

Sector	Reference Scenario (Grid electricity substituted by net electricity export from the project / Discharging for energy storage)	Project scenario (Net grid electricity consumed / Charging for energy storage)
Energy intensive industry	Expected 2050 electricity grid mix	Expected 2050 electricity grid mix
CCS	[Not applicable]	2050 electricity grid mix
Renewable electricity	2030 electricity grid mix	2050 electricity grid mix
Renewable heat	[Not applicable]	Expected 2050 electricity grid mix
Energy storage	Single-cycle natural gas turbine (used for peaking power)	Expected 2050 electricity grid mix

1.2 Specification of a sector for the purpose of the GHG emission avoidance calculations

When submitting the application, the applicant needs to choose the sector under which the project falls (see Appendix M.1. for list of sectors). This choice will influence the points to be awarded for the first sub-criterion on the potential of absolute GHG emission avoidance (see call text for details).

The application may only be submitted for one sector. However, applicants may combine activities related to two or more eligibility categories (energy-intensive industry, CCS, RES, energy storage) to be referred to as **hybrid projects**. In this case, applicants would need to choose a main sector, which correspond to the principal product(s) they intend to produce. The application can also concern two or more sectors in one category.

In case that a project will **earn revenues from the sale of a single product** (e.g. steel, solar electricity), it will be straightforward to choose the according sector. Where a product will substitute another one of different composition (for example, ethanol to substitute gasoline in transport, rather than ethanol as a fine chemical), the relevant sector of the substituted product may be chosen (the refinery sector in this case).

In the case that a project will **earn revenues from the sale of several products**, the applicant should define the 'principal product(s)'. The principal product(s) should reflect the main aim and innovation of the project: is the project e.g. designed to principally save emissions in the steel industry, or to make alternative transport fuel (as a by-product of steelmaking)? The applicant will need to choose the sector to which the 'principal product(s)' belong and claim the absolute GHG emission avoidance from the project in this sector.

If multiple products are in the same sector (e.g. a CCU process may produce gasoline, diesel, kerosene and fuel oil), the applicant can consider all or some of them as the 'principal products'. The applicant can also choose only one 'principal product'. This choice of principal product(s) will influence the estimate of the project's *relative* GHG emission avoidance (see section 1.3.2).

The products that are not considered principal products should be listed under 'other products' in Application Form Part B.

<u>Example</u>

A steelworks proposes a project to modify its existing plant to produce ethanol as well as steel products. The ethanol will be sold as an alternative transport fuel for blending in gasoline for road transport.

The principal product could be chosen to be either steel or transport fuel. Either would be eligible for IF because they displace products made in the EU ETS, and because both the improvement of the carbon performance of the steel process and the production of ethanol are main aims of the project. It is not possible to consider both the steel and ethanol principal products, however, as they are in different sectors (iron and steel vs refinery). As the project makes a relatively minor change to the steel emissions, relative emissions savings are likely to be higher if transport fuel is claimed to be the principal product. However, the applicant may consider that there is less competition for IF funds in the steel sector.

Toluene is a minor by-product of the ethanol production. It could be added as a second principal product in the case that transport fuel is chosen as the principal product, as both are in the refinery sector. However, it would be artificial and disallowed to propose that toluene is the only principal product.

Projects may aim also to sell the products in a market where they would displace a different product than the conventional use of the product, for example hydrogen that is used for heating rather than in a refinery. The reference emission factor will then be determined by the intended use, i.e. by the emission factor for the product that is being replaced. The sector of choice would however still be the sector where the main innovation takes place. In such cases, applicants will have to prove the intention with draft contracts or letters of intent from the buyers. Copies of contracts will have to be submitted once the project has entered into operation to ensure the intended emissions saved during the use phase are indeed taking place.

The concept of "functions" is added, because some new products may not be identical to existing ones, but provide the same functions. Thus, for example, if a new process produces a stronger plastic that enables bottles to be made twice as thin, the throughput of the reference plastic-producing process must be double that in the project scenario.

1.3 GHG emission avoidance calculation

The GHG emission avoidance represents the difference between the emissions that would occur in a reference scenario, in the absence of the proposed project, and the emissions from the project activity over a defined period.

For the purpose of the Innovation Fund, the GHG emission avoidance criteria will be composed by two criterion: absolute GHG emission avoidance, and the relative emission avoidance.

1.3.1 *Absolute* GHG emission avoidance

The **absolute GHG emission avoidance** shall be calculated based on the expected emissions avoided in each year from entry into operation over a 10 years' period, using the equation below.

$$\Delta \mathrm{GHG}_{\mathrm{abs}} = \sum_{y=1}^{10} (\mathrm{Ref}_y - \mathrm{Proj}_y) \qquad [1.1]$$

Where:

$\Delta \mathrm{GHG}_{\mathrm{abs}}$ = Net absolute GHG emissions avoided thanks to operation of the project during the first 10 years of operation, in tCO_2e.

Ref_y = GHG emissions that would occur in the absence of the project in year y, in tCO_2e.
Proj_y = GHG emissions associated with the project activity and site in year y, in tCO_2e.

1.3.2 Relative GHG emission avoidance

The **relative GHG emission avoidance** potential shall be calculated by dividing the absolute emission avoidance ($\Delta\mathrm{GHG}_{\mathrm{abs}}$) by the reference emissions (Ref_y), i.e. the GHG emissions that would occur in the absence of the project over a 10 years period.

$$\Delta\mathrm{GHG}_{\mathrm{rel}} = \frac{\Delta\mathrm{GHG}_{\mathrm{abs}}}{\sum_{y=1}^{10}(\mathrm{Ref}_y)} \qquad [1.2]$$

Where:

$\Delta\mathrm{GHG}_{\mathrm{rel}}$ = Relative GHG emissions avoided due to operation of the project during the first 10 years of operation, in percent.

Ref_y For energy storage, carbon capture and storage, renewable energy and industrial projects where there are no products other than the "principal product(s)" = GHG emissions in the reference case in year *y* (t CO_2/yr)
For industrial projects with multiple products = the part of the GHG emissions in the reference case in year *y* (t CO_2/yr) that are attributed to the chosen "principal product(s)".

In **case that the project operates for less than 10 years**, operational data will be set to zero for those years in which the project does not operate. As such, both $\Delta\mathrm{GHG}_{\mathrm{rel}}$ and $\Delta\mathrm{GHG}_{\mathrm{abs}}$ shall reflect the reduced period. When forecasting operational data, applicants may also consider an **expected ramping up period**, i.e. reduced performance over the first years due to necessary stops and starts of the production for technical adjustments. All the above considerations should be duly explained and justified in the description of the calculations.

Hybrid projects shall calculate the absolute GHG emission avoidance and the project emissions according to the individual methodologies and add these up while removing double counting of avoidance and/or emissions, if any. In such cases, the relative GHG emission avoidance shall be calculated based on the cumulated emission avoidance and the cumulated reference emissions.

Any project including intermittent use and/or generation of electricity at times when there is an excess of renewables in the grid-mix (e.g. smart grid applications) will need to resolve the demand profile into a continuous component plus a virtual storage activity as explained in the section on energy-intensive industries (see Section 2.2.2.6), in order to make sure the proper emission factors are applied to its electricity demand, generation and storage.

1.3.3 Greenhouse gases considered

The greenhouses gases that must be taken into account in emissions calculations shall be at least those listed in the EU Emissions Trading System (EU ETS) Directive 2003/87/EC, Annex II: carbon dioxide (CO_2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF6). The Global Warming Potentials (GWP) to be used are those in the Annex to Commission Delegated Regulation supplementing Regulation (EU) 2018/1999 of the European Parliament and of the Council with regard to values for global warming potentials and the inventory guidelines and with regard to the Union inventory system and repealing Commission Delegated Regulation (EU) No 666/2014[2].

1.3.4 Greenhouse gas emissions covered

The methodology was structured with the intention of capturing the most common and/or representative emission sources in the eligible sectors.

[2] https://eur-lex.europa.eu/legal-content/en/TXT/HTML/?uri=CELEX:32020R1044

This means that applicants are able to assess projects that aim at avoiding GHG emissions in the use and end-of-life phase of products, as well as those that intend to avoid emissions by replacing process inputs such as biomass, biofuels, intermediate products and by-products of other processes, wastes, as well as feedstocks or process chemicals that are outside the scope of the EU Emissions Trading System.

For instance, for projects involving the production of low-carbon products, GHG emission avoidance will also take into account emissions from inputs also from outside EU ETS boundaries and end-of-life emissions. However, emissions for fossil fuel refining, extraction and transport have been disregarded from the methodology, for consistency with EU ETS (see also next sub-section).

1.3.5 GHG emissions generally excluded

Generally, the following emissions are excluded for all projects unless specified otherwise:

- Emissions from capital goods (i.e. manufacture of machinery and equipment).
- Emissions due to the extraction, processing, transportation and storage of fossil fuel are also excluded inasmuch as they contribute to the emissions attributed to material inputs to IF projects.[3]
- Fugitive CO_2 and CH_4 emissions due to well testing and well bleeding in geothermal power plants.
- Combustion emissions for biomass, biogas, biomethane, biofuels and bioliquids.
- Biogenic CO_2 combustion emissions for biomass fuels. But emissions of non-CO_2 greenhouse gases (CH_4 and N_2O) from the fuel in use shall be included.
- Decomposition or degradation CO_2 emissions at end of life for biomass, biogas, biomethane, biofuels and bioliquids. GHGs emissions other than CO_2 emissions must be taken into account.
- Other emissions of biogenic CO_2 resulting from chemical processes (e.g. fermentation CO_2 emissions). GHGs emissions other than CO_2 emissions must be taken into account.
- Indirect land use change emissions from supply of crops, and consideration of carbon debt in forestry.
- Decommissioning of the power plant and machinery at the End-of-Life (EoL).
- Emissions related to employee commuting, business travels and waste generation at the administrative offices.
- Emissions due to the manufacturing process in the case of manufacturing plants for components for renewable energy and energy storage.
- Should there be substantial GHG emissions savings from emission sources that are excluded from the project boundaries, actions may provide a **separate calculation of these potential emission savings**, which will be considered under degree of innovation. These **shall not be added** to the calculation of Absolute and Relative GHG Emissions Avoidance.

1.4 Monitoring, reporting and verification of performance for disbursement and knowledge-sharing

During operation, beneficiaries will have to demonstrate GHG emission avoidance following the same assumptions that were made during the application for funding. Further requirements are introduced for the purpose of knowledge-sharing (KS), which will allow reporting on the actual emissions avoided during operation.

In general beneficiaries shall obtain, record, compile, analyse and document monitoring data, including assumptions, references, activity data and calculation factors in a

[3] This allows aligning with the methodology for calculating the EU ETS benchmarks, which considers only combustion emissions.

transparent manner that enables the checking of performance achieved during the operation of the project. Beneficiaries shall ensure that the operational data determination is neither systematically nor knowingly inaccurate. They shall identify and reduce any source of inaccuracies as far as possible. They shall exercise due diligence to ensure that the calculation and measurement of emissions exhibit the highest achievable accuracy. Reported activity data shall be free from material misstatement as defined in Article 3(6) of Commission Implementing Regulation (EU) 2018/2067[4] and avoid bias in the selection of assumptions. In selecting a monitoring methodology, the improvements from greater accuracy shall be balanced against additional costs.

The general conditions on monitoring, reporting and verification (MRV) of performance, disbursement of the grant and knowledge-sharing are described in the call text. The respective sub-sections on MRV and KS therefore provides detail on the specific requirements for reporting for the purposes of disbursement and for knowledge sharing for the different categories.

[4] Commission Implementing Regulation (EU) 2018/2067 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council (Text with EEA relevance)

2 Energy intensive industry (EII), including CCU, substitute products and biofuels

2.1 Scope

This section deals with the approach to estimate GHG emission avoidance in projects, including CCU projects and substitute products falling in the energy-intensive industry activities covered by Annex I of the EU ETS Directive. Processes based on biomass feedstocks are also include here such as innovative processing of various types of biomass to biofuel or innovative production of other bio-based products in bio-refineries.

> The objective of this methodology is very different from the emission-saving methodology the Commission will propose for Renewable Fuels of Non-Biological Origin and Recycled Carbon fuels in RED2. The IF seeks to assess future emissions savings from innovations that are needed to reach climate goals in 2050, whereas the REDII estimates the "well-to-tank" emissions for fuels produced under current conditions, including current emissions attached to electricity consumption.

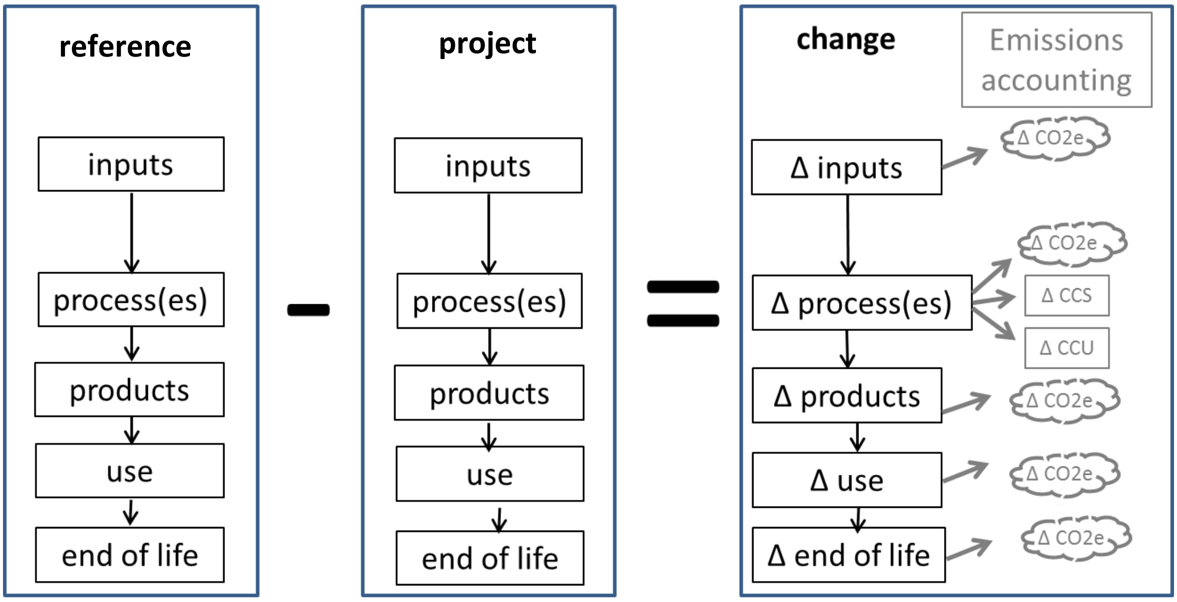
2.2 GHG emission avoidance

The life-cycle emissions from a project applying for the IF are evaluated by comparing a scenario including the proposed project, with a reference scenario without the project, as illustrated in Figure 2.1. The reference scenario provides the same products or functions as the project scenario.

Each applicant will submit a block diagram based on Figure 2.1, with the boxes filled with the main items of relevance: inputs, processes, products, use and end-of-life differences (if necessary, the individual boxes may be expanded onto separate pages).

The **absolute emissions** avoided by the project are those of the reference scenario minus those of the project scenario (cf. section 1.3.1). The **relative emissions avoidance** is then calculated by dividing the absolute emissions avoided by the GHG emissions reported for the reference scenario (cf. section 1.3.2).

Figure 2.1 Schematic of GHG emission avoidance related to IF projects



The reference scenario includes the alternative process(es) that provide the same or equivalent function(s) as the project's principal product(s) in the absence of the project. An "**equivalent function**" is usually the same quantity of an identical product(s) made in the conventional way. However, if the new product does not have an identical equivalent, or is to be utilised to fulfil a specific function conventionally delivered in another way, it would be the conventional product(s) that would fulfil the same function.

Emissions sources and sinks should be divided into five "boxes" as shown in Figure 2.1, corresponding to "inputs", "process(es)", "products", "use" and "end of life". The absolute change in emissions attributed to the project, ΔGHG_{abs} is the sum of the change in its component parts over 10 years of time, each of which may be positive or negative:

$$\Delta GHG_{abs} = \sum_{y=1}^{10} (\Delta E_{inputs} + \Delta E_{processes} + \Delta E_{products} + \Delta E_{use} + \Delta E_{EoL}) \quad [2]$$

In most cases, several of these components will be identical for the project and reference scenarios, and so their change in emissions can be simply set to zero when calculating the absolute emission avoidance. All emissions in the reference scenario must however be considered when assessing the relative emissions avoidance.

In some cases, the applicant may have to choose which emission box to include a given emissions source or sink within. For example, an applicant may have a choice to either expand the system boundary to include the production of a utilised material within the "process(es)" box or to treat that material as a major "input".

