Innovation Fund (InnovFund)

Methodology for GHG Emission Avoidance Calculation

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HISTORY OF CHANGES		
Version	**Publication date**	**Changes**
1.0	15.03.2022	▪ Initial version
2.0.	01.11.2022	▪ Main table from previous Annex 1 moved to the body of the GHG methodology, clarification for projects with multiple principal products and for hybrid projects, addition of subsection 1.1.2.1. for Net Carbon Removals, previous section 1.15 "GHG emissions from inputs" is now section 1.3.3., Clarifications in table 1.1 on sector classification, addition of a paragraph for principal products of a project replacing the function of a physically different conventional product (section 1.2), Clarifications for projects earning revenues from the sale of multiple products, clarification for manufacturing of components, adding specific data references for projects manufacturing electrolysers (load factor and CAPEX), restructuring of the section related to "Calculation of GHG emission avoidance", added clarification to table 1.3, added paragraph "Simplification for PILOT topic projects", Creation of a subsection 1.3.5. for combustion emissions, addition of 2 example cases for setting the reference scenario for a principal product, addition of elements for Case 3 in section 2.2.4.3., addition of elements for Case 4 in section 2.2.4.4., addition of elements for case 6 in section 2.2.4.6., addition of a reference for methane leakage in section 2.2.5., addition of examples for "Other relevant inputs", addition of element in section 2.2.9.1., reformulation of section 3 "Carbon Credits", clarification of the scope of section 4 and 5, addition of an equation for manufacturing of components of renewable energy systems, addition of examples for auxiliary services, update of the table of contents to the new structure and annex numbering, reworking of sentences for clarity, spelling mistake correction
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1 Introduction

The purpose of the Innovation Fund (InnovFund) is to support projects demonstrating highly innovative technologies, processes and products, to help reduce GHG emissions in line with the climate neutrality objective of the EU. The Innovation Fund can support projects aiming at reducing GHG emissions directly (for example by developing a new technology) or if they demonstrate innovative use of low carbon energy carriers, such as hydrogen in fuel cells system.

The methodology for the calculation of the GHG emission avoidance is described in the following sections:

Section 2: Energy intensive industries (EII), including substitute products, and carbon capture and use (CCU)

Section 3: Calculating a credit for projects involving carbon capture and storage (CCS) or carbon capture and utilisation (CCU)

Section 4: Renewable energy (RES), including manufacturing plants for components

Section 5: Energy storage (ES), including manufacturing plants for components.

Each methodology section provides the details to be used when:

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

The principles are the same across the methodology. Each section could encompass several sectors for classification of the Innovation Fund project proposals (see Table 1.1). The methodology presents more detailed calculation formulas for some sectors because they display smaller variation of typical project proposals presented to the Innovation Fund. For instance, potential project proposals falling in the sectors of the energy intensive industries are varied. They may concern new plants, modifications to existing plants, substitution of products, electrification, use of biomass, biofuels, synthetic fuels, products that save emissions in use or in their end-of-life stage, or combinations of these. It is thus difficult to foresee every permutation of a project. The methodology seeks to indicate the choices to make in the calculation of emissions in as many situations as can be foreseen, but each project will come up with a different combination of these choices in different parts of the calculation.

It is a central principle of the GHG emission avoidance calculation that specific GHG emissions and each GHG saving should only be counted once ('no double counting'). It is possible that in some cases following the detailed methodology described below may seem to call for a given emission or saving to be counted twice. In any such case, the 'no double counting' principle supersedes the other text of the methodology. If the applicant believes they have identified such a case, the applicant should consider seeking clarification via the InnovFund helpdesk.

1.1 GHG emission avoidance: principles and scope

The Innovation Fund aims to support project proposals that will help to change the industry landscape. All sectors need to reduce emissions, however sectors report different levels of

[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.

GHG emission avoidance in terms of volumes of emissions (absolute) and possibilities for reducing emissions (relative). For the purpose of the Innovation Fund, the GHG emission avoidance criterion will be composed by two criteria: absolute and relative GHG emission avoidance.

At the submission stage the GHG emission avoidance is calculated over a period of 10 years after entry into operation. This is the value that will be taken into account during the evaluation of a proposal. **In the case that the project operates for less than 10 years**, but not less than 3 years, operational data will be set to zero for those years in which the project does not operate. As such, both $\Delta\mathrm{GHG}_{\mathrm{abs}}$ and $\Delta\mathrm{GHG}_{\mathrm{rel}}$ shall reflect the reduced period.

The monitoring and reporting period depends on whether the project is submitted in a large-scale or small-scale call. The default period for large-scale projects is 5 years with a possibility to go down to 3 years if duly justified, for proposals submitted under a PILOT topic the monitoring and reporting period is 3 years, while the default period for small-scale projects is 3 years, and can be higher in duly justified cases but not longer than 10 years.

The InnovFund grant depends on verified emission reductions and therefore it is important that the emissions reductions described in the application can be delivered. When forecasting operational data, applicants should consider any expected **ramping up period**, i.e., if reduced performance can be expected over the first years due to necessary stops and starts of the production for technical adjustments, this should be reflected in the calculations. The final split of products and expected functions for those products needs to be clearly identified. If the application claims that a product will be used for a specific purpose (which will result in higher emission avoidance) this should be demonstrated with evidence (e.g., draft contracts).

> <u>*Example: hydrogen to be supplied for fuel cell vehicles*</u>
> *If a project producing hydrogen states that this hydrogen will be supplied for use in vehicles (allowing the reference to be set based on fossil fuel consumption by a conventional vehicle instead of using the hydrogen benchmark) the application should demonstrate that a draft contractual arrangement exists with a hydrogen refuelling facility for mobility applications.*

The GHG emission avoidance calculations should take into account both in the reference and project scenarios the potential diversified **offtake strategy**, i.e., different share of final products or possible uses as the emissions savings are calculated in accordance with the final use. In the case of a change in the share of produced products or the use / uses as products have different GHG intensities, the project may not be able to reach the 75% of GHG emission avoidance[2] claimed at the time of the application. In such a case, the grant may be reduced proportionally.