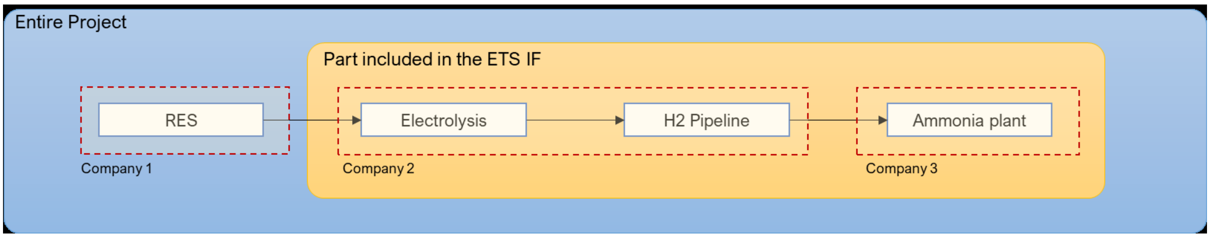
2.2.1 $E_{process(es)}$

First, the applicant identifies the principal product(s) or functions from the project. To be eligible for one of the energy intensive industry sectors, the principal products must be, or must substitute, a product whose conventional production is covered by EU ETS. Substituting a product may include substituting the **function** of a product. In such a case, it may not be necessary for the principal products to match exactly between the project and reference scenarios providing the functions delivered are matched.

<u>Example</u>

A project that includes hydrogen fuelling a fuel-cell car substitutes the transport function of conventional cars running on fossil fuel. So the reference scenario for substituted function is the consumption of the fossil fuel required for a comparable conventional car to transport the same load an equal distance. The applicant must convincingly establish that the hydrogen would indeed be used for fuel cell cars through letters of intent at application and copies of supply contracts from entry into operation (otherwise the project replaces generic hydrogen according to EU ETS benchmark).

<u>Another example:</u>



Companies 2 and 3 jointly submit a project to use additional renewable electricity to produce hydrogen for making ammonia, replacing hydrogen from an existing steam reformer in the ammonia plant. The principal product is ammonia (which falls under EU ETS), and the project can be defined as a modification to the ammonia plant, so the reference process may be taken to be the current ammonia production plant, provided that the process-emissions from new configuration of ammonia production (including the electrolysis plant), calculated using EU ETS rules, are lower than the EU ETS product benchmark for ammonia.

Alternatively, company 3 could propose the project alone. The reference scenario would be the same. The hydrogen coming out of the pipe from the electrolyser would now be treated as an input, but the result of the *emissions calculation would nevertheless come out the same as in the joint application.*

However, if company 2 applied alone, the principal product is "hydrogen delivered to that particular ammonia plant" and the plant counts as new hydrogen production rather than modified ammonia production, so the reference process would be made up of the generic EU ETS benchmark for hydrogen, plus emissions attributable to the pipeline delivery.

2.2.1.2 *Definition of the processes in the project and reference scenarios*

For the project scenario, the applicant must include in the "process(es)" box all the processes associated with production of the chosen principal product(s) or functions that are under the control of the applicant, and any installations controlled by third parties that have been added to the system boundary of the project. The boundaries of the process box coincide with EU ETS boundaries, so process box emissions do not generally include distribution or storage of the product, nor emissions from the supply of fuels and materials inputs; only the GHG emissions from the installations themselves.

Inputs from processes that are outside the control of the applicant and cannot be assessed within the system boundary of the project are to be dealt with in the "inputs" section. Differences between any other ("non-principal") products between the project and reference scenarios are dealt with in the "products" box (section 2.2.3).

For the reference scenario, the applicant must include in the "process(es)" box emissions from all processes associated with producing the same quantity of those principal products or meeting those same functions. Many or all of the processes in the reference scenario will be included within an EU ETS product benchmark or fossil fuel comparator (see below)~~,~~ and in that case need not be separately assessed by the applicant.

The applicant needs to show all the information that the evaluators need (a) to understand the project, and (b) to check the calculation of the change in process emissions for the project and reference scenarios. If the information does not fit in the boxes, a supplementary table or other appropriate format should be used.

Having identified processes for which emissions must be assessed in the two scenarios, the applicant should calculate the associated emissions following the current EU ETS methodology.

In the case of a project to **modify an existing plant**, the reference scenario may contain the unmodified process(es) (rather than the EU ETS benchmarks) **provided** that where modifications are made to at least one sub-process of a process corresponding to an EU ETS product benchmark, the total of emissions for that process is less than the EU ETS product benchmark emissions[5]. The objective is to allow improvements to current plants without "locking in" high-emissions plants that emit more than the EU ETS benchmark. This requirement is not relevant to cases where there is not a corresponding EU ETS product benchmark for at least one principal product of the project.

If a new plant is **substituting an existing plant**, the sum of GHG emissions associated with all installations and sub-installations within the new plant should be better than the respective EU ETS benchmarks.

For plants producing **novel transport fuels falling under the definition of biofuels, renewable fuels of non-biological origin (RFNBOs) or renewable carbon fuels (RCFs)** under REDII, the emissions for the equivalent quantity[6] of substituted conventional fuel shall be included in the "process(es)" box of the reference scenario using the "IF fossil

[5] Summed in both cases for the years of operation of the project.

[6] For fuels that are blended into fossil transport fuel or used as their direct replacements in existing unmodified vehicle engines, the equivalent quantity of the substituted fuel is that with an equal lower heating value (LHV; = net calorific value, NCV). For fuels (such as hydrogen) used in heavily modified vehicles, the equivalent quantity of substituted fuel is that which provides the same transport function (i.e. delivers the same kilometres x tonne of load), derived from v5 of the JEC-WTW report.

fuel comparator"[7] of the substituted fuel in table 2.1. For projects using a fossil fuel comparator as the reference scenario, the stoichiometric combustion emissions of the novel fuel must be included in the "process(es)" box of the project scenario[8]. This procedure also applies to projects producing synthetic crude oil where the upgrading of the synthetic crude into transport fuels will take place outside the project boundary. In the case of fuels used only in highly-modified vehicles, such as hydrogen for fuel cell cars, the applicant may take into account a change in vehicle efficiency based on typical vehicle efficiencies documented in JEC-WTW report v.5 (matching the **function** provided as detailed above). Such projects should include in the process(es) box emissions for the distribution of the novel (unblended) fuel to the vehicles if possible. Proposals considering improved vehicle efficiency in this way must show evidence, for example contracts from distributors, that the novel fuel is indeed destined to be used in transport. If the fuel or transport mode (e.g. maritime, aircraft) is not dealt with in JEC-WTW report v.5, the relative efficiency compared to fossil fuels in conventional vehicles is found from the literature hierarchy, section Appendix 2.3 of the methodology.

Table 2.1 "IF fossil fuel comparators" and the Lower Heating Values for fossil fuels displaced by IF projects producing RFNBOs or RCFs and biofuels.[9]

Substituted fossil transport fuel	IF fossil fuel comparator (gCO_2e/MJ)	LHV = NCV (MJ/kg)
Diesel	80.4	43.0
Gasoline	78.9	44.3
LPG	65.4	47.3
Aviation kerosene	78.3	44.1
Aviation gasoline	78.9	44.3
Marine fuel (including gas oil and fuel oil)	78.0	42.8
Synthetic crude	75.5	42.0

Similarly, for plants producing **natural gas substitute products** where the ultimate disposition of the substitute gas is unknown or may fall outside the energy-intensive industry activities covered by Annex I of the EU ETS Directive, the emissions in the "process(es)" box of the reference scenario shall be based upon the combustion emissions intensity of natural gas (**56.1 gCO_2e/MJ**). If the disposition of the natural gas substitute is known (e.g. power generation, transport or industrial use) then the reference scenario should reflect emissions associated with providing that equivalent function, which may be different from a natural gas combustion reference.

For **projects where the principal product replaces carbon-based fuels or chemicals not listed above** (e.g. methanol) and the ultimate disposition of the substitute fuel or chemical is unknown or may fall outside the energy-intensive industry activities covered by Annex I of the EU ETS Directive, it is allowable to take as a reference scenario an emission factor drawn from the hierarchy of data sources in Appendix 2.3 **provided that the emission factor is based on a process with natural gas as a feedstock**. If the emission factor drawn from the data hierarchy includes upstream emissions from fossil fuel supply then 15% should be subtracted from the value, as is the case for REDII input data. For the particular case of **methanol**, the suggested value to be used is **82.5 gCO2e/MJ[10].**

As for natural gas, if the disposition of the fuel substitute is known (e.g. power generation, transport or industrial use) then the reference scenario should reflect emissions associated

[7] The IF fossil fuel comparator differs from that in REDII because the IF methodology (in order to align with EU ETS) does not consider the emissions from extraction and transport of crude oil, nor the transport and distribution of the final fuel.

[8] This procedure corrects for any differences in combustion emissions expressed in gCO2/MJ fuel. As biomass-derived CO_2 is not counted as an emission, no combustion emissions are reported in the case of biofuels.

[9] These are not combustion emissions: they are not to be used as emissions factors for these fuels as inputs.

[10] Calculation based on the report "Definition of input data to assess GHG default emissions from biofuels in EU legislation."

with providing that equivalent function, which may be different from a fuel combustion reference.

For **new or modified plants** producing other products, the reference scenario shall be built as far as possible from sub-installations with product benchmarks defined in the applicable Benchmarking Decision at the time of the submission of the application[11].

When the boundaries of the processes in the project do not coincide with EU ETS product benchmark sub-installations, other EU ETS sub-installations may be added to the "process(es)" box in the reference scenario to balance the products. There are three types of other EU ETS sub-installations:

1. Heat benchmark sub-installations;
2. Fuel benchmark sub-installations;
3. Process GHG emissions sub-installations.

Heat benchmark sub-installations may be added to account for additional heat use required to produce an equivalent quantity of principal products in the reference scenario beyond the heat use covered by any EU ETS product benchmark sub-installations.

Fuel benchmark sub-installations may be added to account for additional fuel combustion to produce an equivalent quantity of principal products in the reference scenario beyond the fuel use covered by any EU ETS product benchmark sub-installations.

Process emissions sub-installations may be added to cover any emissions occurring in the reference scenario not covered by any EU ETS product benchmark sub-installations.

Electricity consumption is treated as having zero GHG emissions in the 'process(es)' box assessment and therefore any additional electricity consumption not covered by the EU ETS product benchmark sub-installations may be ignored.

For projects whose principal products cannot be entirely covered in the reference scenario by (combinations of) EU ETS product benchmarks and additional sub-installation emissions, the choice of another reference process needs to be convincingly justified. The applicant must propose an alternative process to deliver the same product or service and demonstrate that it is plausible that this would provide the same products or functions in the absence of the project. The evaluators will check the validity of the arguments for the selection. Applicants will not be permitted to select reference scenarios with artificially high emissions, when lower-emission alternatives would be more consistent with the ETS benchmarking process and may be more realistic.

The applicant must calculate the direct GHG emissions for the combination of processes in the project scenario using calculation methods specified in the Monitoring and Reporting Regulation (MRR)[12]. The derogations in Article 27a of the EU ETS Directive and Article 47 of the MRR relating to installations with low emissions are not relevant in the context of the Innovation Fund. The emissions of biogenic CO_2 from combustion of biofuels is not counted, which is consistent with the EU ETS and REDII Directives.

2.2.1.3 *Changes in emissions from waste processing*

Besides accounting for changes in emissions due to the use of wastes as an input, it is also necessary to account for emissions from the processing of wastes produced by a process. For example, an innovative process may eliminate a waste stream that requires energy-intensive treatment. These emissions are considered part of the process emissions step.

[11] 2011/278/EU: Commission Decision of 27 April 2011 determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council

[12] Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012 (Text with EEA relevance.)

2.2.1.4 *Emission avoidance from CO_2 capture and geological storage*

A project that substitutes an EU ETS product and also stores some or all of its own process emissions with CCS is still accounted in the Energy Intensive Industry Sector, but the emissions savings for the CCS part are calculated using the specific methodology for CCS projects, and are added to the savings from the rest of the project by inclusion in the process(es) box. Projects that should instead be submitted and assessed under the CCS methodology (or potentially as a hybrid project) include those where storage of CO_2 produced occurs outside the project boundary, direct air capture projects, and CCS attached to existing factories without changing their products.

2.2.1.5 *Emission avoidance from CO_2 capture and use (CCU)*

An emission reduction by CCU can only be claimed by **projects that make use of the captured carbon**, within the boundaries of the project, to make products or functions that replace products using fossil carbon. The CO_2 may be bought in from outside the project, but a project that does not include any additional use for captured CO_2 may not report an emission reduction because of CCU. The inclusion in the processes (box) of a credit for the incorporation into products of carbon that would otherwise be in the atmosphere entirely accounts for the emissions saving of CCU. No change in the combustion emissions of CCU fuels should be recorded in the use box. There is no difference in treatment between the incorporation of CO_2 captured from fossil sources and CO2 captured from biogenic sources such as a biomass power plant or ethanol plant.

Both CO_2 capture and use assessable within the process(es) box

It is expected that most CCU projects will be of this sort. If additional CO_2 that was either in the atmosphere or about to enter the atmosphere is both captured and incorporated in a product as a result of an IF project, the incorporated CO_2 is accounted as a reduction in emissions of the project (a credit in the "process(es)" box of the project scenario). Similarly, any CO_2 capture and use in the reference scenario must also be taken into account in deciding what CO_2 capture in the project is additional. The emissions attributed to the capturing process, plus any emissions from transporting the CO_2, are accounted as part of the overall process emissions. The incorporation of the CO_2 into a product may take place within the project boundary, in which case the emissions associated with that incorporation should be fully accounted in the process(es) box. The incorporation of CO_2 into a product may also take place at facility operated by a third party. For example, CO_2 could be captured at a cement plant operated by the applicant, and then supplied to a known partner for incorporation into a recycled carbon fuel product. In this second case, the applicant should provide evidence that the destination facility represents an **additional** utilisation of CO_2. No credit may be claimed if the CO_2 exported from the project is simply replacing an alternative source of CO_2. Where the incorporation of the CO_2 occurs at a facility outside the project boundary, the credit for that incorporation should either be claimed in one Innovation Fund application, or it may be split between the applications, but in any case the sum should not exceed the total incorporated CO_2.

Incorporation of imported CO_2

Other CCU projects may use CO_2 imported from a plant that is not under the control of the applicant. If the captured CO_2 is an **input** from **a known source** outside the project and its carbon content incorporated into the product(s) of the project, the carbon incorporated into the product(s) shall reduce the CO_2 emissions attributed to the product, but the emissions from the capture and transport of the CO_2 must be also included in the project emissions.

This results in essentially the same calculation for the capture and transport emissions as in section 3 on carbon capture and storage (without the emission involved in the storage).

If the CO_2 is bought off the industrial gas market (and therefore in liquid form) from a producer who does not provide data, the estimated emissions for the transport must be included by the project applicant.

Projects proposing only CO_2 capture but without any additional use of CO_2

Under present and medium-term market conditions, far more CO_2 is emitted, also in concentrated form, than is needed by industry. Therefore, an increase in the demand for industrial CO_2 leads to more CO_2 capture, but increasing CO_2 capture without increasing its usage merely displaces capture of CO_2 by another installation, with no overall avoidance of CO_2 emissions.

Therefore, projects proposing capture of CO_2 cannot subtract the amount of captured CO_2 from the calculated project emissions, unless the additional use of that CO_2 is also part of the calculation boundary[13].

Use of geological CO_2
If CO_2 is being released naturally to the atmosphere (e.g. in a geyser), but a project captures it and then incorporates it in a CCU product, then the avoided natural CO_2 emissions can be used to reduce the net emissions of the production process, which may end up negative as a result.

However, if the project provoked the release of the geological CO_2 which would otherwise have stayed underground (e.g. by drilling for geothermal steam from a reservoir where it is mixed with CO_2), then there are no avoided emissions, so it does not reduce the emissions of the production process.

Combustion/end-of-life emissions of CCU fuels/products
To avoid double counting, as the incorporation of captured CO_2 in a fuel (or other product) is already counted as reducing the emissions attributed to its production (and could make them negative), this does not influence (decrease) the combustion emissions attributed to the CCU fuel (or, for a non-fuel CCU product, its emissions in its use or end-of-life).

2.2.2 E_{inputs}

The applicant must specify the inputs that enter the boundary of the "processes" box of the project and reference scenarios. This may include both **energy and material inputs.**

Where the reference scenario is based on one or more EU ETS benchmarks, this includes any inputs with an associated emissions intensity that are not covered by EU ETS direct emissions calculations. This includes inputs that are residues or intermediate products of processes outside the control of the applicant, process chemicals not otherwise accounted for, and inputs of biomass, bioliquids and biofuels. The applicant may choose to bring the production of any input into the "process(es)" box and assess the emissions directly, provided that the applicant is able to cooperate with the producer of that input to make the necessary data available to do so.

Where the reference scenario is constructed from a combination of one or more EU ETS sub-installation benchmarks (product, heat, fuel, process) any **inputs** with production emissions that are not covered by EU ETS direct emissions calculations should be included here in the "inputs" box. Where use of inputs is not specified in the benchmarking documentation the applicant should use reasonable estimates of expected input use in an installation with emissions consistent with the benchmark. ΔE_{inputs} is the change in emissions arising from changes in the inputs to processes between the project and reference scenario.

As the objective of the Innovation Fund is to support future breakthrough technologies that will help EU reach climate neutrality in 2050, for the purposes of the GHG emission avoidance calculation, where electricity is fed from the grid to an energy intensive industries project, or where additional electricity is exported from the project to the grid, it should be assumed that the electricity sector is fully decarbonised, i.e. **the emission factor for the electricity consumed is zero** and there is no credit under the Energy Intensive Industries methodology for exporting excess electricity. If electricity exported from the project is renewable, the applicant may consider submitting a hybrid application

[13] It is essential that the CO2-use is integrated in the project boundary because almost always very considerable additional emissions are spent in transforming the CO2 into a useful product, and these emissions will disappear if the use of the CO2 is split off.

including a 'Renewable electricity and heat' element in order to receive credit for the electricity export.

For the reference scenario only, the applicant may choose to **simplify the calculation by ignoring the (positive) emissions of any number of inputs**. Note however that ignoring some inputs in the reference scenario would reduce the reportable absolute and relative GHG emissions reductions from the project. Any inputs from the reference scenario that the applicant chooses to ignore in this way may not be included when assessing other inputs as significant/de minimis (see below).

The **emissions for water provision** as an input may be neglected provided water provision does not involve desalination or additional pumping.

2.2.2.1 *Types of input*

Inputs are divided into three categories. The three categories of inputs are 'rigid', 'semi-elastic' and 'elastic'. Elastic inputs are in turn divided into two levels of materiality: 'de-minimis' and 'significant'. The category and level of materiality for an input affect the way that its associated emissions are to be assessed.

Rigid inputs are inputs for which overall availability is fixed, i.e. inputs for which production would not be expected to increase even if demand increases. Using rigid inputs is expected to result in displacement effects due to changes in current use or disposition of those inputs. *Elastic inputs* are inputs for which overall production is variable, i.e. inputs for which production would be expected to increase as demand increases. *Semi-elastic inputs* are inputs that fall between these cases.

De minimis inputs are inputs that make such a small contribution to the overall emissions of a project or reference that they may reasonably be ignored when assessing GHG emissions avoidance. All other inputs are considered significant.

These terms are explained in more detail below, along with rules for including these inputs in the GHG emissions avoidance calculations. The levels of materiality are relevant only to elastic inputs, as during the assessment process rigid inputs will be replaced in the calculations with associated quantities of elastic inputs (which may then be given a level of materiality) and/or with defined emissions from changed disposition which need not be further adjusted. This is further explained below.

2.2.2.2 *RIGID inputs*

As the GHG emission calculations take account of processes which divert materials from other uses, it is necessary to consider whether an input is "rigid".

If the input has a fixed supply, then it is considered "rigid": it can only be supplied to a new project by diverting it from another use or disposition. Its emissions intensity then considers the impact of diverting it from its existing use (rather than any emissions associated with the generation of the rigid input). The emissions intensity may be negative (i.e. avoidance of GHG emission) if the input was releasing emissions in its existing use/disposition, or positive (additional GHG emissions) if it was avoiding emissions through its existing use (for example by avoiding demand for other materials).The exact definition of a rigid input is given in the Appendix 2.2.

Examples of rigid inputs include:

- municipal waste, used plastics, used lubricating oil;
- intermediate streams from existing processes: e.g. blast furnace gas, black liquor;
- process heat or waste heat taken from an existing process; and
- economically minor by-products of existing processes, where the ratio of the outputs cannot be changed significantly (to determine what are minor by-products see Appendix 2.2.). An example of this type of rigid input is hydrogen recovered from an existing chlor-alkali process, which was already being sold as an industrial gas. If such inputs have an economic value of 10% to 50% of the total value of all co-products from the

relevant process, then they are considered 'semi-elastic' (see below and in Appendix 2.2.).

- There are four possible outcomes from assessing the diversion of a rigid input:
  1. The **diversion of the rigid input is expected to increase demand for one or more elastic inputs**. In this case, the rigid input may be replaced in the list of inputs in the "inputs" box with the relevant quantities of these elastic materials, which should be treated as any other elastic input.
  2. The **diversion of the rigid input is expected to create no additional demand for other inputs** (i.e. the rigid input would otherwise have been disposed without productive use). Any change in emissions due to changing the disposition of the input should be counted as the emissions intensity of the input.
  3. The **diversion of the rigid input is expected to increase demand for other inputs that are rigid or semi-elastic**. In this case, the results of diversion of those other rigid inputs (or the rigid fraction of semi-elastic inputs) should be assessed in the same way. This should continue until the emissions implications of diverting the original rigid input have been fully characterised as a combination of increased demand for elastic inputs and emissions changes due to changes in disposition.
  4. **A combination of the other three outcomes**. In this case, the emissions implications of the diversion of other elastic, rigid, and semi-elastic inputs and other dispositions should be assessed as above, and combined to give the overall emissions implication of use of the rigid input.

The implications of diverting a rigid input from its existing use should be assessed as far as possible with reference to the specific source of the input that is to be used by the project/is used by the reference. The results of the diversion analysis may therefore be specific to the location of the project and the nature of the source of the input.

Where a reference scenario includes use of a rigid input, for instance in cases where an unmodified facility is used as the reference scenario and is utilising a rigid input, then the logic of the assessment is reversed – rather than assessing the expected impacts of diverting an additional amount of the rigid input, the applicant must assess the expected impacts if that supply of the rigid input were made available to other uses. In such a case, the result of the assessment will be some combination of reduced demand for other elastic inputs and emissions that would result from increased alternative disposition of the input.

The following are examples of assessing emissions from the diversion of rigid inputs:

<u>Example: municipal waste as a rigid input</u>

Taking municipal waste as an input will not affect the generation of municipal waste, and therefore it is considered a rigid input. The emissions intensity takes into account the existing fate of the waste, as well as the emissions associated with any additional treatment and transport. For example, if its existing fate was incineration without energy recovery, the emissions from the incineration are avoided, and this means the emissions attributed to using the waste are negative, i.e. avoiding the original fate saves emissions, so there is a CO_2 *credit for its novel use. If it is diverted from landfill, the carbon emissions attributed to it at the point of collection will also be negative. These shall be assumed equal to those for incineration without energy recovery, because although landfill sequesters part of the carbon, it is not desirable to encourage landfill for other environmental reasons (such as fugitive GHG emissions of CH4). If a project can demonstrate an avoidance of CH4 emissions, this can also be included as a credit.*

If instead the municipal waste input is diverted from being burnt to provide district heating, the emissions avoided by the burning of the waste for *district heating are offset by the additional emissions incurred by replacing that district heat, for example by using a natural gas boiler.*

Example: excess process heat as a rigid input

Using excess process heat from an existing process will not affect the generation of excess heat by that process, and therefore it is considered a rigid input. A process may take heat from another existing process outside the control of the applicant or outside the system boundary of the project/reference scenario. In this case, the emissions attributed to the heat input shall be the increase in the emissions of any other processes associated with the heat export. Thus, if the heat is truly "waste heat", it would be considered free of emissions. On the other hand, if extra fuel needs to be burnt to replace the heat in the existing processes, its emissions intensity is the emissions from burning that extra fuel.

Example: industrial off-gas as a rigid input

Using off-gases from an existing process will not affect the generation of off-gases by that process, and therefore it is considered a rigid input. For example, if a stream of industrial off-gas containing carbon monoxide is diverted from flaring with release of the CO_2 to the atmosphere, the emission attributed to that input is negative, equal in magnitude to the CO_2 release that is avoided.

If instead the industrial off-gas would otherwise be combusted to produce process heat, the applicant should estimate the emissions from the source of heat that replaces the heat lost by diverting the gas its use in the project, and add these to the project scenario.

As emissions for electricity are set to zero there is no emissions penalty in the Innovation Fund for diverting off-gases from electricity production.

Example: hydrogen from a chlor-alkali process

Projects using hydrogen from a chlor-alkali (Solvay) process as a major input provide two different scenarios for emissions calculations. Hydrogen is an economically minor by-product of a chlor-alkali plant, and it is produced in a fixed ratio to the other products because of the stoichiometry of the reaction. So it is considered a rigid source of hydrogen. Depending on the local situation, there may be difference consequences to the displacement of this hydrogen:

- *The hydrogen is piped from an existing chlor-alkali plant, where it was being burnt to provide process heat. The process heat is then provided by natural gas instead. The emissions attributed to the hydrogen are the emissions from the supply and combustion of this natural gas for heat.*
- *The hydrogen is piped from an existing chlor-alkali plant, which previously sold it in cylinders on the general industrial gas market. The hydrogen is being diverted from the industrial gas market, and is unlikely to be replaced by more hydrogen production from chlor-alkali plants, because it is a rigid source. The elastic source that is likely to supply extra hydrogen to replace the hydrogen diverted from the industrial gas market is steam reforming of natural gas.*

Application of the Waste Framework Directive

Projects that involve the use of "waste" materials must respect the current version of the Waste Framework Directive[14]. The waste hierarchy in the Waste Framework Directive puts top priority on material recycling (e.g. recycling used plastic as plastic). Converting waste

[14] Directive 2008/98/EC on waste and its amendments

to a fuel is specifically excluded from the definition of "recycling" in the Waste Framework Directive, and does not count towards recycling targets for Member States: it is classed as "recovery", on a lower level of the waste hierarchy, along with burning it for electricity and/or heat production,

Therefore projects that use, as feedstock, materials covered in the Waste Framework Directive, such as used plastics, must precisely define the "waste" they are intending to use, and justify why it cannot be given a higher-priority treatment under the Waste Framework Directive during the lifetime of the project.

2.2.2.3 *SEMI-ELASTIC inputs*

Some inputs are one of several co-products produced in fixed ratios from an existing process, but with less value than other co-products. In such cases, it may not be clear whether the input should be characterised as rigid or elastic. To simplify the assessment of these cases, any input that represents less than 10% of the full economic value of products from a process may be considered rigid, any input that represents more than half of the full economic value of products from a process may be considered elastic, and any input with a value from 10% to 50% of the full economic value of products from a process may be considered semi-elastic. The emissions of a semi-elastic material shall be assessed as the weighted combination of the emissions if it was entirely rigid and the emissions if it was entirely elastic. This calculation is described fully in Appendix 2.2.

2.2.2.4 *ELASTIC inputs*

If the supply of the input can be varied in order to meet the change in the demand, then the input is considered "elastic", and its emission factor is found from the emissions involved in supplying the extra quantity of that input. The exact definition of an elastic input is given in the Appendix 2.2.

As explained in section 2.2.2.1, the emissions intensity of a rigid input may be based on the elastic input that replaces it in its existing use. The provisions in this section also apply to elastic inputs identified as substitutes for diverted rigid inputs: they are considered on the same basis as the other elastic inputs that change between project and reference scenarios.

<u>Determining the level of materiality of elastic inputs</u>

The applicant should make a list of all elastic inputs for each of the project and reference scenarios, including the elastic inputs identified by considering diversion of rigid inputs. Inputs used in very small quantities that would obviously not make a significant contribution to the GHG emissions profile of the relevant scenario may be stated generically, e.g. "maintenance materials", and assigned zero emissions.

The remaining listed elastic inputs should now have preliminary emissions factors assigned to them from the data hierarchy given in Appendix 2.3. The preliminary assessment of emissions associated with each elastic input shall be undertaken by multiplying the quantity of each elastic input to be used in the relevant scenario by the emissions factor. Any input assessed as having total associated annual emissions of 10 tCO_2e or lower during full project operation may be treated as *de minimis* and ignored. The elastic inputs may now be ordered by the preliminary emissions assessment from lowest contribution to highest.

Having ordered the list of inputs for each scenario thusly, the elastic inputs to be considered *de minimis* may be established. The applicant may select from the list inputs whose emissions jointly amount to less than 5% of the total emissions ascribed to the inputs in the relevant scenario to be considered *de minimis*. For monitoring and reporting for knowledge-sharing, the selection of *de minimis* inputs must be restricted so that they jointly amount to less than 2% of the total emissions ascribed to the inputs.

The emissions of *de minimis* inputs may be neglected from that point onwards, and need not be included in the calculation of either absolute or relative GHG emissions avoidance.

All other inputs are considered significant and must be included in the emissions calculation based on the emissions factors assigned from the data hierarchy, subject to the rules detailed below.

Fossil Fuels Inputs

The carbon content for inputs of fossil fuels appears either in the process emissions (for the part that is combusted) or in the combustion or end-of-life emissions of the product. Consistent with the EU ETS-based accounting of changes in process emissions, as long as the EU ETS-based accounting of emissions is performed (by carbon mass-balance and/or direct measurement) **no separate accounting of fossil fuel inputs is needed**.

Biomass, biogas, biomethane, bioliquid and biofuels inputs

Any such fuels, derived from biomass used in IF projects must conform to the sustainability requirements of the REDII. The emissions factor for biomass, biogas, biomethane, bioliquid or biofuels from an **indeterminate supplier**, are the default emissions tabulated in Annex V and VI of REDII, generally[15] diminished by 15%.

Remember that the CO_2 emissions from the **combustion** of bio-based carbon are not counted in the process(es) step.

Other significant inputs

Other inputs, such as high value chemicals, may have much higher processing emissions than simple fuels. The required GHG emission intensity data must be taken from the reference literature according to the method and hierarchy in Appendix 2.3. The applicant must reference all the literature values that are used for the emissions factors, so the evaluators can check them. If several emission factors are available at the same level of the hierarchy, representing different processes for obtaining the same product, the applicant shall select the process that best describes the marginal source (otherwise known as the "swing producer") of the product, and explain the choice.

For inputs including organic molecules (i.e. containing carbon compounds) life cycle and well-to-wheel databases will generally show total carbon intensity, which is the sum of the stoichiometric carbon content and all emissions from processes in the supply chain (i.e. the carbon intensity of the product assuming that its carbon is entirely converted to carbon dioxide during use/end-of-life). Including stoichiometric carbon dioxide release in the emission intensity of the input as well as in the "process(es)"/"use"/"end-of-life" box for the products would result in double counting of those carbon emissions. For carbon-containing inputs, the appropriate emission factors to use **for the inputs** can therefore be found by subtracting from the carbon intensity the stoichiometric carbon content of the input converted to mass of CO_2 using the molar weight ratio 44/12.

Life cycle and well-to-wheel databases may also include the emissions from upstream fossil fuel supply (i.e. the emissions intensity of fossil fuel extraction and transport to market). If the emissions calculations cannot be made without considering upstream emissions for fossil fuel supply, an approximate adjustment to the complete lifecycle emissions should be made by subtracting 15% from the emissions intensity result.

Attribution of emissions between co-products in the supply of elastic inputs

In some circumstances, it may be necessary to attribute emissions between co-products in order to determine the GHG emissions intensity of an elastic input. This would include

[15] By exception, emissions for biogas and biomethane (which may be negative) are derived by summing the adjusted disaggregated default emissions in Annex VI, section C (p. 113) of the REDII: the adjustments are that (a) the 'cultivation' emissions are reduced by 15%, (b) emissions from 'compression at the filling station' are set to zero (as that uses electricity); (c) 4.5gCO2e/MJ are subtracted from the emissions for upgrading. The 'manure credit' (for avoided emissions from conventional use of manure) is unaltered.

the case that a significant elastic input is one co-product from a process that has only an overall GHG emissions intensity available in the data hierarchy.

For a **rigid input** the calculation of emissions intensity may be based on the elastic input that replaces it in its existing use, so the attribution may be needed there too.

For the purposes of the calculation of attribution of emissions to co-products, the emissions to be shared shall be all the considered emissions that take place up to and including the process step at which the co-products are produced. Obviously, if an input to the process is itself a co-product of another process, the sharing out of emissions at the other process must be done first to establish the emissions to be attributed to the input.

ISO 14044 (2006) provides a framework for such an attribution and for calculating the emissions intensities for the supply of elastic inputs that are co-products of another process as illustrated in Appendix 2.1.

- In the flow chart "allocation by physical causality" at the second level requires analysis showing the emissions consequences of changing the output of the product without changing the output of co-products, and will often require process modelling.
- At the third level, allocation shall generally be made by the economic value of the co-products. In general, allocation by any other property (e.g. mass, chemical energy) will only be justified in the case that the specific emissions being allocated are directly related to that property – for example, transport emissions may be largely determined by mass or volume of a good rather than its value.
- A lack of comprehensive value data shall generally not be considered an adequate reason to use an alternative allocation method. Where value data for a specific input is not readily available, it may be inferred by reference to comparable inputs for which prices are available. Alternative allocation choices would need to be well justified and should only be used as a last analytical resort.