1.1.1 Absolute GHG emission avoidance

The **absolute GHG emission avoidance** represents the difference, over a defined period, between **all** the emissions that would occur **in a reference scenario** in the absence of the proposed project, and **all** the emissions **from the project activity**. Note that it is necessary to include all the emissions. If "common" emissions would be excluded from both scenarios, then the *relative* emission calculation would be distorted. The absolute GHG emission avoidance shall be calculated based on the expected emissions avoided in each year from the entry into operation over a 10 years' period, using the equation below.

[2] A project that enters into operation should demonstrate a total amount of GHG emissions planned avoidance of at least 75% for a full grant disbursement.

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

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 in year y, in tCO_2e.

For projects with multiple principal products and for hybrid projects, Ref_y and Proj_y represent the sum of the reference and project emissions respectively across all principal products and eligibility categories. In some cases this will require adding together reference and project scenario emissions calculated using different chapters of this guidance.

1.1.2 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) cumulated 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 change in GHG emissions avoided due to operation of the project cumulated over 10 years of operation, in percent.

$\Delta \mathrm{GHG}_{\mathrm{abs}}$ = Net absolute change in GHG emissions avoided due to operation of the project cumulated 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.

Note that for projects that consist of direct air capture of CO2 for the purpose of permanent storage, Ref_y is set as zero and therefore this equation cannot be used. For these projects, the relative emission avoidance shall always be set as 200%.

1.1.2.1 Net carbon removals

Projects with a relative GHG emission avoidance of over 100% may be delivering net carbon removals. To be considered a net carbon removals project, a project must have negative project emissions. For EII projects, this must exclude credits for non-principle products (section 2.2.10) and for timed operation (section 2.2.6.3.6), i.e. $\sum_{y=1}^{10} \left(\mathrm{Proj}_y - \mathrm{NPP}_y - \mathrm{TO}_y\right) < 0$, where NPP_y is the emission credit associated with production of non-principal products in year y and TO_y is the emission credit associated with timed operation in year y.

Projects meeting this threshold must calculate a relative emission avoidance score adjusted to remove any contribution from timed operation. Negative emissions from non-principal products may be included in calculation of this adjusted relative emissions avoidance score, they simply may not be the only source of negative emissions for a project claiming net carbon removals. The adjusted relative emissions avoidance $\widehat{\Delta \mathrm{GHG}}_{\mathrm{rel}}$ is therefore calculated as:

$$\widehat{\Delta GHG}_{rel} = \frac{\Delta GHG_{abs} + \sum_{y=1}^{10}(TO_y)}{\sum_{y=1}^{10}(Ref_y)} \qquad [1.3]$$

Direct air capture projects shall be given an adjusted relative emissions avoidance score of 200% even if they claim credit for timed operations.

1.1.3 GHG considered and global warming potentials

The greenhouse 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 (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6).

Emissions factors for methane and nitrous oxide, when given, may be converted into CO_2 equivalents ("CO_2e").

The global warming potentials (GWPs) to be used are those in the Annex to the 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.[3]

The methodology is structured with the intention of capturing the most common emission sources. However, some GHG emissions are generally excluded (see section 1.1.4).

Examples of emissions that may occur in stages in the lifecycle (non-exhaustive list):

- Emissions of non-CO_2 greenhouse gases (in particular methane[4] and nitrous oxide) due to fuel combustion (including from combustion of renewable fuels),
- End-of-life (i.e., decomposition or degradation) emissions of non-CO_2 greenhouse gases,
- Emissions of non-CO_2 greenhouse gases resulting from chemical processes such as refrigerant manufacture.

1.1.4 GHG emissions that are generally excluded

Generally, the following emissions are excluded for all projects unless specified otherwise. **These shall not be added to the calculation** of absolute and relative GHG emissions avoidance.

- Emissions from capital goods (e.g. manufacture of machinery and equipment) and during construction.
- When fossil fuels are used as inputs for processes that are part of either the project or reference scenario only the combustion emissions should be accounted for - emissions due to fossil fuel extraction, processing, refining, distribution and storage are excluded from the calculation. This allows aligning with the methodology for calculating the EU ETS benchmarks, which considers only combustion emissions of fossil fuels.

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

[4] In particular, the methodology makes reference several times to the "stoichiometric combustion" of a carbon-based product or part of it. Given that in a certain amount of cases, some carbon atoms in a product could generate CH_4 rather than CO_2 emissions, the reference to "stoichiometric combustion" must be understood as "stoichiometric combustion of all carbon atoms that are not released to the atmosphere as CH_4". When CH_4 emissions occur in a stage of the lifecycle, they must be added to the CO_2 emissions calculated according to the "stoichiometric combustion" of the residual carbon atoms.

- Fugitive CO_2 and CH_4 emissions due to well testing and well bleeding in geothermal power plants.
- Biogenic CO_2 emissions from:
    - combustion of biomass (including solid biomass, biogas, biomethane, biofuels and bioliquids),
    - decomposition or degradation at end of life from biomass, biogas, biomethane, biofuels and bioliquids,
    - other chemical or biological processes (e.g. fermentation).

However, emissions of non-CO_2 greenhouse gases (CH_4 and N_2O) associated with biomass combustion, decomposition or degradation of biogenic materials and other chemical or biological processes must be included based on the relevant GWPs.

- Indirect land use change (ILUC) emissions from supply of crops, and consideration of carbon debt in forestry.
- Emissions related to decommissioning of the plants and machinery at the end of life.
- 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 when they are classified in the sector "Manufacturing of components for production of renewable energy or energy storage".
- Emissions associated with transport in energy intensive industries projects: it is in general not necessary to account in either the project or reference scenario for emissions associated with: transport of raw materials (except for biomass and waste feedstock whose emissions must be taken into account), inputs, intermediate products between sites within the system boundary (i.e., applies to both the project and reference scenarios), process waste sent to treatment, and distribution of final products. See further information given in section 1.1.

Should there be substantial GHG emissions savings from emission sources excluded from the project boundaries, the applicant should provide a separate calculation of potential emission savings, which may be considered under "Other GHG savings". These shall not be added to the calculation of absolute and relative GHG emissions avoidance.

1.2 Specification of a sector for the purpose of the GHG emission avoidance calculations, and principal products

When submitting the application, the applicant needs to choose the sector under which the project falls (see Table 1.1). This choice will influence the points to be awarded for the sub-criterion on the potential of absolute GHG emission avoidance (see call text for details).

The sector shall be determined based on the function of the principal product that is the main aim of the project.

The following synoptic Table 1.1 provides an overview of sector classification combined with possible products and/or services and an indication of the methodology section to follow for the calculation of a given project GHG emission avoidance calculation. The sector **must** be chosen from the list, but the principal product may not be explicitly listed (for example a project in the sector 'glass, ceramics and construction material' might specify its principal product as 'shatterproof glass' rather than identifying one of the more generic products listed below).

Table 1.1. Sector classification and methodology section

CATEGORY[5]	SECTOR[6]	PRODUCTS/SERVICES[7]	SECTION
Energy Intensive Industries (EII)	Refineries	fuels (incl. e-fuels, bio-fuels)	Section 2
	Iron & steel	coke iron iron ore steel cast ferrous metal products other ferrous metal products or substitute products, please specify	Section 2
	Non-ferrous metals	aluminium, precious metals, copper, other non-ferrous metal, cast non-ferrous metal products, other ferrous metal products or substitute products, please specify	Section 2
	Cement & lime	cement cement clinker lime, dolime, sintered dolime other cement or lime products or substitute products, please specify	Section 2
	Glass, ceramics & construction material[8]	flat glass container glass glass fibres other glass products tiles, plates, refractory products bricks houseware, sanitary ware other ceramic products mineral wool gypsum and gypsum products other construction materials or substitute products please specify	Section 2
	Pulp & paper	chemical pulp mechanical pulp paper and paperboard sanitary and tissue paper other paper products or substitute products, please specify	Section 2
	Chemicals	organic basic chemicals inorganic basic chemicals nitrogen compounds plastics in primary forms synthetic rubber	Section 2

5 Categories are derived from the legal basis – Article 10(a) of the EU ETS Directive

6 Sectors are derived from the activities listed in Annex I of the EU ETS Directive, the type of renewable energy source or energy storage.

7 The lists of products given for each sector are non-exclusive and most give 'other products' as an option, where applicant is expected to specify the principal and other product(s) both in Application Form B and C.

8 The sector 'Glass, ceramics & construction material' is a combination of the EU ETS activities 'Glass and ceramics', 'Mineral wool' and 'Gypsum'.

CATEGORY[5]	SECTOR[6]	PRODUCTS/SERVICES[7]	SECTION
		other chemical products or substitute products, incl. bio-based products, please specify	
	Hydrogen	hydrogen	Section 2
	Manufacturing of components for production of renewable energy or energy storage (in case of production of electrolysers and fuel cells)	electrolysers and fuel-cells as well as their sub-components recycling of materials for production of electrolysers fuel-cells other, please specify	Section 2
	Other[9]	Dispatchable electricity, incl. bio-electricity heat, incl. bio-heat other, please specify	Section 2, including for timed-operation projects and for electricity saving projects; or Section 4 for bio-electricity and bio-heat, including projects where bio-waste is used as (partial) feedstock for energy purposes.
Energy Intensive Industries (EII) where CCS is the main aim of the project[10]	choose an EII sector	Annex I product	Section 2 and Section 3
	choose EII ⍰ Other	CO_2 Transport	Section 3
	choose EII ⍰ Other	CO_2 Storage	Section 3
Renewable energy	Wind energy	non-dispatchable electricity heating cooling	Section 4
	Solar energy	non-dispatchable electricity heating cooling	Section 4
	Hydro/Ocean energy	non-dispatchable electricity dispatchable electricity heating cooling	Section 4

9 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 electricity and heat produced from biogenic feedstocks. The sector also covers all other combustion for industrial purposes, which falls under the EU ETS if the thermal heat input exceeds 20 MW. 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.

10 Full value chain CCU/S projects, i.e. projects capturing CO_2 for geological storage or use, are categorised in the sector where they capture the CO_2. Direct air capture plants or waste-to-energy plants that capture CO_2 for incorporation in substitute products choose the sector of the material product they substitute. Direct air capture plants for geological storage, waste-to-energy plants for geological storage, CO_2 transport and/or CO_2 storage projects are all categorised in sector 'EII / Other'.

CATEGORY[5]	SECTOR[6]	PRODUCTS/SERVICES[7]	SECTION
	Geothermal energy (including ambient energy through heat pumps)	dispatchable electricity heating cooling	Section 4
	Use of renewable energy outside Annex I[11]	use of renewable energy in waterborne transport use of renewable energy in water desalination use of renewable energy in wastewater treatment other	Section 4
	Manufacturing of components for production of renewable energy or energy storage (for the production of components of renewable energy)	wind plants and their sub-components solar plants and their sub-components hydro/ocean plants and their sub-components geothermal / ambient plants (including heat pumps) and their sub-components recycling of materials for production of RES plants other, please specify	Section 4
Energy storage	Intra-day electricity storage	electricity[12]	Section 5
	Other energy storage	electricity heating cooling	Section 5
		hydrogen-based energy storage e-fuel-based energy storage	Section 5 (noting that hydrogen/e-fuels projects should only be considered under the Energy Storage eligibility category when storage of excess renewable energy is a primary aim of the project)
	Manufacturing of components for production of renewable energy or energy storage (for production of components for energy storage)	batteries and their sub-components recycling of materials for production of batteries other, please specify	Section 5

In some cases, the principal product of a project may **replace the function** of a physically different conventional product. Where a product will substitute another one of different

11 The sector 'use of renewable energy outside Annex I' is aimed at projects whose main innovation is linked to the use rather than production of renewable energy and the final product or service falls outside Annex I activities.

12 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.

composition or physical characteristics, the relevant sector **of the substituted product** should be chosen for the application. The reference emissions will be determined by the product that is being replaced. In such cases applicants have to prove the intention for use of the product in this way 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. This will be checked thoroughly by financial experts, and if the project does not reach the expected GHG emissions avoidance due to a change in product use it may not get the full grant.

> *Example: Project focusing on the introduction of low-carbon hydrogen in heating: the sector where the main innovation takes place falls under EII/other rather than EII/hydrogen.*

> *Example: The sole product of a project is ethanol that will substitute gasoline in transport (rather than ethanol being sold as a fine chemical). The relevant sector of the substituted product is the refineries sector.*

The application may only be submitted for one sector. Some applications may output products in more than one sector, and potentially across multiple eligibility categories. For such projects, the applicant must choose the appropriate sector for the application based on the principal product or products that represent the main aim of the project. Applications that include principal products in more than one eligibility categories are referred to as **hybrid projects** (see section 1.2.1). In case that a project will earn revenues from the sale of a single product that substitutes a similar conventional product, it will be straightforward to choose the sector according to the identified product.