2.2.2.5 Electricity inputs supplied to industrial projects

No emissions shall be ascribed to electricity either consumed or exported continuously or at times not correlated with grid emissions variations. However, for **knowledge-sharing purposes**, the actual change in electricity consumption or export between the project and reference scenarios shall be reported. The project should also report whether the timing of the consumption or export is correlated with the time-varying emissions of the grid, and in this case hourly electricity consumptions shall be reported for the reporting period.

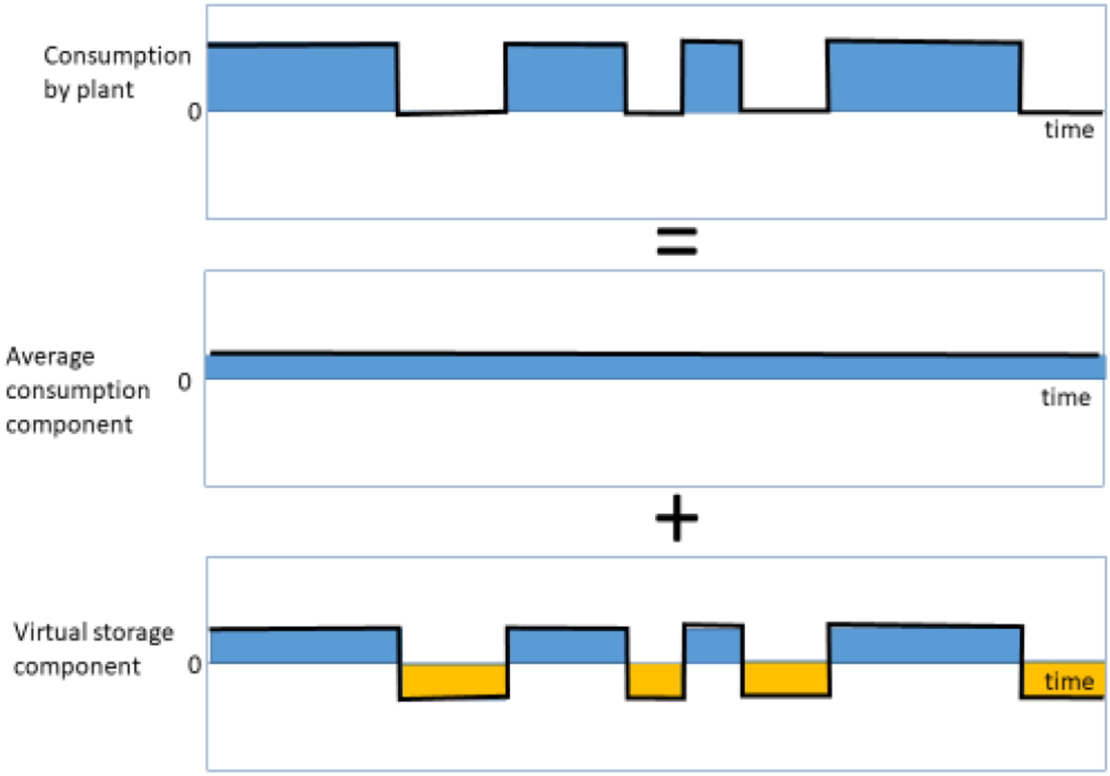
2.2.2.6 Lowering grid electricity emissions by timing plant operation

Even without any certification or contracts to use additional renewable electricity, a plant using electricity (such as an electrolyser) can reduce the emissions of its electricity supply by operating only at times when the emissions of the electricity supply are below average. This demand management will become more important in the future as the grid accommodates increasing fractions of intermittent wind and solar electricity. It helps grid stability in the same way as electricity storage.

To estimate the electricity emissions in this mode of usage, the applicant resolves the time-dependent electricity demand into a storage component plus a constant average consumption, as indicated in the diagram below. In order to claim such a credit the applicant must provide details of their plan to manage power consumption to coincide with times when the emissions of the electricity supply are below average. The emission avoidance of the virtual storage component shall be calculated as in section on emissions accounting for energy storage (see Section 5). Counterintuitively, a project using timed operation **may actually show negative reportable emissions for electricity consumed**. Such reportable negative emissions arise because the Innovation Fund simultaneously offers credit for timed operation (which can deliver real emissions savings in the short-term) while allowing applicants to use a long-term value (zero) for the emissions from electricity production. Such facilities should not be understood as truly delivering negative emissions by consuming more electricity, but as being given extra credit for operating in the most climate friendly possible way from both a short- and long-term perspective.

Credit may only be claimed for periods of lower electricity consumption where the reduction in consumption results from a decision by the applicant based on data about the supply of low GHG emissions electricity to the grid. This could include the instantaneous fraction of renewable power supplied to the grid, the instantaneous price of grid electricity as a proxy for the level of renewable power supply, or other similar metrics. Credit may not be claimed for reduced electricity consumption during periods of necessary maintenance, emergency shutdowns or shutdowns due to a lack of market demand for either principal or non-principal products, unless it can be demonstrated that such shutdowns can be purposefully timed to coincide with periods of higher than average grid electricity GHG emissions intensity.

Figure 2.2 Calculation of emissions from projects using electricity when marginal emissions are low



2.2.3 $E_{products}$

The processes in both the project and reference scenarios should produce exactly the same quantity of the principal products or deliver an exactly equivalent function; however, there may be changes in non-principal co-products associated with the adoption of innovative processes. To balance the scenarios, the emissions attached to changes in non-principal co-products must be considered. Non-principal co-products produced in the project scenario but not in the reference scenario **increase** the project's emission avoidance by the emissions attributed them; conversely non-principal co-products produced in the reference scenario but not in the project scenario **reduce** the project's emission avoidance by the emissions attributed them. The emissions factors needed for this calculation are calculated according to the method in the paragraph on **other significant inputs**, 2.2.2.3. Allocation approaches **should not** be used to deal with the emissions credit to be assigned to additional by-products.

<u>Example</u>

Consider the modified steelworks mentioned in an example above that produces a little toluene co-product along with the ethanol that has been *chosen as the principal product. The toluene should be included in the products box of the project-scenario. The avoided emissions for toluene production are derived from the hierarchy of literature sources as explained in section 2.3.*

2.2.4 E_{use}

Innovative products may save emissions in the use phase of the principal product by increasing energy efficiency or reducing emissions during use. For example, new agrochemicals could reduce nitrous oxide emissions when used on the soil; innovative absorbents or catalysts could save emissions in the chemical industry.

The emission avoidance in use are first estimated per tonne of product. Then the scale of production assumed in the calculation of total emission avoidance is limited to the quantity that the applicant is confident to be able to sell into the specific EU, Norway or Iceland market within which these in-use savings are achievable. During the monitoring and reporting stage, applicants will be required to prove the amount of products sold into that market in addition to monitoring and reporting of the parameters related to the production of the product.

2.2.5 $E_{end\text{-}of\text{-}life}$

Where carbon is incorporated into principal products and is not released through combustion of those products as fuels, CO_2 emissions from eventual carbon release should be included in the "end-of-life" box on a stoichiometric basis. This should be done for example for cases where a carbon-containing principal product has a material or chemical use, such as methanol production for non-fuel purposes. It is important that these end-of-life emissions are included in the project and reference scenarios even where they are not changed by the project, in order that the relative emissions avoidance may be correctly calculated.

Other than this stoichiometric carbon release, it is not necessary to include in the calculation any other end-of-life emissions that are unchanged by the project. If a project does deliver further changes to end-of-life emissions compared to the reference scenario, then these changes should be included in the calculation. For example, innovative refrigerants could replace others with higher global warming potential, avoiding emissions if they leak or are not collected at end-of-life. Furthermore, some projects may enable more efficient recycling due to changes in products. In such cases, changes in end-of-life emissions may be estimated and added to the emissions changes from other project stages. Any such credits should be clearly justified, and in general such credits will only be considered where they relate to fundamental physical properties of the materials at end-of-life (such as a different global warming potential for refrigerant gases) and not where reductions at end of life are conditional on behaviour changes outside of the control of the applicant (such as changed recycling practices that are predicated on very specific waste sorting protocols that may not be adopted).

2.3 Absolute and relative GHG emissions avoidance

Applicants have to calculate estimates of both the absolute and relative emissions avoidance expected from the project. For the general formulas, please look at sections 1.3.1 and 1.3.2. In case of multiple principal products, the relative emission avoidance for the project is found by dividing the summed emission avoidance of the project by the sum of the estimate emissions for the production of the chosen principal products in the reference scenario.

2.4 Data and parameters

Each project will present the parameters that will be deemed as constant throughout the duration of the project and, consequently, shall not be monitored choosing the sources of data as explained above. These will include all emission factors, combustion emissions (carbon contents) and lower heating values (net calorific values) after approval at the evaluation.

2.5 Monitoring, reporting and verification of performance for disbursement and knowledge-sharing

A monitoring plan consisting of a detailed, complete and transparent documentation of the parameters used in calculations and data sources shall be submitted by the applicant. The documentation should include the following elements:

- Process diagrams for the "project", "reference" and "change" scenarios, filling out Figure 2.1 by indicating all the sub-processes, inputs, and products that will be changed by the project, either in terms of technology or output ("activity level").
- Explanation of the choices in the reference scenario, as described in section 2.2.1.2
- A list or diagram quantifying all the material and energy flows between the sub-processes in the project and reference scenarios.
- A list quantifying each of the products (or functions) delivered by the "processes" stage of in the three scenarios.
- Identification of the selected "principal product(s)" (or functions) from the list of products for the project scenario.
- Lists quantifying each material and energy input entering the "process(es)" stage of each scenario, organized in decreasing order of size. At the bottom of the list, descriptions may be generic (e.g. "other process chemicals", "lubricants").
- From the list of inputs for the "change" scenario, identification of "de minimis" and "significant inputs" following section 2.2.2.1.
- List of the emissions intensities taken from the literature and the sources of the data.
- A documented calculation of the absolute and relative emission avoidance from the project.

At the reporting stage, all measurements should be conducted with calibrated measurement equipment according to relevant EU ETS MRR requirements.

Monitoring is not necessary for the inputs of biological origin, since either REDII default emissions factors are used, or the actual values which are checked under the monitoring provisions of REDII. It is enough to document the provenance of the batches of inputs of biological origin.

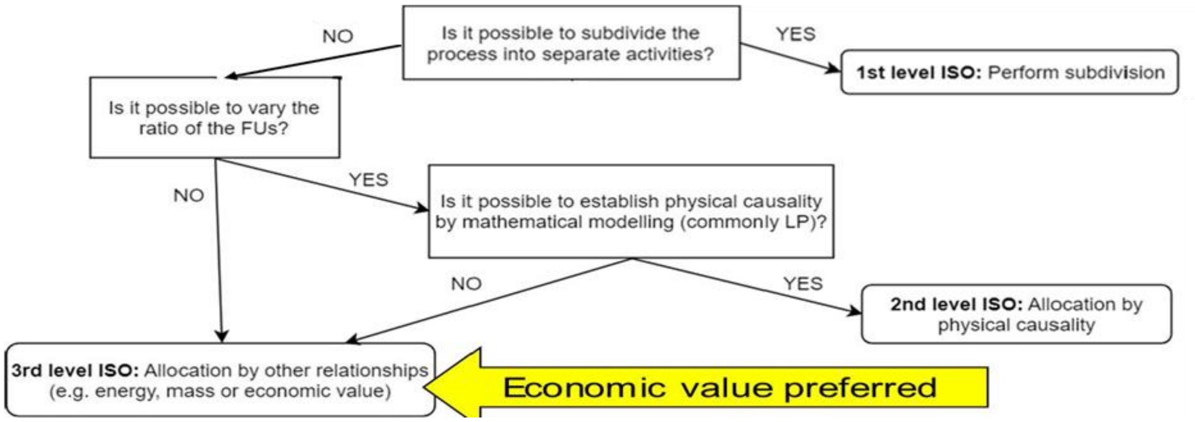
In addition to the parameters listed above, the following parameters will be monitored and reported for **knowledge sharing purposes** for projects using grid electricity where applicable:

- Hourly profiles for use and feed-in of grid electricity.
- Hourly profiles for generation of electricity delivered to the project from PPAs.
- Hourly profiles for avoided curtailment based on final physical notifications of co-located RES plants or grid operator instructions.

Appendix 2.1. Attribution of emissions to co-products in emissions calculations for IF projects

A simplified version of the ISO 14044 (2006) multifunctionality framework is used to attribute emissions to co-products.

Figure A1.1 Simplification of the ISO 14044 (2006) hierarchy for sharing emissions between co-products[16]



Following the diagram, the applicant first sees if any installation inside the project boundary treats only one of the project's co-products: then obviously the emissions from that installation can be ascribed entirely to that co-product.

If that does not completely solve the problem, the next question is whether the process allows one to change the ratio of the co-products produced (as is possible, for example in a "complex" oil refinery) or whether the ratio is fixed, for example by the stoichiometry of a chemical reaction. If the ratio of outputs is variable, allocation of emissions between products is made, if possible, by "physical causality" (level 2 of the ISO hierarchy): calculating the effect on the process' emissions of incrementing the output of just one product whilst keeping the other outputs constant. **This is not the same as allocating using an arbitrary physical property** of the products.

If it is impossible to make the incremental calculation just described, or if the ratio of the products, is fixed, the 3rd level of the hierarchy is invoked. In an industrial process, the motivation for making different products is the market value of the products. So, at this 3rd level, allocation by the economic value[17] of the products is the preferred choice. Allocation by other properties, such as weight or volume, of the different products may only be done where it can be shown that they are the "cause of the limit" of the function.

The point in the supply chain where the allocation is applied shall be at the output of the process that produces the co-products. The emissions allocated shall include the emissions from the process itself, as well as the emissions attributed to inputs to the process.

[16] The option in ISO 1044 (2006) to "enlarge the system boundaries to include all the co-functions" does not exist in this case, because we must find the emissions attributable to the "principal product(s)", which are already fixed. Also the option in ISO 1044 (2006) to apply substitution to by-products has been eliminated in order to simplify calculations. Note: LP: linear programming, FU: functional unit.

[17] The average price over the previous 3 years should be used; any other assumption must be justified. Objections that "the price varies" will not be considered: it is better to have a method that is approximately correct than one which is exactly wrong.

Appendix 2.2. Processes with a fixed ratio of outputs: definition of rigid, elastic and semi-elastic products

Some inputs may be products of processes that produce a fixed ratio of outputs. Consider a process that produces various outputs (products, by-products, residues or wastes) in fixed ratios and with different prices. If the incentive for a company to increase the production of the whole plant is proportional to the sum of the economic value of all the outputs; the fraction of the incentive from one output is proportional to its value-fraction in the total value of products produced by the plant.

For example, if one output is a waste with zero value, its value-fraction is zero and there is no incentive to increase overall production to supply more of it. This means the waste has a rigid supply. At the opposite extreme, if the process only has one output, then it represents the entire incentive to increase production, so the supply of that output will increase with demand, its supply is perfectly elastic.

In order to reduce the administrative burden of the calculation for products that are in between these extremes, the following simplification is applied:

- A product that represents less than 10% of the value of the total products of the supplier are treated as perfectly rigid, and their emissions calculated accordingly.
- A product that represents more than 50% of the total value of the products of the supplier are treated as perfectly elastic, and their emissions calculated accordingly.
- The emissions attributed to a product that represent between 10% and 50% of the total value of the products of the production process shall be:

$$\frac{(emissions\ assuming\ elastic\ source\ ) * (VF - 0.1) + (emissions\ assuming\ rigid\ source) * (0.5 - VF)}{(0.5 - 0.1)}$$

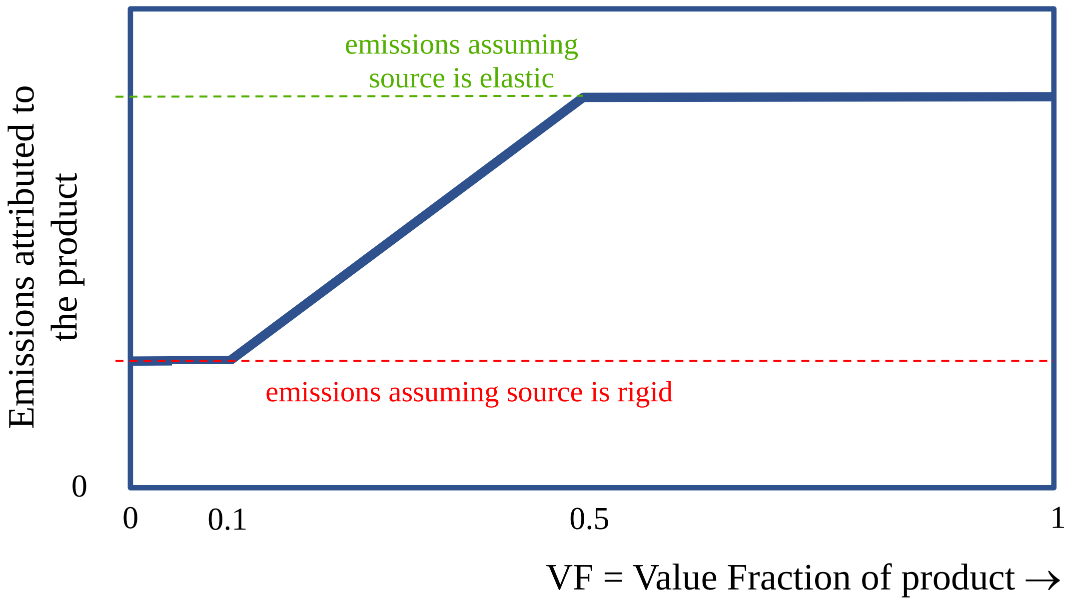
…where *VF* = Value Fraction of the product =

$$\frac{(value\ of\ the\ product)}{(total\ value\ of\ all\ the\ products\ produced\ by\ the\ process)}$$

This relation is represented in the following graph. This graph is only schematic; the emissions calculated assuming the result is elastic are not necessarily higher than those assuming that it is rigid, and calculated emissions can also be negative.