> *Example: The sole product of the project is steel produced using renewable electricity to substitute traditional steel production. The principal product is steel and the relevant sector to choose is the steel sector under EII/Iron and Steel.*

> Example*: If a project intends to generate electricity through installation of photovoltaic panels, the relevant sector to choose is RES/Solar energy.*

In the case that a project will earn revenues from the sale of **several products**, the applicant should define the 'principal product(s)' which should reflect the main aim and innovation of the project. The set of products that would generate the bulk of the revenues from a project should be identified as principal products. Other products may be identified as principal or non-principal at the discretion of the applicant.[13]

The conventional products substituted by principal products must be included in the reference scenario for the GHG emissions calculation, whereas non-principal products are included in the project scenario only. In the case that a project involves principal products in more than one sector, the applicant must determine the sector for the application based on the principal product(s) that reflect the main aim of the project. In some cases, the revenue and innovation in a project will be evenly distributed across products in more than one sector – in those cases, the applicant may choose which sector to apply in.

> *Example: A steelworks proposes a project to modify its existing plant to produce ethanol in addition to steel products. Ethanol will be sold as an alternative transport fuel for blending in gasoline for road transport.*
> *Both steel and ethanol for transport fuel could be treated as principal products. The applicant must decide whether to apply in the 'Refineries' or the 'Iron and steel' sector, giving consideration to what the primary aim of the project is. Is the project designed to principally save emissions in the steel industry? Or is the project*

[13] For the attention of applicants in previous calls, these requirements have been revised – previously additional products in different sectors but the same eligibility category were required to always be assessed as non-principal products.

> *designed to principally make alternative transport fuel as a by-product of steelmaking? Either would be eligible to set the sector for InnovFund because they replace products covered by the EU ETS. As toluene would represent only a small part of the revenue from the project the applicant may choose to treat it as a third principal product or as a non-principal product. The applicant could not, however, treat toluene as the only principal product and steel and ethanol as non-principal products as this would not reflect the main aims of the project.*
>
> *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 InnovFund funds in one sector than in another.*

The choice of sector will influence the points to be awarded for the criterion of the *absolute* GHG emission avoidance (see call text for details). The choice of principal product(s) and non-principal products will influence the project's *relative* GHG emission avoidance.

Some projects involve **manufacturing components** to be used in renewable energy generation or energy storage systems. Such projects will generally be classified in the sector manufacturing of components for renewable energy or energy storage. In principle, an applicant may choose also to submit such a project within energy intensive industries (e.g., in the sectors of chemicals or non-ferrous metals) especially if the produced component is further upstream in the value chain such as e.g., production of lithium, in which case the GHG emissions from the project may be compared to an appropriate reference process producing comparable components.

1.2.1 Hybrid projects

When a project combines activities in the scope of sections 2, 4 or 5 and/or related to two or three eligibility categories (a hybrid project), the applicant shall still choose a main sector and associated principal product(s) that best corresponds to the main aim and innovation of the project. The main aim should be identified primarily by considering the potential revenues from the products or services that the project will produce or deliver. In order to make a hybrid application, the part of the project that produces product(s), which define the main sector must be innovative.

> *<u>Example</u>: a hybrid project involves installation of a large wind power electricity generation facility coupled to an electrolyser producing hydrogen. The export of electricity is anticipated to generate ten times as much revenue as the sale of hydrogen. The applicant should choose wind energy as the main sector.*
>
> *If, however, the innovation is related only to the electrolyser rather than the wind farm, it would not be appropriate to make a hybrid application. The applicant may instead consider making an application for the electrolyser only under the energy intensive industries or energy storage eligibility categories (i.e. considering hydrogen as the principal product and treating electricity production as out of scope).*

In cases where the expected revenues for products in different sectors under a potential hybrid project are comparable (i.e., cases where a lower revenue product would generate at least 70% of the expected revenue of the highest revenue product) and the innovation is associated with a lower revenue product, the applicant may choose the main sector based on the more innovative product rather than the product with the highest revenue share. The applicant shall then clearly identify the two or three distinct parts in the project relating to the relevant eligibility categories so that the calculations follow the respective sections of the methodology.

Hybrid projects shall calculate the absolute GHG emission avoidance by taking the reference GHG emissions and the project emissions for each principal product according to the relevant sections of the methodology (energy-intensive industry, renewable energy, energy storage), then adding these up (while removing double counting of avoidance and/or emissions, if any). The relative GHG emission avoidance (in percent) shall be calculated based on the cumulated net absolute GHG emissions avoided, divided by the cumulated reference GHG emissions, see 1.1.2.

1.2.1.1 Energy intensive industries (EII) and renewable energy (RES) projects

For a project including EII and RES parts, the applicant should consider submitting a hybrid application in order to get credits if there is renewable energy exported. A typical case could be a project that proposes to export renewable electricity and/or renewable heat from an industrial plant belonging to one of the EII sectors.

Applicant should pay particular attention to use in the calculation of the correct emission factor for electricity, for each part of the project. An applicant should use the RES EF value in Table 1.3 for the net electricity exported from the RES part of the project (i.e., 47 gCO_2e/MJ), even if the hybrid project application is submitted for an EII sector. The emissions accounting of EII and RES parts follows the principle of "adding up while removing double counting".

> *<u>Example</u>**:** A project proposes a hydrogen electrolyser, with principal product hydrogen, combined with an on-site wind energy farm. During wind peaks, the project plans to export half of the power to the grid. The project is a hybrid project with an EII part (hydrogen sector) and a RES part (wind energy sector).*
>
> *However, if all the renewable energy power is to be used in the production of hydrogen with no electricity export, then the calculation follows only the EII section and the project does not need to be considered as hybrid.*

For a hybrid EII+RES project, the applicant shall demonstrate that the power from the RES part will be preferentially supplied to local use in the EII part.