In calculating VF, the prices should be the average of the data for the last 3 years.

Figure A2.2.1. Determining emissions for semi-elastic inputs



In practice, we it is expected that the great majority of inputs to fall into either the "elastic or "rigid category, so the simplification is considerable in most cases. The prices should be the average of the data for the last 3 years.

An example of such a process is the chlor-alkali process, which produces sodium hydroxide, chlorine and hydrogen in a ratio that is fixed by stoichiometry. Here, we consider the case where all three are sold as inputs to a process in IF. By contrast, if the hydrogen is not sold, but is being burnt for process heat, then the emissions of the plant are obviously only attributed to sodium hydroxide and chlorine. If it is then proposed to start selling the hydrogen, replacing the process heat with natural gas, the hydrogen is a rigid source, and its emissions are given by those of the natural gas that replaces it.

Appendix 2.3. Hierarchy of data sources for inputs and products in industrial projects

The GHG emissions intensity and combustion emissions of inputs or products, **that is not specified elsewhere in the section on industrial projects**, and need to be found from literature (which never includes heat or electricity), will be taken from the following sources, in order of preference (top to bottom). Note that the **emissions intensity** is not the same as **combustion emissions** (which are used for calculating the direct carbon emissions for processes in EU ETS). **Emissions intensity** is also known, for transport fuels, as **well-to-wheels** emissions: it comprises not only combustion emissions, but also all the emissions from the supply chain: extraction of raw materials, all steps in the processing, transport and distribution.

1. Stoichiometric combustion emissions for a wide range of fuels is provided in 2019 Refinement to the IPCC 2006 Guidelines for National Greenhouse Gas Inventories. More precisely, this information can be found in tables 2.2 and 2.3 of Vol.2 Energy of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.[18]
2. Emissions intensity for most widely-used process chemicals are provided in Table 47 of the Report "Definition of input data to assess GHG default emissions from biofuels in EU legislation" (European Commission 2019)[19]. The same values are intended to be shown also in a revised version of the BIOGRACE tool[20]. These data are already used for calculating emissions for biomass, bio-liquids and biofuels in Annex V of REDII. However, these data include a wider range of emissions than those in EU ETS, and the rest of the present calculations; in particular they include both upstream emissions for the provision of fossil fuels, emissions for transport and distribution of products, and the combustion emissions of any fuel products. Therefore, to obtain values that are approximately coherent with the emissions calculated in EU ETS from combustion of fossil fuels, first 15% is subtracted from all the values to account for the upstream (etc.) emissions.
3. If the data are not available there, coherent data for a different range of inputs/products may be found in JEC-WTW v.5, WTT Annexes[21], which shares the same input database as the calculations in Annex V of REDII.
4. Calculations using input data from ECOINVENT 3.5. Calculations in ECOINVENT should use the "cut-off system model". An equivalent calculation may also be made in proprietary software packages (e.g. GABI, openLCA) using the same input data. If the emissions calculations cannot be made without considering upstream emissions for fossil fuel supply, an approximate adjustment to the complete lifecycle emissions should be made by subtracting 15% from the emissions intensity result. If the calculation calls for allocation of emissions between multiple products, allocation by economic allocation should be selected (the database includes the cost of products).
5. "Official" sources, such as IPCC, IEA or governments (but note that most IPCC and IEA tables show combustion emissions, not emissions intensity).
6. Other reviewed sources of data, such as E3 database, GEMIS database.
7. Peer-reviewed publications.
8. Duly documented own-estimates.
9. "Grey literature": unreviewed sources, such as commercial literature and websites.

[18] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf
[19] https://ec.europa.eu/jrc/en/publication/definition-input-data-assess-ghg-default-emissions-biofuels-eu-legislation.
[20] www.biograce.net/
[21] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC119036/jec_wtt_v5_119036_annexes_final.pdf

3 Carbon Capture and Storage

Carbon capture and storage (CCS) projects are characterised by the capture of exhaust gases from point sources in industrial processes or power generation, or directly from ambient air, followed by a separation and compression of the CO_2, which will then be transported by road tankers, ships, rail and/or pipelines to a suitable storage site where it will be injected and permanently stored in a storage site permitted under Directive 2009/31/EC, such as depleted oil and gas reservoirs, un-mineable coal beds, saline aquifers, or basalts.

Applications for such projects can be submitted by any players in the CCS supply chain, i.e. by the legal entity hosting the capture installation, or by legal entities providing transport services or storage infrastructure. If the full CCS supply chain is not part of the application, the applicant should demonstrate the provision of the remaining services in the CCS supply chain by third parties, since the IF grant is dependent on verified emission reductions. Where the capture, transport and/or storage occur outside the project boundary, the credit for the CO2 capture may be split between the different parts and the sum should not exceed the total CO2 captured.

Building on the reporting requirements for EU ETS, the GHG emission avoidance for CCS projects will be calculated by deducting project emissions (i.e. emissions that are only occurring due to the project activity) from the reference emissions that would occur in the absence of the project, which is represented by the amount of CO_2 transferred to the capture installation.

Projects aiming at capturing and storing CO_2 from biogenic origin, shall be considered hybrid projects under the IF, and shall combine the calculations for the CCS component of the project described in this section, and the component related to the industry where the biomass is used and burned (i.e. Section 2 if from a bio-industry or Section 4, if bio-electricity or bio-heating production plant), **whilst removing any double-counting**.

Project emissions from the CO_2 capture activity using direct air capture (DAC), pre-, post-, oxyfuel or chemical looping combustion techniques, the injection in the geological storage site and the transport network of CO_2 by pipelines shall be quantified according to Article 21, 22 and 23 of Annex IV of Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018.

Project emissions due to transportation by road, rail and maritime modals can be disregarded from the calculation of the GHG emissions avoidance, if the total distance between the point of capture and the point of storage is inferior to 5,000 kilometres.

Successful projects will be required to maintain records of measurements, quality assurance and quality control procedures and calculations used in the development of data reported for three years, along with copies of reported data and forms submitted.

3.1 Scope

This methodology applies to project activities that involve capturing and compressing of biogenic or fossil CO_2 from point sources (e.g. power and heat generation facilities, including biomass power plants, or energy-intensive industries) or directly from the ambient air for injection in a storage sites permitted under Directive 2009/31/EC on the geological storage of carbon dioxide.

This methodology is applicable to CCS project activities such as but not exclusive to:

3.1.1 Plant of origin

- Energy intensive industries,
- Bio-refineries
- Power generation facilities, using fossil fuels or bioenergy.

- Natural gas processing.

3.1.2 Technologies

- Pre-combustion,
- Post-combustion,
- Oxyfuel combustion,
- Chemical looping combustion,
- Direct air capture (DAC)

3.1.3 Storage sites

- Depleted (or nearly depleted) oil and gas reservoirs,
- Unmineable coal beds,
- Saline aquifers,
- Basalts.

3.2 Project boundary

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in Table 3.1.

Table 3.1 Emission sources included in or excluded from the reference and project boundaries

Emission sources		Included
Reference (Ref)	CO_2 that would be released or available in the atmosphere in the absence of the project activity ($Ref_{release}$)	Yes
Project (Proj)	CO_2 capture activities. Includes emissions from fuel and input material use for compression and liquefaction of the CO_2, as well as fugitive and venting pre-injection. ($Proj_{capture}$)	Yes
	Transport of CO_2 by pipeline. Includes emissions from combustion and other processes at installations functionally connected to the transport network such as booster stations; fugitive emissions from the transport network; vented emissions from the transport network; and emissions from leakage incidents in the transport network. ($Proj_{transport\ pipeline}$)	Yes
	Injection at the geological storage site. Include emissions from fuel use by associated booster stations and other combustion activities including on-site power plants; venting from injection or enhanced hydrocarbon recovery operations; fugitive emissions from injection; breakthrough CO_2 from enhanced hydrocarbon recovery operations; and leakages. ($Proj_{injection}$)	Yes
	Transport of CO_2 by road, rail and maritime modal. Includes emissions from combustion at tank trucks, sea tanker and other vehicles. ($Proj_{transport\ road}$; $Proj_{transport\ rail}$ and $Proj_{transport\ maritime}$)	Yes, if $K_{c\text{-}s}$ > 5,000 km

3.3 Absolute GHG emission avoidance

The equation to be applied for the calculation of absolute GHG emission avoidance for CCS projects is described in the following.

GHG emission avoidance	=	Reference scenario emissions	-	Project emissions	
$\Delta GHG_{abs,CCS}$	=	$\sum_{y=1}^{10} Ref_{release,y}$	-	$\sum_{y=1}^{10} (Proj_{capture,y} + Proj_{pipeline,y} + Proj_{transport,y} + Proj_{injection,y})$	[3.1]

Where:

$\Delta GHG_{abs,CCS}$ = Absolute GHG emissions avoided by the CCS project, in tonnes CO_2e.

$Ref_{release,y}$ = Amount of CO_2 transferred to the capture installation in year y, in tonnes CO_2e, determined in accordance with Commission Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012, especially Articles 40 to 46 and Article 49 and Annex IV, Section 21.

$Proj_{capture,y}$ = GHG emissions from CO_2 capture activities for the purposes of transport and geological storage in a storage site permitted under Directive 2009/31/EC in year y, in tonnes CO_2e. This includes emissions from fuel and input material use for compression and liquefaction of the CO_2, as well as fugitive and venting pre-injection. It shall be calculated according to Regulation (EU) 2018/2066, Annex IV, Section 21.

$Proj_{pipeline,y}$ = GHG emissions from transport of CO_2 by pipelines for geological storage in a storage site permitted under Directive 2009/31/EC in year y, in tonnes CO_2e. This includes emissions from combustion and other processes at installations functionally connected to the transport network including booster stations; fugitive emissions from the transport network; vented emissions from the transport network; and emissions from leakage incidents in the transport network. It shall be calculated according to Regulation (EU) 2018/2066, Annex IV, Section 22.

$Proj_{injection,y}$ = GHG emissions from geological storage of CO_2 in a storage site permitted under Directive 2009/31/EC in year y, in tonnes CO_2e. This includes emissions from fuel use by associated booster stations and other combustion activities including on-site power plants; venting from injection or enhanced hydrocarbon recovery operations; fugitive emissions from injection; breakthrough CO_2 from enhanced hydrocarbon recovery operations; and leakages. It shall be calculated according to Regulation (EU) 2018/2066, Annex IV, Section 23.

$Proj_{transport,y}$ = GHG emissions due to the transportation of CO_2 in tank trucks, rail or other road modals and in sea tankers or other maritime modals, in year y, to be calculated according to Equation [3.2] and sub equations, in tonnes CO_2e.

y = year of operation

Should the total distance between the point of capture and the point of storage (Kc-s) exceed 5,000 kilometres, $Proj_{transport,y}$ shall be calculated as follows.

Parameter	=	Equation	
$Proj_{transport,y}$	=	$Proj_{transport,road,y} + Proj_{transport,rail,y} + Proj_{transport,maritime,y}$	[3.2]
$Proj_{transport,road,y}$	=	$\sum_{L=1}^{T} (K_{road,L} * CO_{2road,L} * EF_{road} * 10^{-3})$	[3.3]
$Proj_{transport,rail,y}$	=	$\sum_{L=1}^{T} (K_{rail,L} * CO_{2rail,L} * EF_{rail} * 10^{-3})$	[3.4]

$Proj_{transport,maritime,y}$	=	$\sum_{L=1}^{T}$ $(K_{maritime,L} * CO_{2maritime,L} * EF_{maritime} * 10^{-3})$	[3.5]

Where:

$Proj_{transport,road,y}$ = GHG emissions due to the transportation of CO_2 in tank trucks or other road modals, in year y, in tonnes CO_2e.

$Proj_{transport,rail,y}$ = GHG emissions due to the transportation of CO_2 by rail, in year y, in tonnes CO_2e.

$Proj_{transport,maritime,y}$ = GHG emissions due to the transportation of CO_2 in sea tankers or other maritime modals, in year y, in tonnes CO_2e.

$K_{road,L}$ = distance of one-way trip travelled by road vehicles, in kilometres.

$CO_{2road,L}$ = amount of CO_2 transported in each one-way trip in road modals, in tonnes.

EF_{road} = emission factor for road vehicles, in kg CO_2-eq / tonne.km. The EF presented in Table 3.2 shall be applied.

$K_{rail,L}$ = distance of one-way trip travelled by rail, in kilometres.

$CO_{2rail,L}$ = amount of CO_2 transported in each one-way trip by rail, in tonnes.

EF_{rail} = emission factor for rail transportation, in kg CO_2-eq / tonne.km. The EF presented in Table 3.2 shall be applied.

$K_{maritime,L}$ = distance of one-way trip travelled by maritime transportation, in kilometres.

$CO_{2maritime,L}$ = amount of CO_2 transported in each one-way trip in maritime transportation, in tonnes.

$EF_{maritime}$ = emission factor for maritime transportation, in kg CO_2-eq / tonne.km. The EF presented in Table 3.2 shall be applied.

L = outbound trip by the modal.

T = total number of outbound trips by the modal in year y.

Please note that the more broken-down is the information available on distance between sites, and volume transported, the more accurate will be the estimation of $Proj_{transport,y}$. Therefore, if your data is available per trip, then you shall calculate the emissions for each trip, using the average distance in each leg, and the amount of CO_2 transported in that exact leg (which can be derived from the estimate capacity of the truck), and add them up, as described in the above Equations. Otherwise, a rough estimate of the total distance travelled in the year and the total emissions transported in the year will be accepted as a proxy.

3.4 Relative GHG emission avoidance

Please refer to Section 1.3.2 for Guidance on the calculation of ΔGHG_{rel}. For DAC projects, ΔGHG_{rel} shall be set as 100%.

3.5 Data and parameters

Please refer to Regulation (EU) 2018/2066, Annex IV, Section 23 to information on conversion factors to be used for the calculation of $Proj_{capture}$, $Proj_{pipeline}$ and $Proj_{injection}$.

The table below presents the parameters that will be deemed as constant throughout the duration of the project for the calculation of $Proj_{transport}$. Should applicant wish to adopt emission and conversion factors different to those proposed, a justification shall be provided and the corresponding parameter(s) shall be included in the monitoring plan.

The emissions attributed to electricity use for injection and/or capture shall be zero (EUCO 2050 scenario).

Table 3.2 Parameters not to be monitored (fixed ex-ante)

Data / Parameter	Value to be applied	Data unit	Description	Source of data	Comment
EF_{road}	0.108	kg CO_2e / tonne.km	Emission factor for liquid CO_2 transport by heavy truck.	JRC based on M.L. Perez et al. *Low Carbon Economy, 2012, 3, 21-33. http://dx.doi.org/10.4236/lce.2012.31004*	40 tonne articulated truck carrying 20m3 pressurized cryotank. Includes empty return trip.
EF_{rail}	0.065	kg CO_2e / tonne.km	Emission factors for freight by maritime modals	M.L. Perez et al. *Low Carbon Economy, 2012, 3, 21-33. http://dx.doi.org/10.4236/lce.2012.31004*	Transport in liquid form. Includes necessary boil-off
$EF_{maritime}$	0.030	kg CO_2e / tonne.km	Emission factors for freight by maritime modals	IPCC special report on Carbon Capture and Storage, chapter 4. https://www.ipcc.ch/site/assets/uploads/2018/03/srccs_chapter4-1.pdf	Lower end of IPCC range, Includes fuel combustion and boil-off of CO_2 an empty return trip.

3.6 Monitoring, reporting and verification of performance for disbursement and knowledge-sharing

A monitoring plan consisting of a detailed, complete and transparent documentation of the parameters used in calculations and data sources shall be submitted by the applicant. This document shall contain at least the elements laid down in Equations [3.1] to [3.5].

Table 3.3 presents the parameters that, at minimum, shall be monitored throughout the project and be part of the project's monitoring and reporting plan to be submitted

For the parameters for monitoring corresponding to the $Proj_{capture}$, $Proj_{pipeline}$ and $Proj_{injection}$, please refer to the Monitoring and Reporting Regulation, especially Articles 40 to 46 and Article 49 and Annex IV, Sections 21, 22 and 23. For estimating such emissions, the applicant may also consider the adoption of standard ratios in GHG emissions per tonne of CO_2 stored based on industry benchmarks, should these be available.

All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

For carbon capture and storage projects, there will not be a difference in the MRV for disbursement and for knowledge-sharing.

Table 3.3 Parameters for monitoring

Data / Parameter	Data unit	Description
$CO_{2\ transferred\ to\ the\ capture\ installation}$	tonnes CO_2	Amount of CO_2 transferred to the capture installation
$K_{road,L}$	km	Distance of each one-way trip travelled by road modals

Data / Parameter	Data unit	Description
$CO_{2road,L}$	tonnes CO_2	Amount of CO_2 transported in each one-way trip by road modals
$K_{rail,L}$	km	Distance of each one-way trip travelled by rail
$CO_{2rail,L}$	tonnes CO_2	Amount of CO_2 transported in each one-way trip by rail
$K_{maritime,L}$	km	Distance of each one-way trip travelled by maritime modals
$CO_{2maritime,L}$	tonnes CO_2	Amount of CO_2 transported in each one-way trip by maritime modals

Each parameter monitored shall be accompanied of the following information:

- Source of the data
- Measurement methods and procedures
- Monitoring frequency
- QA/QC Procedures
- Responsibility for collection and archiving

In addition to the parameters listed above, the following parameters shall be monitored on a yearly basis and reported for **knowledge sharing purposes**. Substantial monthly deviations if any should also be reported.

- Capture ratio, in tonnes CO_2e emitted / tonne CO_2 fossil transferred to the capture installation.
- Transport by pipeline ratio, in tonnes CO_2e / tonne CO_2 fossil transferred to the capture installation.
- Injection ratio, in tonnes CO_2e emitted / tonne CO_2 fossil transferred to the capture installation.
- Type(s) of modal(s) used in the transportation of the CO_2 from the site of origin to the storage site
- Weight fraction of the truck, train wagon or ship occupied by the compressed CO_2 and, separately, the empty tank (i.e. fully or partially loaded), per trip and modal.
- High-level mapping of environmental impacts and mitigation measures.
- High-level risk screening and mitigation measures.

4 Renewable electricity, heat and cooling

This section describes the calculation of GHG emission avoidance from small scale innovative renewable energy projects such as bioelectricity, bio-heat, solar, geothermal, wind, and hydro/ocean energy.

The emissions of the project are defined by the difference between the main emissions from the project activity, and the emissions that would occur in the absence of the project for the generation or use of the same amount of energy using the conventional technology or fuel.

For the sake of simplification and to enable a fair competition between projects, the reference scenario has been pre-defined for all projects producing the same output, despite the regional differences that will invariably be observed in real life. Therefore, for the purpose of the IF, if the output is grid-connected electricity, the emissions attributed to grid electricity in the reference scenario corresponds to the typical EU grid emissions during in 2030 according to the Commission's PRIMES/EUCO3232.5 scenarios. For all projects generating renewable heating, a natural gas boiler with 90% LHV efficiency shall be adopted as the reference scenario.

In terms of the project emissions, sources of GHG emissions depend on the technology and supporting infrastructure for the operation of the plant.

For the purpose of the call for small scale projects, GHG emissions due to purchased electricity and fossil fuel consumption in stationary machinery and on-site vehicles at the project site(s) can be disregarded for all project types.

For projects delivering electricity or heat from geothermal energy and from biogenic sources, leakage during the operation of geothermal power plants and GHG emissions from the production and supply of biomass-based fuels used shall be accounted for in the calculations.

Applicants for projects generating more than one energy output, e.g. heat and electricity, biofuel and heat, etc., shall calculate the GHG emission avoidance separately using the appropriate equation for each energy output and add them up.

For projects that include physical or virtual storage of renewable electricity at times when there is an excess of it in the grid-mix, e.g. smart grid applications, should be considered as hybrid projects. They should split their feed-in of grid electricity into a storage component and the residual uncontrolled feed-in. In order to claim such a credit the applicant must provide details of their plan to manage power consumption to coincide with times when the emissions of the electricity supply are below average. The emission avoidance of the storage component shall be calculated as in section on emissions accounting for energy storage (see Section 5).

Funding could be used for the retrofitting (or repowering), rehabilitation (or refurbishment), replacement or capacity addition of an existing renewable power plant, the construction of a power plant that will use renewable energy sources to generate energy; or the construction of a manufacturing plant of components of innovative technologies that will generate renewable energy, when implemented.

Successful projects will be required to maintain records of measurements, quality assurance and quality control procedures and calculations used in the development of data reported, along with copies of reported data and forms submitted.

4.1 Scope

This methodology applies for innovative renewable energy projects for the purpose of generating electricity and heating/cooling, including electricity and/or heat produced from biomass or fuels derived from biomass.

Any innovative renewable energy generation projects that can demonstrate GHG emission avoidance could be eligible for funding.

This methodology envisages applications from activities that meet the conditions listed below.

4.1.1 Products

- Electricity from wind, solar, ocean, hydro, geothermal energy, biomass
- Combined heating and power from geothermal energy or biomass
- Heating and cooling, including from solar and geothermal energy, biomass
- Components for renewable energy installations (e.g. production of innovative heat pumps, PV modules and wind turbines)

4.1.2 Possible types of projects

- Retrofitting (or repowering), rehabilitation (or refurbishment), replacement or capacity addition of an existing renewable power plant.
- Construction of a power plant that will use renewable energy sources to generate electrical and thermal energy; or
- Construction of a manufacturing plant of components of innovative renewable technologies

4.1.2.1 Construction of a manufacturing plant of innovative technologies' components

Where funding will be used to finance the construction of a manufacturing plant (i.e. manufacturing plant) of components for innovative technologies, applicants shall demonstrate the existence of a buyer (i.e. a company that will run the innovative technology to generate renewable electrical or thermal energy or to store energy) through provisional contract agreements to ensure:

- accountability over the intended GHG emission avoidance, and
- that the use takes place in the territory of the EU/Norway/Iceland.

For information on how GHG emission avoidance will be calculated for such projects, please refer to Section 4.2.2.

4.1.3 Project boundary

The emission sources that shall be included within the boundaries of the calculations for wind, ocean, solar, geothermal and bio-fuels[22] to grid or to heat projects are shown in Table 4.1.

Table 4.1 Emission sources included in or excluded from the boundaries of the GHG emission avoidance calculation

	Source	Included
Reference (Ref)	GHG emissions for the generation of grid-connected electricity (Ref_{grid}), heating (Ref_{heat}) or cooling (Ref_{cool}) in fossil fuel fired power plants, which will be displaced due to the project activity	Yes
Project (Proj)	GHG emissions due to purchased electricity and fossil fuel consumption in stationary machinery and on-site vehicles at the project site(s) ($Proj_{on\text{-}site}$)	No
	GHG emissions due to leakage during the operation of geothermal power plants ($Proj_{geo}$)	Yes

[22] Bio-based fuels comprises biomass, biogas, biomethane, biofuels and bioliquids in their REDII definitions.

	Source	Included
	GHG emissions from the production and supply of supply of consumed materials other than fuels ($Proj_{bio}$)	Yes

4.2 Absolute GHG emission avoidance

The equation to be applied for the calculation of the Absolute GHG emissions avoidance is are described in the following sections.

Project type	GHG emission avoidance	=	Reference emissions	-	Project emissions	
Delivered electricity from wind, hydro, ocean, solar, geothermal energy and from biogenic sources. Including manufacturing plants	$\Delta GHG_{abs,RES\text{-}to\text{-}grid,y}$	=	$\sum_{y=1}^{10} Ref_{grid,y}$	-	$\sum_{y=1}^{10} (Proj_{bio,y} + Proj_{geo,y})$	[4.1]
Delivered heat from solar, geothermal energy and from biogenic sources. Including manufacturing plants	$\Delta GHG_{abs,\ RES\ to\ heat,y}$	=	$\sum_{y=1}^{10} Ref_{heat,y}$	-	$\sum_{y=1}^{10} (Proj_{,bio,y} + Proj_{geo,y})$	[4.2]
Delivered cooling from solar, geothermal energy and from biogenic sources. Including manufacturing plants	$\Delta GHG_{abs,\ RES\ to\ cool,y}$	=	$\sum_{y=1}^{10} Ref_{cool,y}$	-	$\sum_{y=1}^{10} (Proj_{,bio,y} + Proj_{geo,y})$	[4.3]

Where:

$Ref_{grid,y}$, GHG emissions for the generation of electricity in fossil fuel fired power plants, which will be displaced due to the wind, solar, ocean and geothermal activity or from liquid, gaseous or solid biofuels in year y, in tonnes CO_2e. Calculated according to Equation [4.3].

$Ref_{heat,y}$ = GHG emissions for the generation of heating in fossil fuel fired plants, which will be displaced due to the wind, solar, ocean and geothermal activity or from liquid, gaseous or solid biofuels in year y, in tonnes CO_2e. Calculated according to Equation [4.5].

$Ref_{cool,y}$ = GHG emissions for the generation of cooling in fossil fuel fired plants, which will be displaced due to the wind, solar, ocean and geothermal activity or from liquid, gaseous or solid biofuels in year y, in tonnes CO_2e. Calculated according to Equation [4.7].

$Proj_{bio,y}$= GHG emissions from the production and supply of biomass-based fuels for conversion into heat or electricity in year y, in tonnes CO_2e. Calculated according to Equation [4.9].

$Proj_{geo,y}$ = GHG emissions from the operation of the geothermal power plant in year y, in tonnes CO_2e. Calculated according to Equation [4.10].

y = year of the operation

4.2.1.1 Reference emissions sub-equations

Parameter	=	Equation	
$Ref_{grid,y}$	=	$EG_{grid,y} * EF_{grid,ref}$	[4.3]
$EG_{grid,y}$	=	$P_{elec} * PLF * T_y$	[4.4]
$Ref_{heat,y}$	=	$EG_{heat,y} * EF_{NG,ref} / 0.90$	[4.5]
$EG_{heat,y}$	=	$P_{heat} * PLF * T_y$	[4.6]
$Ref_{cool,y}$	=	$EG_{cool,y} * EF_{grid,ref}$	[4.7]
$EG_{cool,y}$	=	$P_{cool} * PLF * T_y$	[4.8]

Where:

$EG_{grid,y}$ = Net[23] amount of electricity to be generated by the renewable technology in year y, in MWh. Calculated according to Equation [4.4].

$EG_{heat,y}$ = Net amount of heat to be delivered by the renewable technology in year y, in MWh. Calculated according to Equation [4.6].

$EG_{cool,y}$ = Net amount of cooling to be delivered by the renewable technology in year y, in MWh. Calculated according to Equation [4.8].

P_{elec} = Electric power plant installed capacity, i.e. maximum power output, in Watts.

P_{heat} = Heating generation plant installed capacity, i.e. maximum power output, in Watts.

P_{cool} = Cooling generation plant installed capacity, i.e. maximum power output, in Watts.

PLF = Plant Load Factor, i.e. plant's capacity utilisation, in %

T_y = operating hours in year y, in hours.

$EF_{grid,ref}$ = EU grid emissions factor in the reference period, in tonnes CO_2e/MWh. The appropriate EF presented in Table 4.2 should be applied.

$EF_{NG,ref}$ = Emission factor due to the combustion of the reference fuel, in tonnes CO_2e/MWh. Assumed to be natural gas for all projects generating heat. The EF presented in Table 4.2 should be applied.

y = year of operation

4.2.1.2 Project emissions sub-equations

Parameter	=	Equation	
$Proj_{bio,y}$	=	$\sum_{y=1}^{n} EC_{bio.f,y} * EF_{bio,f} * 0.85$[24]	[4.9]

Where:

$EC_{bio,f.y}$ =Amount of bio-based fuel *'f'* consumed by the project in year y , in MJ (LHV).

[23] Only the energy generated for external usage, i.e. fed into the grid or directly to another party or to a use not directly related to the renewable energy production should be accounted for. Any on-site usage or losses occurring during the renewable energy production shall be deducted from the calculation of EG. For the situations where the project involves retrofit/capacity added to an existing plant, only the surplus should be accounted for.

[24] To deducted emissions from the extraction and transport of crude oil, NG etc., as well as transport and distribution of the final fuel that are comprised in REDII but are not accounted for in EU ETS.

$EF_{bio,f}$ =GHG emissions from the supply of bio-based fuel '*f*' used to make heat and/or electricity, produced, in tonnes CO_2e /MJ of bio-based fuel. Calculated according to 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), Annexes V and VI

y = year of operation

Parameter	=	Equation	
$Proj_{geo,y}$	=	$Proj_{dry\_flash,y} + Proj_{binary,y}$	[4.10]
$Proj_{dry\_flash,y}$	=	0.00544695[25] $* M_{steam,y}$	[4.11]
$Proj_{binary,y}$	=	$(M_{inflow,y} - M_{outflow,y}) * 0.00544695 + M_{working\ fluid,y} * GWP_{working\ fluid}$	[4.12]

Where:

$Proj_{dry\_flash}$ = GHG emissions due to release of non-condensable gases from produced steam during the operation of dry steam or flash steam geothermal power plants in year y, in tonnes CO_2e.

$Proj_{binary}$ = GHG emissions due to physical leakage of non-condensable gases and working fluid during the operation of binary geothermal power plants in year y, in tonnes CO_2e.

$M_{steam,y}$ = Quantity of steam produced in year y, in tonnes steam.

$M_{inflow,y}$ = Quantity of steam entering the geothermal plant in year y, in tonnes steam.

$M_{outflow,y}$ = Quantity of steam leaving the geothermal plant in year y, in tonnes steam.

$M_{working\ fluid,y}$ = Quantity of working fluid consumed in year y, in tonnes of working fluid.

$GWP_{working\ fluid}$ = Global Warming Potential for the working fluid used in the binary geothermal power plant.

y = year of the operation.

When estimating leakage emissions for geothermal plants, the applicant may also consider the adoption of standard ratios for parameters like the mass of steam per MWh generated, steam losses and working fluid per tonne of steam, based on industry benchmarks, should these be available.

4.2.2 Construction of a manufacturing plant of innovative technologies components

For the situations where funding will be used to finance the construction of a manufacturing plant of innovative technologies components, the same equations presented in Section 4.2 and subsections shall be used. The difference will rest on how the net amount of energy to be generated by the renewable technology shall be estimated.

For such projects, this will result from credible forecasts of:

- Number of components produced each year,
- Capacity for each component when implemented,
- Load factor, and
- Operating hours,

[25] Based on IPCC AR5 and CDM benchmarks. Assumes: Average mass fraction of methane in the produced steam = 0.00000413 tonnes CH4/ tonne steam; Average mass fraction of carbon dioxide in the produced steam = 0.00533144 tonnes CO2/tonne steam.

The rationale for the assumptions adopted to forecast the performance of the component produced as well as of other components that will be needed at the power plant but are not necessarily covered by the manufacturing plant shall be surrendered.

4.3 Relative GHG emission avoidance

Please refer to Section 1.3.2 for Guidance on the calculation of ΔGHG_{rel}. For wind, solar and ocean projects, ΔGHG_{rel} shall be set as 100%.

4.4 Data and parameters

The table below presents the parameters that will be deemed as constant throughout the duration of the project, unless otherwise stated.

For inputs that are not listed here, please look them up in the hierarchy of sources in Appendix 2.3.

Table 4.2 Parameters not to be monitored

Data / Parameter	Value to be applied	Data unit	Description	Source of data	Assumption / Comment
$EF_{NG,ref}$	0.202	tonnes CO_2e / MWh NG	Emission factor for combustion of natural gas	Commission Delegated Regulation (EU) 2018/2066, Annex VI	56.1 tCO_2/TJ times 0.0036 TJ/MWh.
$EF_{grid,ref}$	0.150	tonnes CO_2e / MWh	Emissions of electricity production in 2030	Technical Note Results of the EUCO3232.5 scenario on Member States	Base year 2030. Combustion only.

4.5 Monitoring, reporting and verification of performance for disbursement and knowledge-sharing

A monitoring plan consisting of a detailed, complete and transparent documentation of the parameters used in calculations and data sources shall be submitted. The table below presents the parameters that, at minimum, shall be monitored throughout the project and be part of the project's monitoring and reporting plan.