> *<u>Example</u>: A project intends building a RES facility that supplies 100% of its power to the grid and it is co-located in an EII facility. In such a case the applicant may consider submitting two separate funding applications for the RES and EII facilities, but may not make a hybrid application.*

1.2.1.2 Energy intensive industries (EII) and energy storage (ES) projects

A project that includes energy storage in an EII plant should split the GHG calculation into two contributions based on the energy intensive industry section 2 and based on the energy storage section 5. The EII emissions and the ES emissions need to be then summed up while removing double counting.

In case of activities overlapping between the EII and the ES parts, the revenue should be the guiding principle to split production activities between the EII part and the ES part.

> *<u>Example</u>: a project produces steel through the electric-arc method, and has on-site battery storage to take advantage of low electricity prices. During some periods of high electricity price the plant will release stored electricity to the grid instead of using it for steel production. It is expected that 85% of the revenue comes from steel production (EII part) and 15% from the energy stored (ES part). The applicant should apply in the sector iron and steel and then follow section 2 for the EII part (principal product steel) and section 5 for the ES part (principal product intra-day or other electricity storage).*

1.2.1.3 Renewable energy (RES) and energy storage (ES) projects

Projects that include production of renewable energy and storage of energy should be presented as hybrid projects combining a RES component and an ES component. The application should clarify the system boundaries for the two parts. The RES emissions and the ES emissions need to be then summed up while removing double counting.

> *Example: Projects that include physical or virtual storage of renewable electricity at times when there is an excess of it in the grid, e.g., smart grid applications, are an example of hybrid projects. The application should clarify the split for their feed-in of grid electricity into a storage component and the residual uncontrolled feed-in. The emission avoidance of the storage component shall be calculated as in section 5. The emission avoidance of the uncontrolled feed-in shall follow the calculation of section 4.*

For a hybrid RES+ES project, the applicant should demonstrate that the power from the RE facility will be supplied to the ES project when the timing of power generation is consistent with the needs of the storage facility, and may claim credit under the RES methodology for any excess power exported. This also means that the combined facility should never be assumed to store power from the grid at the same time as it is exporting renewable power to the grid.

> *Example: Consider a hybrid project with a wind farm co-located with a battery storage facility. If the windfarm is generating power during a period when the battery is being charged, the wind power should be used to charge the battery. Any excess power not required for battery charging may then be exported to the grid. To calculate the GHG emissions avoidance the equations described in sections 4 and 5 should be combined, and any double counted emissions removed.*

1.2.1.4 Energy intensive industries (EII), renewable energy (RES) and energy storage (ES) projects

For a project that includes EII, ES and RES parts, the applicant should consider submitting a hybrid application in order to get credits for the renewable energy exported and for the energy stored in addition to the GHG emissions avoided in the EII part. Such hybrid projects application should combine the three components and clarify the system boundaries for the three parts. The three GHG emission terms need to be then summed up while removing double counting.

1.2.2 Manufacturing of components

Certain manufacturing (production) facilities for innovative components which will be used in specific strategic energy systems[14] are eligible for InnovFund funding. This includes the production of innovative components which will be used in:

- electrolysers;
- fuel cells;
- renewable energy generation, including heat pumps, and
- energy storage systems.

[14] COM(2022) 230 final: "A specific REPowerEU window will support (1) innovative electrification and hydrogen applications in industry, (2) innovative clean tech manufacturing (such as electrolysers and fuel cells, innovative renewable equipment, energy storage or heat pumps for industrial uses), and (3) mid-sized pilot projects for validating, testing and optimising highly innovative solutions."

<u>Examples</u>: for renewable energy generation: manufacturing polysilicon for solar PV panels, wind turbines, transformers for utility-scale PV, inverters and subsidiary components, production of steel and concrete wind turbine towers.

<u>Examples</u>: for energy storage: batteries, smart grid technologies.

Components manufactured by Innovation Fund projects may be used in facilities which themselves produce products within the scope of the Innovation Fund or may be used in relevant consumer products.

<u>Example</u>: components for solar panels may be used in largescale solar farms (facilities) or in solar panels for household use (consumer products).

<u>Example</u>: batteries may be used for intra-day electricity storage (facilities) or in electric vehicles (consumer products).

Such projects may be submitted in the sector "manufacturing of components", and applicants must determine the eligibility category for component manufacturing projects based on the way that the components will be used:

- Projects manufacturing renewable energy components should apply in the renewable energy eligibility category.
- Projects manufacturing energy storage components should apply in the energy storage eligibility category.
- Projects manufacturing electrolysers should apply in the energy intensive industries eligibility category.

In these projects, for the purpose of the GHG calculation applicants should bring the operation of the facilities that will be built with those components into the system boundary (subject to the requirement below regarding allocation of emissions savings). Applicants must provide clear justification for assumptions regarding the use of the produced components (e.g. load hours). Note that this means that the number of facilities included in the system boundary will increase over time. The component manufacturing facility itself shall be outside the system boundary of the GHG calculation.

Any additional GHG emission reduction compared to the existing processes of components manufacturing is outside of the scope of the GHG avoidance calculation for these projects, but may be considered under "Other GHG savings".

Projects applying under "manufacturing of components" must produce specialised components, and projects producing bulk materials may not apply as component manufacturing projects. "Components" projects for specific strategic energy systems shall have all the following characteristics distinguishing them from mere bulk materials:

- They shall be either a part of the energy system or a specialized material used in the energy system (e.g. the cooling fluid in a heat pump) and could be replaced with a spare part or material of the plant;
- When leaving the manufacturing facility, they already have the intended specialized function relevant to the final purpose of the energy system;
- They show the main innovation of the project (possibly in conjunction with other parts or materials);
- They are in a ready to use form, i.e. they need only to be directly assembled into the energy system.

Applicants must allocate emissions avoidance from the use of the individual components proportionally based on the innovative components' cost as a fraction of the total capital cost of the relevant facility or the total retail price of the relevant consumer product. The total capital cost for a facility is the sum of the cost of an innovative component plus standard costs of the remaining components constituting a typical operational renewable energy or energy storage facility using the innovative component. For components used in consumer products, the retail price should be based on a typical use case for the component, and may exclude sales taxes. Applicants must provide appropriate references to justify this cost assessment.