All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

Table 4.3 Parameters for monitoring

Data / Parameter	Data unit	Description	Comment
EG_{grid}	MWh	Net amount of electricity to be generated by the renewable technology and fed into the grid	Alternatively, derived from: P_{elec}, PLF, Ty
EG_{heat}	MWh	Net amount of heat to be generated by the renewable technology	Alternatively, derived from: P_{heat}, PLF, Ty

Data / Parameter	Data unit	Description	Comment
EG_{cool}	MWh	Net amount of cooling to be generated by the renewable technology	Alternatively, derived from: P_{cool}, PLF, Ty
$M_{steam,}$	tonnes steam	Quantity of steam produced	
$M_{inflow,}$	tonnes steam	Quantity of steam entering the geothermal plant	
$M_{outflow,}$	tonnes steam	Quantity of steam leaving the geothermal plant	
$M_{working\ fluid}$	tonnes working fluid	Quantity of working fluid leaked/reinjected	
$GWP_{working\ fluid}$	tonnes CO_2 / tonnes working fluid	Global Warming Potential for the working fluid used in the binary geothermal power plant.	
$EC_{bio.f,y}$	MJ	Amount of bio-based fuel 'f' consumed by the project	
$EF_{bio.f}$	tonnes CO_2e /MJ	GHG emissions from the supply of bio-based fuel 'f'	

Each parameter monitored shall be accompanied of the following information:

- Source of the data
- Measurement methods and procedures
- Monitoring frequency
- QA/QC Procedures
- Responsibility for collection and archiving

In addition to the parameters listed above, it is suggested that the following parameters are monitored and reported for **knowledge sharing purposes**:

- [All RES] Energy generated by hour, based on the actual load factor, and technology efficiency per operating hour.
- [All RES] Key raw materials and feedstock used at the power plant, and their origin.
- [All RES] Quantity of fossil fuel type FF combusted in stationary sources at the project site
- [All RES] Quantity of fossil fuel type FF combusted in mobile sources at the project site
- [All RES] Amount of electricity imported from the grid and consumed at the project site

- [Geothermal] Composition of steam by month, in % of each element.
- [Geothermal] Average loss, by month, i.e. Quantity of steam leaving the geothermal plant / Quantity of steam entering the geothermal plant, in %.
- [Geothermal] Average amount working fluid leaked/reinjected by month, in t working fluid/t steam entering the geothermal plant.
- [Geothermal] Heat production by month, in kWh / t steam entering the geothermal plant.
- [Geothermal] Electricity production by month, in kWh / t steam entering the geothermal plant.
- [Waste to energy] Original use/treatment of the feedstock.
- [Bioelectricity and heat] Type of bio-based fuel used (refer to annexes V and VI of the REDII). Any pre-treatment(s) of biomass before processing.
- [Bioelectricity and heat] Type(s) of modal(s) used in the transportation of solid biomass fuels from the site of origin to the bio-refinery or power plant.
- High-level mapping of environmental impacts and mitigation measures.
- High-level risk screening and mitigation measures.

5 Energy storage

GHG emission avoidance of an energy storage project is calculated as an annual comparison of the project emissions and the emissions in a reference scenario without the presence of an energy storage unit.

Specifically, emissions in the reference scenario will correspond to the emissions avoided due to the displaced energy by the output of the energy storage, whereas project emissions will be those associated with the input to the energy storage during operation. On-site emissions of fugitive GHGs and from energy use other than energy storage will not be considered but have to be reported for knowledge sharing purposes.

The methodology distinguishes between the storage of various types of energy, among others electricity, heat and hydrogen. Multiple outputs are considered. The energy stored may both be sourced from an energy grid or directly from a plant and be delivered to an energy grid or directly to a plant. The applicant will be able to supply evidence for the origin and the user of the energy stored. Otherwise, default factors depending on the source and user will be applied. If the project delivers also auxiliary services to energy networks, this will be valued positively under the degree of innovation criterion. Applicants should demonstrate this through additional calculation of the emissions avoided through these services and also argue their case in the degree of innovation part of the Application Form Part B.

Successful projects will be required to maintain records of measurements, quality assurance and quality control procedures and calculations used in the development of data reported, along with copies of reported data and forms submitted.

During the operating period, the applicant will need to prove, based on the same annual methodology, that the GHG emission avoidance is delivered. In addition, the project operators will be asked to deliver hourly load profiles for knowledge sharing purposes.

5.1 Scope

This methodology applies to projects that include the construction and operation of a greenfield plant or the extension of an existing plant by a unit that stores any type of energy (in particular electricity, heat, cold, hydrogen, gaseous or liquid fuels) that was supplied to the moment of use. The storing of energy may include the conversion of one energy type into another.

A project is classified as an energy storage project, if energy storage (in any of the forms defined above) is the major purpose or one of its major purposes.

A project that includes energy storage but has industrial production as a major purpose should follow the guidance for energy intensive industry projects (see Section 2). For a project focusing on the production of hydrogen or renewable fuels of non-biological origin, the applicant should select to use this methodology if the majority of the revenue for the project comes from the energy stored (e.g. due to avoided curtailment). Otherwise, the applicant should follow the methodology for energy intensive industry projects. If such a project or any other industrial project makes use of fluctuations in electricity markets, it should calculate the associated GHG emission avoidance based on the guidance for energy storage projects.

This methodology is applicable to energy storage projects related to the following services, technologies, energy sources and energy sinks (though not limited to the list below):

5.1.1 Services and products

- Short-term electricity storage (among others arbitrage, reserve power, ramping),
- Avoidance of renewable energy curtailment,
- Other energy storage,
- Manufacture of components for energy storage, such as batteries.

5.1.2 Technologies

- Electricity storage technologies,
- Heat and cold storage technologies,
- Hydrogen storage technologies,
- Gaseous fuel storage technologies,
- Liquid fuel storage technologies, or
- Combinations of the above, including smart grid technologies.

5.1.3 Energy sources

- Electricity grid,
- Heat grid,
- Gas grid,
- Pipelines and trailers,
- Renewable energy plants, or
- Waste heat recovery.

5.1.4 Energy sinks

- Electricity grid,
- Heat grid,
- Gas grid,
- Pipelines and trailers,
- Fuelling stations, or
- Industrial plants.

5.2 Project boundary

The spatial extent of the project boundary includes the project energy storage plant/unit and all facilities that the IF project energy storage plant is connected to and are not metered separately. In well justified cases, such as for management of distributed renewable energy, the condition for a single metering point may not be applicable.

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in Table 5.1.

Table 5.1 Emission sources included in the project boundary

	Source	Included
Reference scenario (Ref)	Ref_{energy}: Emissions related to the provision of energy in the absence of the project activity. This includes direct emissions from the use of fossil fuels and generation of heat, indirect emissions from the use of grid electricity and grid heat, process-related emissions from the production of hydrogen as well as from transmission losses associated with the network transport.	Yes

	Source	Included
	$Ref_{services}$: Emissions related to the provision of auxiliary services to the grids in the absence of the project activity. This includes direct emissions from the use of fossil fuels and generation of heat, in particular from inefficient operation of fossil-fuelled plants, indirect emissions from the use of grid electricity and grid heat as well as from transmission losses associated with the grid transport.	No
Project (Proj)	$Proj_{energy}$: Emissions related to the provision of energy caused by the project activity. This includes direct emissions from the use of fossil fuels and generation of heat, indirect emissions from the use of grid electricity and grid heat, process-related emissions from the production of hydrogen as well as from transmission losses associated with the grid transport.	Yes
	$Proj_{on\text{-}site}$: On-site emissions of fugitive GHGs and from energy use other than energy storage. This includes emissions from combustion at the vehicles, and other processes at installations functionally connected to the transport network including booster stations; fugitive and vented emissions from the transport network.	No

5.3 Absolute GHG emission avoidance

The equations to be applied for calculating absolute GHG emission avoidance by an energy storage plant are described below.
TThe absolute GHG emission avoidance by an energy storage plant shall be calculated according to Equation [5.1]. For a manufacturing plant that produces energy storage units, the absolute GHG emission avoidance shall be calculated according to Equation [5.2]. In the case of a manufacturing plant, the term 'energy storage plant' occurring in the sub-equations is meant to refer to one energy storage unit delivered to the markets.

GHG emission avoidance	=	Reference scenario emissions	–	Project emissions	
$\Delta GHG_{abs,storage}$	=	$\sum_{y=1}^{10} Ref_{energy,y}$	–	$\sum_{y=1}^{10} Proj_{energy,y}$	[5.1]
$\Delta GHG_{abs,storage}$	=	$\sum_{y=1}^{10} N_y \times Ref_{energy,y}$	–	$\sum_{y=1}^{10} N_y \times Proj_{energy,y}$	[5.2]

Where:

$Ref_{energy,y}$ = Energy-related GHG emissions present in the reference scenario in year y that will not occur due to the energy storage plant put in place, in tonnes CO_2. This includes direct emissions from the use of fossil fuels and generation of heat, indirect emissions from the use of grid electricity and grid heat, process-related emissions from the production of hydrogen as well as from transmission losses associated with the grid transport. It shall be calculated according to Equation [5.3] below.

$Proj_{energy,y}$ = Energy-related GHG emissions not present in the reference scenario in year y that will occur due to the provision of energy by the energy storage plant, in tonnes CO_2. This includes direct emissions from the use of fossil fuels and generation of heat, indirect emissions from the use of grid electricity and grid heat, process-related emissions from the production of hydrogen as well as from transmission losses associated with the grid transport. It shall be calculated according to Equation [5.4] below.

N_y = number of energy storage units supplied to markets by the proposed manufacturing plant of energy storage units, in year *y*. The applicant shall estimate this based on the expected output of the manufacturing plant and the current market potential.

y = year of operation.

Parameter	=	Equation	
$Ref_{energy,y}$	=	$EF_{transport,y} * E_{transport,y} + \sum_{x=1}^{X} EF_{out,x,y} * E_{out,x,y} / (1 - \theta_x)$	[5.3]

Where:

X = number of energy types considered. This includes all energy types replaced, in particular all kinds of energy carriers as well as energy types with associated indirect GHG emissions such as electricity and heat.

$E_{transport,y}$ = electricity supplied for the use in non-rail vehicles, in year *y*, in terra Joules (TJ). For the application, this shall be estimated by the applicant based on the foreseen operation of the energy storage in line with the planned storage capacity, storing cycles as well as the rated input and output power. For the situations where funding will be used to finance the construction of a manufacturing plant of innovative technologies' components, it shall be estimated based on forecasted power, useful storage capacity, state-of-charge range and operating cycles that the innovative technology(ies) or component(s) will be able to generate when implemented.

$EF_{transport,y}$ = emission factor for the energy displaced by the output of the energy storage in non-rail vehicles, in year *y*, in tonnes CO_2e/TJ. For the emission factors, the values presented in Table 5.2 shall be applied as the default case. If the energy is delivered to a pre-defined set of end-users with a reference emission intensity deviating from the default case, the applicant shall use an emission intensity tied to the specific case, providing verifiable information on it.

$E_{out,x,y}$ = secondary energy supplied to energy grids or final energy delivered to end-user of energy type *x*, in year *y*, in terra Joules (TJ). For the application, this shall be estimated by the applicant based on the foreseen operation of the energy storage plant in line with the planned storage capacity, storing cycles as well as the rated input and output power. For the situations where funding will be used to finance the construction of a manufacturing plant of innovative technologies' components, it shall be estimated based on forecasted capacity, load factor and operating hours that the innovative technology(ies) or component(s) will be able to generate when implemented.

$EF_{out,x,y}$ = emission factor for the energy displaced by the output of the energy storage plant of energy type *x*, in year *y*, in tonnes CO_2e/TJ. For the emission factors, the values presented in Table 5.2 shall be applied as the default case. If the energy is delivered to a pre-defined set of end-users with a reference emission intensity deviating from the default case, the applicant shall use an emission intensity tied to the specific case, providing verifiable information on it.

θ_x = mean losses from transport of energy type *x*, in percent. The EU default values presented in Table 5.2 should be applied.

Parameter	=	Equation	
$Proj_{energy,y}$	=	$\sum_{x=1}^{X} EF_{in,x,y} * E_{in,x,y} / (1 - \theta_x)$	[5.4]

Where:

X = number of energy types considered. The applicant needs to include all energy types used, in particular all kinds of energy carriers as well as energy types with associated indirect GHG emissions such as electricity and heat.

$E_{in,y,x}$ = energy used by the energy storage plant of energy type *x*, in year *y*, in terra Joules (TJ). This includes both the energy stored in the energy storage plant and its self-consumption of energy. For the proposal, this shall be estimated by the applicant based on the foreseen operation of the energy storage unit in line with the planned storage capacity, storage efficiency, storing cycles and the rated input power. For the situations where funding will be used to finance the construction of a manufacturing plant of innovative technologies' components, it shall be estimated based on forecasted capacity, load factor and operating hours that the innovative technology(ies) or component(s) will be able to generate when implemented.

$EF_{in,y,x}$ = emission factor of energy type *x* for the energy used by the energy storage plant, in year *y*, in terra Joules (TJ). For the emission factors, the values presented in Table 5.2 shall be applied as the default case. If the energy is supplied by a pre-defined set of suppliers with a reference emission intensity deviating from the default case, the applicant shall use an emission intensity tied to the specific case, providing verifiable information on it.

θ_x = mean losses from transport of energy type *x*, in percent. The EU default values presented in Table 5.2 should be applied.

5.4 Relative GHG emission avoidance

Please refer to Section 1.3.2 for Guidance on the calculation of ΔGHG_{rel}.

Data and parameters

The table below presents the parameters that will be deemed as constant throughout the duration of the project, unless otherwise stated.

Table 5.2 Parameters not to be monitored

Data / Parameter	Value to be applied	Data unit	Description	Source of data	Comment
$EF_{in,H2,y}$ / $EF_{out,H2,y}$	62.4 (8.85)	t CO_2e / TJ (t CO_2e / tonne H_2)	Emission benchmark for generating hydrogen under the ETS in year *y*	COMMISSION DELEGATED REGULATION (EU) 2019/331	Starting point for determination of annual reduction rate for benchmark value update not yet defined
$EF_{in,heat,y}$ / $EF_{out,heat,y}$	62.3	t CO_2-eq / TJ	Emission benchmark for generating heat under the ETS in year *y*	COMMISSION DELEGATED REGULATION (EU) 2018/2066, annex VI	Starting point for determination of annual reduction rate for benchmark value update not yet defined
$EF_{in,natural\ gas}$ / $EF_{out,natural\ gas}$	56.1.	t CO_2-eq / TJ	Combustion emissions of natural gas	Ibid	
$EF_{in,diesel}$/ $EF_{out,diesel}$	74.1	t CO_2-eq / TJ	Combustion emissions of diesel fuel or gasoil	Ibid	

Data / Parameter	Value to be applied	Data unit	Description	Source of data	Comment
$EF_{in,heavy\ fuel\ oil}$ / $EF_{out,heavy\ fuel\ oil}$	77.4	t CO_2-eq / TJ	Combustion emissions of heavy fuel oil (residual fuel oil)	Ibid	
$EF_{in,\ other\ fossil\ fuels}$ / $EF_{out,\ other\ fossil\ fuels}$	look up in table 1 of COMMISSION DELEGATED REGULATION (EU) 2018/2066, annex VI	t CO_2-eq / TJ	Combustion emissions many fossil fuels	Ibid	If not in that table, use the literature hierarchy in Appendix 2.3
$EF_{in,electricity,y}$	0	t CO_2-eq / TJ	Emissions for electricity and steam production in 2050	By assumption	The 2050 value provided here should be applied in all years *y*.
$EF_{out,electricity,y}$	140	t CO_2-eq / TJ	Emissions for with single-cycle NG turbine (used for peaking power)	COMMISSION DELEGATED REGULATION (EU) 2018/2066, annex VI	The value should be applied in all years *y*. Based on $EF_{out,natural\ gas}$ and an electrical efficiency of 40%. Note this corresponds to 504 tCO_2/GWh.
$EF_{transport,y}$	222.3	t CO_2-eq / TJ	Emissions for diesel-fuelled combustion engines (used in vehicles)	Ibid	The value should be applied in all years *y*. Based on $EF_{out,diesel}$ and a three times higher efficiency of electric motors compared to combustion engines. Note this corresponds to 800 tCO_2/GWh.
$\theta_{electricity}$	6.58	%	Mean losses due to transport of electricity to consumers via the grid in the EU in 2018	EUROSTAT 2020	
θ_{heat}	8.54	%	Mean losses due to transport of heat to	EUROSTAT 2020	

Data / Parameter	Value to be applied	Data unit	Description	Source of data	Comment
			consumers via heat networks in the EU in 2018		
Θ_{gas}	0.43	%	Mean losses due to transport of gaseous fuels to consumers via the grid in the EU in 2018	EUROSTAT 2020	

5.5 Monitoring, reporting and verification of performance for disbursement and knowledge-sharing

A monitoring plan consisting of a detailed, complete and transparent documentation of the parameters used in calculations and data sources shall be submitted. This document shall contain at least the elements laid down in Equations [5.3] to [5.8].

The verification of achieved GHG emission avoidance will be based on the annual aggregation of the hourly output profiles, using the same equations and default parameters as during the proposal stage.

Table 5.3 presents the parameters that, at minimum, shall be monitored throughout the project and be part of the project's monitoring and reporting plan.

All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

In addition, at entry into operation, the applicant will need to provide technical documentation of the energy storage plant and its connections to end-users and energy grids, including the current local grid conditions with respect to renewable energy, grid congestions and auxiliary service requirements.