> *Example:* *If an innovative component represents 25% of the total capital cost for an operational renewable energy/energy storage facility, then the emissions in the project and reference scenarios (and therefore the emission avoidance achieved) should be multiplied by 25%.*

Applicants with projects to manufacture electrolyser components may assume that the electrolysers will operate for 5,000 hours a year[15] and may choose to use the following electrolyser capital cost assumptions[16], or may provide their own project specific values:

Electrolyser technology	Alkaline	PEM	Solid oxide	Anion exchange
Capital cost	480 €/kW	700 €/kW	520 €/kW	550 €/kW

Applicants with projects to manufacture fuel cell components for commercial vehicles should assume that the vehicles will be driven for 140,000 km per year. Applicants with projects to manufacture fuel cell components for passenger vehicles should assume that the vehicles will be driven for 12,500 km per year. Applicants may refer to the JEC-WTW v.5 for other typical vehicle data, or may provide their own project specific values. Applicants with projects to manufacture sub-components for fuel cells for commercial vehicles may assume that the full fuel cell unit will cost 450 €/kW, or may provide their own project specific assumptions. Applicants with projects to manufacture fuel cell components for stationary applications may use the following fuel cell capital cost assumptions, or may provide their own project specific values:

Fuel cell technology	< 5 kW	5-50 kW	51-500 kW
Stationary SOFC system (CHP)	8,000 €/kW	7,500 €/kW	7,500 €/kW
Stationary PEMFC system (power generation)	5,500 €/kW	2,150 €/kW	1,550 €/kW

An innovative component shall be understood and treated as the full unitary item that leaves the manufacturing plant, thus including but not limited to the sub-component with specific innovation.

15 Source: Commission Staff Working Document Implementing the Repower EU Action Plan: Investment Needs, Hydrogen Accelerator and Achieving the Bio-Methane Targets,

16 Source: Strategic Research and Innovation Agenda 2021-2027, Clean Hydrogen Joint Undertaking, Annex to GB decision no. CleanHydrogen-GB-2022-02.

<u>Example:</u> a manufacturing plant produces a whole battery as a saleable object. The cost of the whole battery is considered regardless of which part of the battery is innovative.

<u>Example:</u> a manufacturing plant produces lithium ion cells for full batteries being assembled elsewhere. Only the cost of the lithium ion cell shall be relevant.

For such cases, the GHG emission avoidance is calculated based on the intended use of the components during 10 years counted **from the day on which the first produced component leaves the project's manufacturing facility**.

For setting the 10-year period for the calculation it is not necessary to forecast the moment when the components are first used, or the moment when the manufacturing plant is being built: the only relevant moment for the calculation is the moment each component is sold. The applicant may assume for the purpose of the calculation that components enter in use immediately after being produced and sold. This means that every year more components are assumed to enter into operation. The cumulative emission avoidance shall be reflected in the calculation.

<u>Example</u>: *A manufacturing plant produces wind turbines blades. The ten-year period for the project starts when the first wind turbine blade is produced. In reality, there will be a delay before the blades are installed on wind turbines and a further delay before those wind turbines enter operation. For the InnovFund GHG emission avoidance calculation, however, the applicant may assume that blades become operational immediately that they leave the manufacturing facility.*

The emissions calculation will consider the sum of the electricity generated by wind turbines using the manufactured blades through the ten-year monitoring period. For example, blades produced at the end of the fifth year of the project will be assumed to produce wind energy for the following five years. As the number of produced blades accumulates, in each year the project is associated with higher renewable energy generation than the year before, and therefore with a higher GHG emissions avoidance. A blade produced at the end of the ninth year of the monitoring period will contribute only one year worth of emission savings to the calculation.

A component manufacture project may not claim the full emissions savings from the operational facility, but only a fraction consistent with the fraction of the capital cost for that facility spent on the component. If the applicant presented evidence that the rotor blades represented 15% of the capital cost of turbine installation, then the project should include only 15% of the associated reference and project scenario emissions (and therefore 15% of the reportable GHG emissions avoidance) in the GHG calculation.

For a project that produces an innovative component to be used in renewable energy production, the energy that will be generated by the final renewable plant, when up and running, will have to be estimated based on credible assumptions, underpinned with evidence (letters of intent at the application stage) on sales of the component on the market. Applicants will have to present the rationale for the projected performance of the component produced as well as of other components that will be needed at the power plant, but which are not necessarily manufactured at the same facility.

<u>Example: production facilities for energy storage components</u>
If the project is classified as energy storage (intra-daily electricity storage or other energy storage), the main emission reductions stem from the use phase of the product, e.g., batteries.

While it is expected that in most cases component manufacturing projects will be submitted under the sector of "manufacturing of components" of one of the three eligibility categories the applicant may also choose to submit a component manufacturing project under other sectors of the energy intensive industries eligibility category (e.g., in the sectors of chemicals or non-ferrous metals), especially if the production facility achieves substantial GHG emission avoidance in an energy-intensive production process. In this latter case, the emissions savings shall be assessed by comparing the emissions from the innovative component production system to the emissions of an appropriate reference system producing conventional components performing the same function following the principles given in section 2. If submitted under energy intensive industries sectors other than "manufacturing of components", emissions savings from the use of the component are outside the scope of the system boundary and therefore may not be included in the calculation, while the component manufacturing facility will be brought within the system boundary.

1.3 Calculation of GHG emission avoidance

The calculations of GHG emission avoidance should comprehensively cover the impacts from the changes in inputs, processes, and products between the reference scenario and the project. In the following sections some general indications are given for various aspects. Detailed calculation guidance is provided in the following chapters.

1.3.1 The reference scenario

The reference scenarios should reflect the current or expected state-of-the-art in the different sectors, as shown in Table 1.2 and Table 1.3. The default values are also given in the GHG calculators.

Table 1.2. Reference Scenarios

Eligibility category / Sectors / products	**GHG emissions are based in the reference scenario (among others) on:**
EII	EU ETS benchmark(s), fossil fuel comparators (FFCs, see Table 2.2), or proposed by applicants if the reference cannot be constructed by combination of benchmarks and FFCs
EII / Refineries / Biofuels	Adapted fossil fuel comparators from REDII (1)
EII / CCS	CO_2 is released (i.e., not captured) /available in atmosphere
RES / Renewable electricity EII/bio-electricity	Expected 2030 electricity mix
RES / Renewable heat EII/bio-heat	Natural gas boiler
RES / Renewable cooling	Expected 2030 electricity mix
ES / Energy storage RES / Dispatchable renewable electricity	Single-cycle natural gas turbine (used for peaking power)
ES / Electricity grid auxiliary services	Combined-cycle natural gas turbine (partial load)

Eligibility category / Sectors / products	GHG emissions are based in the reference scenario (among others) on:
ES / Heat / Hydrogen storage	EU ETS benchmark for heat / hydrogen production
ES / Energy storage in vehicles	Diesel-fuelled internal combustion engine

([1]) 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.