For the situations where funding will be used to finance the construction of a manufacturing plant of innovative technologies' components, applicants shall demonstrate at the application the contractual arrangements with customers (i.e. companies that will run the innovative energy storage technology).

Table 5.3 Parameters for monitoring

Data / Parameter	Data unit	Description	Comment
P_{in},	MW	Input power rating	
P_{out}	MW	Output power rating	
E_{stor}	TJ	Maximum storage capacity including degradation	
$R_{services,gen}$	MW	Generator rating	Only for intra-daily electricity storage

Data / Parameter	Data unit	Description	Comment
$R_{services,var}$	Mvar	Reactive power rating	Only for intra-daily electricity storage; set to 0 if not applicable
$R_{services,Inert}$	GVAs	Inertia capability rating	Only for intra-daily electricity storage; set to 0 if not applicable
η	%	Input-output efficiency including storage losses	To be derived from stock, input and output
$E_{in,x}$	TJ	Energy used by the project of type *x*	Hourly data required for knowledge sharing purposes
$E_{transport}$	TJ	Electricity supplied for the use in non-rail vehicles	For cars, an average travel distance of 14,300 km/year should be assumed. For other types of vehicles, individual data and data source should be provided.
$E_{out,x}$	TJ	Energy supplied by the project of type *x*	Hourly data required for knowledge sharing purposes

Each parameter monitored shall be accompanied of the following information:

- Source of the data
- Measurement methods and procedures
- Monitoring frequency
- QA/QC Procedures
- Responsibility for collection and archiving

In addition to the parameters listed above, the following parameters will be monitored and reported for **knowledge sharing purposes** where applicable:

- Energy consumed and supplied by each energy storage unit individually metered (per annum).
- Hourly profiles for use and feed-in of grid electricity aggregated on the level of grid zones.
- Hourly profiles for generation of electricity delivered to the project from PPAs by grid zone.
- Hourly profiles for avoided curtailment based on final physical notifications of co-located RES plants or grid operator instructions.
- Hourly profiles for provided system services by grid zone.

- Annual amounts of fugitive emissions of greenhouse gases at the project site
- Annual energy use in stationary and mobile sources (except in the energy storage units) at the project site by energy type.
- Reliability expressed according to reliability indicators such as Energy Not Supplied by grid zone.
- Improvement in voltage variation in the grid and length of voltage variation attributable to the Project versus reference system by grid zone.
- Total Loss of Power, Restoration Time, Equivalent Time of Interruption by grid zone.
- High-level mapping of environmental impacts and mitigation measures.
- High-level risk screening and mitigation measures.

Appendix M.1. Classification of projects into sectors

CATEGORY	SECTOR	PRODUCTS
Energy storage	Intra-day electricity storage	electricity
incl. manufacturing plants for components	Other energy storage	electricity
		heating/cooling
		e-fuels
		hydrogen
Renewable energy	Wind energy	electricity
incl. manufacturing plants for components	Solar energy	electricity
	Hydro/Ocean energy	electricity
	Geothermal energy	electricity, CHP
	Bio-electricity	electricity, CHP
	Renewable Heating/Cooling	heating/cooling
Energy Intensive Industries incl. CCU	Refineries	fuels (incl. e-fuels)
	Biofuels and bio-refineries	biofuel, bio-based products
incl. substitute products	Iron & steel	coke
incl. CCS (CO_2 capture and full chain)		iron ore
		iron
		steel
		cast ferrous metals products
		other ferrous metal products or substitute products
	Non-ferrous metals	aluminium
		precious metals
		copper
		other non-ferrous metal
		cast non-ferrous metal products
		other ferrous metal products or substitute products
	Cement & lime	cement
		lime, dolime, sintered dolime
		other cement or lime products or substitute products
	Glass, ceramics & construction material	flat glass
		container glass
		glass fibres
		other glass products
		tiles, plates, refractory products
		bricks
		houseware, sanitary ware

CATEGORY	SECTOR	PRODUCTS
		other ceramic products
		mineral wool
		gypsum and gypsum products
		other construction materials or substitute products
	Pulp & paper	chemical pulp
		mechanical pulp
		paper and paperboard
		sanitary and tissue paper
		other paper products or substitute products
	Chemicals	organic basic chemicals
		inorganic basic chemicals
		nitrogen compounds
		plastics in primary forms
		synthetic rubber
		other chemical products or substitute products
	Hydrogen	hydrogen
	Other	electricity
		heat
		other
CCS (CO_2 Transport and Storage)	CO_2 Transport and Storage	CO_2 Transport and Storage

Notes:
Categories: those are derived from the legal basis – Article 10(a) of the EU ETS Directive. They also help applicants choose the right methodology section for calculations of the GHG emission avoidance. CCS projects follow the methodology in the section Carbon capture and storage irrespective if they fall in the Energy Intensive Industry category or not.
Sectors: are derived from the sectors listed in Annex I of the EU ETS Directive, the type of renewable energy source or energy storage. For Carbon capture and storage and Energy intensive industries, a sector is defined by its products, i.e. there is a unique relationship between a product and the corresponding sector. This list helps the applicant to choose the sector for the purpose of the GHG emission avoidance calculations.
Products: The list of products in the table given for each sector are non-exclusive and most give 'other products [specified to sector]' as an option. If your project is producing a product that is not specified, please define it clearly in the Application Form.
There are a few exceptions to this rule:

- The only product of the sector 'hydrogen' is hydrogen.
- 'Biofuels and bio-refineries' are defined separately from 'Refineries'. The former covers biologically based products, while the latter accounts for all other activities that lead to the production of fuels, except hydrogen. The generic product 'fuels (incl. e-fuels)' shows that diverse products (and related technologies) are covered here.
- The sector 'Glass, ceramics & construction material' is a combination of the EU ETS sectors 'Glass and ceramics', 'Mineral wool' and 'Gypsum'.

- The sector 'Other' covers all other activities that fall under the EU ETS. This particularly covers combustion to generate heat and electricity. This could include projects that improve efficiency in conventional combustion plants for electricity generation or make use of CCS in the power sector or waste to energy plants. The sector also covers all other combustion for industrial purposes, which falls under the EU ETS if the thermal heat input exceeds 20MW. This can apply to many sectors such as food processing or textiles. The list of products therefore also gives 'other' as an option, next to heat and electricity.
- The list of products in renewable energy is exclusive, which means that projects generating heat outside of 'Geothermal energy' and 'Bio-electricity' are combined in the separate sector 'Renewable Heating/Cooling'. 'Wind energy', 'Solar energy' and 'Hydro/Ocean energy' are associated with electricity as exclusive product.
- For 'Intra-day electricity storage' the only product is electricity, while the products of 'other energy storage' can take different forms, which is accounted for by the different products listed separately and in line with products of other sectors.

Appendix M.2. Definitions[26]

For the purpose of this methodology, the following definitions apply:

(1) 'accuracy' means the closeness of the agreement between the result of a measurement and the true value of the particular quantity or a reference value determined empirically using internationally accepted and traceable calibration materials and standard methods, taking into account both random and systematic factors.

(2) 'activity data' means data on the amount of fuels or materials consumed or produced by a process relevant for the calculation-based monitoring methodology, expressed in terajoules, mass in tonnes or (for gases) volume in normal cubic metres, as appropriate.

(3) 'auxiliary services to electricity grids' mean services required for the operation of electricity grids such as the provision of reserve power, reactive power, inertia, frequency response and similar.

(4) binary geothermal power plant' is a geothermal technology that utilises an organic Rankine cycle (ORC) or a Kalina cycle and typically operates with temperatures varying from as low as 73°C to 180°C. In these plants, heat is recovered from the geothermal fluid using heat exchangers to vaporise an organic fluid with a low boiling point (e.g. butane or pentane in the ORC cycle and an ammonia-water mixture in the Kalina cycle) and drive a turbine. Binary geothermal plants are categorised as closed cycle technology.

(5) 'bio-electricity' means electricity generated from biomass-derived fuels

(6) 'biofuels' means liquid fuel, suitable for transport use, produced from biomass.

(7) 'biogas' means gaseous fuels produced from biomass.

(8) 'bio-heat' means heating or cooling from biomass-derived fuels.

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

(10) 'biomethane' means biogas that is purified to a standard fit to inject into the natural gas grid.

(11) 'biomass-derived fuels' include biomass, solid biofuels, bioliquids, liquid biofuels, biogas and biomethane, in the meanings of REDII.

(12) '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.

(13) 'calculation factors' means net calorific value, emission factor, preliminary emission factor, oxidation factor, conversion factor, carbon content or biomass fraction.

(14) 'calibration' means the set of operations, which establishes, under specified conditions, the relations between values indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values of a quantity realised by a reference standard.

(15) 'capacity addition' is an investment to increase the installed power generation capacity of existing power plants through: (i) the installation of a new power plants/units besides the existing power plants/units; or (ii) the installation of new power plants/units, additional to the existing power plants/units; or (iii) construction of a new reservoir along with addition of new power plants/units in case of integrated hydro power projects. The existing power plants/units in the case of capacity addition continue to operate after the implementation of the project activity.

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[26] Definitions are taken from EU legislative acts from UNFCCC CDM0002.

(16) ‘CO_2 capture’ means the activity of capturing from gas streams CO_2 that would otherwise be emitted.

(17) ‘CO_2 transport’ means the transport of CO_2 for use or storage.

(18) ‘CO_2e’ means any greenhouse gas, other than CO_2, listed in Annex II to Directive 2003/87/EC with an equivalent global-warming potential as CO_2.

(19) ‘combustion emissions’ means greenhouse gas emissions occurring during the exothermic reaction of a fuel with oxygen.

(20) ‘dry steam geothermal power plant’ is a geothermal technology that directly utilises dry steam that is piped from production wells to the plant and then to the turbine. Dry steam geothermal plants are categorised as open cycle technology.

(21) ‘emission factor’ means the average emission rate of a greenhouse gas relative to the activity data of a source stream assuming complete oxidation for combustion and complete conversion for all other chemical reactions.

(22) ‘emission source’ means a separately identifiable part of an installation or a process within an installation, from which relevant greenhouse gases are emitted.

(23) ‘emissions intensity’ is also known, for transport fuels, as **well-to-wheels** emissions: it comprises not only combustion emissions, but also all the GHG emissions from the supply chain that supplies the product: extraction of raw materials, all steps in the processing, transport and distribution.

(24) ‘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.

(25) ‘energy storage plant/unit’ is a facility that stores a certain type of energy. Several energy storage units at one site comprise one energy storage plant, whereas an energy storage unit is characterized by the fact that it can operate independently from other energy storage units at the same site. Where several identical energy storage units (i.e. with the same power rating, age and efficiency) are installed at one site, they may be considered as one single energy storage unit.

(26) ‘enhanced hydrocarbon recovery’ means the recovery of hydrocarbons in addition to those extracted by water injection or other means.

(27) ‘EU ETS product benchmark’ is based on the average GHG emissions of the best performing 10% of the installations producing that product in the EU and EEA-EFTA states. They refer to the direct GHG emissions from the final process in a production chain that produces a unit quantity of a defined product, using a particular process whose boundary is defined. It is only part of the emissions intensity of the product, because it does not consider emissions from previous production stages (usually covered by other benchmarks) or from supplying inputs (or the combustion emissions of the product itself). The benchmark may comprise emissions from several sub-installations.[27] The relevant benchmarks are those applicable at the time of the deadline of submission of the application.

(28) ‘flash steam geothermal power plant’ is a geothermal technology that is used where water-dominated reservoirs have temperatures above 180°C. In these high-temperature reservoirs, the liquid water component boils, or “flashes”, as pressure drops. Separated steam is piped to a turbine to generate electricity and the remaining hot water may be flashed again twice (double flash plant) or three times (triple flash) at progressively lower pressures and temperatures, to obtain more steam. Flash steam geothermal plants are categorised as open cycle technology.

[27] COMMISSION DELEGATED REGULATION (EU) 2019/331 of 19 December 2018 determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council

(29) 'fossil carbon' means inorganic and organic carbon that is not biomass.

(30) 'fugitive emissions' means irregular or unintended emissions from sources that are not localised, or too diverse or too small to be monitored individually.

(31) 'generator rating' means the generator rating of an energy storage unit is the maximum power, expressed in Watts or one of its multiples, for which the energy storage unit's generator has been designed to operate. The generator rating of an energy storage plant is the sum of the generator ratings of its energy storage units.

(32) 'geological storage of CO_2' means geological storage of CO_2 as defined in Article 3(1) of Directive 2009/31/EC.

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

(34) 'greenfield plant' means a new plant that is constructed and operated at a site where no plant of the same type was operated prior to the implementation of the project activity.

(35) 'inertia capability' means the maximum inertia, expressed in Volt-Ampere seconds (VAs) or one of its multiples, which the energy storage unit has been designed to provide at nominal conditions. The inertia capability of an energy storage plant is the sum of the inertia capabilities of its energy storage units.

(36) 'input power rating (or installed input capacity)' means the (active) power, expressed in Watts or one of its multiples, for which the energy storage unit has been designed to operate at nominal conditions. The input power rating of an energy storage plant is the sum of the input power ratings of its energy storage units.

(37) 'installation' is a stationary technical unit where one or more activities under the scope of the European Union Emissions Trading Scheme (EU ETS) and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution.

(38) 'installed power generation capacity' or 'installed capacity or nameplate capacity' means the capacity, expressed in Watts or one of its multiples, for which the power unit has been designed to operate at nominal conditions. The installed power generation capacity of a power plant is the sum of the installed power generation capacities of its power units.

(39) 'intra-daily electricity storage' means all electricity storage units providing auxiliary services to the electricity grid and/or taking part in intra-daily electricity markets

(40) 'leakage' means leakage as defined in Article 3(5) of Directive 2009/31/EC.

(41) 'measurement system' means a complete set of measuring instruments and other equipment, such as sampling and data-processing equipment, used to determine variables such as the activity data, the carbon content, the calorific value or the emission factor of the greenhouse gas emissions.

(42) 'modification' see 'retrofit'

(43) 'net calorific value' (NCV) means the specific amount of energy released as heat when a fuel or material undergoes complete combustion with oxygen under standard conditions, less the heat of vaporisation of any water formed.

(44) 'other energy storage' means all energy storage other than intra-daily electricity storage, in particular including heat / cold storage, gaseous and liquid fuel storage as well as long-term electricity storage

(45) 'output power rating (or installed output capacity)' means the (active) power, expressed in Watts or one of its multiples, for which the energy storage unit has been designed to operate at nominal conditions. The output power rating of an energy storage plant is the sum of the output power ratings of its energy storage units

(46) "plant" in the case of energy intensive industries is any of the installations in the "processing" box. Those are defined as all installations under the control of the applicant that will be changed by the project, compared to the reference scenario.

(47) 'power plant/unit' is a facility that generates electric power. Several power units at one site comprise one power plant, whereas a power unit is characterised by the fact that it can operate independently from other power units at the same site. Where several identical power units (i.e. with the same capacity, age and efficiency) are installed at one site, they may be considered as one single power unit.

(48) 'proxy data' means annual values which are empirically substantiated or derived from accepted sources and which an operator uses to substitute the activity data or the calculation factors for the purpose of ensuring complete reporting when it is not possible to generate all the required activity data or calculation factors in the applicable monitoring methodology.

(49) 'reactive power rating' means the maximum reactive power, expressed in volt-ampere reactive (var) or one of its multiples, which the energy storage unit has been designed to provide at nominal conditions. The reactive power rating of an energy storage plant is the sum of the reactive power ratings of its energy storage units.

(50) 'rehabilitation' or 'refurbishment' means an investment to restore the existing plants/units that was severely damaged or destroyed due to foundation failure, excessive seepage, earthquake, liquefaction, or flood. The primary objective of rehabilitation or refurbishment is to restore the performances of the facilities. Rehabilitation may also lead to increase in efficiency, performance or production capacity of the plants/units with/without adding new lants/units.

(51) '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.

(52) 'replacement' or 'substitution' is an investment in new plants/units that replaces one or several existing units at the existing plant. It shall be treated as a new/greenfield plant.

(53) 'retrofit' or 'modification' means an investment to repair or modify existing operating plants/units, with the purpose to increase the efficiency or performance of the plants/units, without adding new plants/units. A retrofit restores the installed production capacity to or above its original level. Retrofits include measures that involve capital investments and not regular maintenance or housekeeping measures.

(54) 'reporting period' means a calendar year during which emissions have to be monitored and reported.

(55) '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.

(56) 'storage site' means storage site as defined in Article 3(3) of Directive 2009/31/EC.

(57) 'tonnes of CO_2e' means metric tonnes of CO_2 or CO_2e.

(58) 'transport network' means transport network as defined in Article 3(22) of Directive 2009/31/EC.

(59) 'substitution' see 'replacement'

(60) 'vented emissions' means emissions deliberately released from an installation by provision of a defined point of emission.

(61) ‘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.