Source: European Commission internal elaboration.

> *Example: A project converts biogenic residues into heat and sells it to an Energy Intensive Industry (EII) installation (which currently purchases heat from a coal-fired CHP plant), and to a district heating provider. The reference scenario for renewable heating is pre-set as natural gas boiler (see Table 1.2) with a pre-set efficiency.*

> *Example: A project produces hydrogen to be used in vehicles. The reference scenario is the fossil fuel comparator (the emission factor) needed to drive such vehicles in the absence of the project.*

1.3.1.1 Relationship to calculation of relevant cost

The choice of Reference scenario should be in principle aligned with the choice of reference product or reference investment in the Relevant Costs methodology. This will be for example the case when choosing the EU ETS benchmark plant as reference for both Relevant Costs and GHG avoidance methodology.

Applicants should be aware that the reference product or process used as the basis for relevant costs calculations will, however, differ in some cases. This is because the methodology used as a reference for estimating GHG emission avoidance adopts a life-cycle approach while the relevant costs are concerned with the product that will be sold or the investment that will be done.

> *Example: In a CCU project, in the GHG methodology applicants are expected to consider GHG impacts related to the capture of CO_2 which may fall outside the boundary of the investment project.*

> Example*: In a manufacturing facility, the GHG methodology focuses on the emissions during the use of the components while the relevant cost considers the investment in the* manufacturing *plant.*

1.3.2 GHG emission factors for electricity

The InnovFund seeks to assess the potential for emissions avoidance from innovations that are needed to reach climate neutrality in 2050. The EU intends to achieve full decarbonisation of grid electricity by 2050, and therefore electrification of industry is seen as an important route to long-term decarbonisation. In order to assess Innovation Fund applications based on their long-term potential in a decarbonised economy, the GHG emissions for Innovation Fund projects shall be assessed treating **grid electricity consumed as having zero associated GHG emissions, the expected average emissions of the 2050 grid electricity mix**[17]. This avoids penalising projects that include an element of electrification for the fossil fuel use associated with the current grid

[17] In contrast, the REDII estimates the "well-to-tank" emissions for fuels produced under current conditions, including current emissions attached to electricity consumption. The objective of this methodology is different from the emission-saving methodology the Commission proposes for renewable fuels of non-biological origin and recycled carbon fuels under REDII.

electricity mix. Applicants must still report expected electricity consumption by their projects for knowledge-sharing purposes.

The Innovation Fund also seeks to support projects that will make a contribution to **delivering a fully decarbonised grid**: the GHG emissions for projects that will supply renewable energy shall therefore be assessed treating electricity replaced as having the expected average emissions of the 2030 grid electricity mix (with an emission factor of 48.81 gCO_2e/MJ [0.1757 tonnes CO_2e/MWh][18]), while the GHG emissions for projects that provide dispatchable renewable electricity or energy storage shall be assessed treating electricity replaced as having the GHG emissions of dispatchable single cycle natural gas power generation (with an emission factor of 140 gCO_2e/MJ [0.504 tonnes CO_2e/MWh][19]).

Credit is also given to projects in the energy intensive industries sector that manage their electricity consumption so they use:

- less electricity (this type of projects cannot be combined with other type of projects as explained in more detail in section 2.2.6.3.5), or
- predominantly electricity with low emission factor thereby increasing absorption of variable renewable electricity and reducing the need for dispatchable fossil power by treating such projects as offering a 'virtual' energy storage service (this is explained in more detail in section 2.2.6.3.6).

Table 1.3 summarises which emission factor for electricity should be used in the calculations depending on the type of project and whether the electricity is consumed by or exported from it. These emissions factors apply to both the project and reference scenarios. The treatment of electricity under each of the sectoral GHG emission calculations is detailed in the respective sections.

Table 1.3. Emission factors for applications involving production, use and/or storage of grid electricity

Category / sector / products	**Net electricity exported**	**EF**	**Electricity consumed**	**EF**
Energy intensive industry	Net amount of electricity exported from the project to the grid	0.00 gCO_2e/MJ	Amount of electricity fed from the grid to the project	0.00 gCO_2e/MJ
Electricity-saving projects in energy intensive industry	An electricity-saving projects would not deliver net electricity export	n/a	Amount of electricity saved (i.e. no longer fed from the grid to the system)	48.81 gCO_2e/MJ [0.1757 tCO_2e/MWh]
Timed electricity demand (see section 2.2.6.3.6):	A virtual-stored-energy-release component	140 gCO_2e/MJ [0.504 tCO_2e/MWh]	A constant average consumption component	0.00 gCO_2e/MJ
CCS	A CCS-only project would not deliver net electricity export	n/a	Electricity consumed for injection and/or capture:	0.00 gCO_2e/MJ

[18] Source: EU Reference Scenario 2020 https://ec.europa.eu/energy/data-analysis/energy-modelling/eu-reference-scenario-2020_en.

[19] Source: Commission Delegated Regulation (EU) 2018/2066 of 19 December 2018, Annex VI.

Category / sector / products	Net electricity exported	EF	Electricity consumed	EF
Renewable non-dispatchable electricity	Net amount of electricity produced in the reference scenario and replaced by non-dispatchable electricity in the project scenario	48.81 gCO_2e/MJ [0.1757 tCO_2e/MWh] $EF_{electricity,ref}$	Amount of electricity imported from the grid and consumed at the project site:	0.00 gCO_2e/MJ $EF_{electricity,proj}$
Renewable dispatchable electricity	Net amount of electricity produced in the reference scenario and replaced by dispatchable electricity in the project scenario	140 gCO_2e/MJ [0.504 tCO_2e/MWh] $EF_{electricity,ref}$	Amount of electricity imported from the grid and consumed at the project site:	0.00 gCO_2e/MJ $EF_{electricity,proj}$
Energy storage	Net amount of dispatchable electricity supplied by the project	140 gCO_2e/MJ [0.504 tCO_2e/MWh] EF_{out}	Amount of electricity consumed by the project (both storage and self-consumption)	0.00 gCO_2e/MJ EF_{in}

Source: European Commission internal elaboration.

Example: A project aims at generating renewable electricity by torrefaction and combustion of biomass feedstock in a combined heat and power (CHP) plant.

The reference scenario: A term for the net amount of dispatchable electricity generated by the renewable technology and fed into the grid multiplied by EFelectricity,ref = 140 gCO_2e/MJ, plus a term for the amount of heat supplied by the project multiplied by $EF_{NG,ref}$ / 0.90 (see section 4).

1.3.3 GHG emissions from inputs

The applicant must specify the **energy and material inputs** that enter the system boundary, according to the specific guidance given in sections 2 to 5.

The following guidance on inputs apply to projects following Section 2 and 3. Inputs are divided into three categories: ‘rigid’, ‘semi-elastic’ and ‘elastic’. Elastic inputs are in turn divided into three levels of materiality: ‘major’, ‘minor’ (for projects submitted to the IF in a small scale call: not applicable) and ‘de minimis’. 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 rigid inputs. *Elastic inputs* are inputs for which overall production is variable (flexible), i.e., inputs for which production would be expected to increase as demand increases. *Semi-elastic inputs* are inputs that fall between these cases.

The levels of materiality are relevant only to elastic inputs, as during the assessment process rigid inputs are replaced in the calculations with associated quantities of elastic inputs (which should then be given a level of materiality) and/or with defined emissions from changed **disposition** which need not be further adjusted.

1.3.3.1 Level of materiality of elastic inputs

The level of materiality of elastic inputs can be major, minor or *de minimis*. Inputs that do not fall under the definition of minor, or *de minimis* are major.

Minor elastic inputs (Not applicable to Small Scale calls)

The applicant should make a list of all elastic inputs for the project and reference scenarios.

The applicant may select from this list minor elastic inputs whose emissions jointly amount to less than 15% of the total emissions ascribed to the inputs.

For monitoring and reporting for disbursements, the selection of minor elastic inputs must be restricted so that their emissions jointly amount to less than 15% of the total emissions ascribed to the inputs; for monitoring and reporting for knowledge-sharing to less than 10% of the total emissions ascribed to the inputs.

The emissions associated with the selected minor elastic inputs may be derived from reference literature, according to the method and hierarchy in the Appendix 1.

De minimis inputs

De minimis inputs are elastic inputs that make such a small contribution to the overall emissions of a project or reference scenario that they should reasonably be ignored when assessing emissions avoidance. 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. As a rule of thumb, 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 applicant may select from the list of inputs de minimis inputs whose emissions jointly amount to less than 5 % of the total emissions ascribed to the inputs for the whole project.

For monitoring and reporting for disbursement the selection of de minimis inputs must be restricted so that their emissions jointly amount to less than 5% of the total emissions ascribed to the inputs; for monitoring and reporting for knowledge-sharing to less than 2% of the total emissions ascribed to the inputs.

The emissions of *de minimis* inputs may be disregarded. De minimis inputs do not count as minor elastic inputs in calculating the joint emissions of the minor elastic inputs.

For projects submitted in a Small Scale call:

The remaining listed elastic inputs should have emissions factors assigned to them from the data hierarchy given in Appendix 1. The 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.

The emissions of *de minimis* inputs may be disregarded.

All other inputs are considered major and must be included in the emissions calculation.

Simplification for projects submitted in a Large-scale call, PILOT topic

For PILOT topic projects *de minimis* status can be granted based on use of an illustrative emission factor rather than requiring estimated emission factors for all inputs. Applicants could show that inputs would result in only modest emissions even if given a high emission factor, which would imply that if calculated with correct (and probably lower) emission factors the input emissions would be low to insignificant. For example, fossil fuels have associated CO_2 emission factors of up to about 3 tonnes CO_2 per tonne of fuel, while the document "Definition of input data to assess GHG default emissions from biofuels in EU legislation" identifies chemical inputs with emission factors of up to 12 tonnes CO_2 per tonne of input (but most chemicals considered have lower footprints). Alternatively, if it can be demonstrated that some group of process inputs would account for less than 10% of the reference emissions even if assessed with a high emission factor, these inputs could be taken as *de minimis* with little risk of a major distortion to the results.

1.3.4 GHG emissions associated with transport

Emissions associated with transport are to be considered in the following cases:

Where a project includes an element of carbon capture and utilisation or carbon capture and storage (CCU/S) the project emissions must include any emissions associated with CO_2 transport. This is to ensure that the net GHG benefits from carbon capture are not unduly undermined by any energy intensive CO_2 handling.

Where a project is basing the reference scenario for one or more of its principal products on a physically different product that is used for a comparable function, then the project emissions must include any emissions associated with distributing that principal product to the point of use. This is to ensure that the net GHG benefits from a shift to the use of novel products are not unduly undermined by energy intensive distribution practices.

> *Example: Project scenario: hydrogen supplied for transportation.*
> *The project scenario must include in the processes box the emissions associated with distributing the principal product (hydrogen) to the vehicle tank, including any emissions from the transfer of hydrogen by truck, pipeline or other means to a hydrogen refuelling station. Hydrogen refuelling stations may lose hydrogen by boil-off from the liquid hydrogen storage tank, or use energy to re-liquefy the boiled-off hydrogen - any emissions from re-liquefaction must be included in the processes box, and the amount of energy supplied in the reference scenario should reflect the amount of hydrogen that is finally supplied to vehicles if this is less than the amount of hydrogen leaving the hydrogen production facility. The reference scenario emissions shall be calculated based on the relevant fossil fuel comparator.*

Where a project uses biomass or waste materials as feedstock/inputs, the project emissions must include any additional emissions associated with gathering those materials and transporting them to the first point of processing/treatment when the transport range exceeds 500 km. This is to ensure that the net GHG benefits associated with utilising biomass or resources that would otherwise be wasted are not unduly undermined by the emissions associated with their transport, given that they may be transported over potentially large distances.

In order to calculate GHG emissions from the transportation of biomass or waste feedstock which are input to or used as fuels in the system, applicants shall either:

- Use actual expected values in the calculation submitted when data can be tracked from the transporters, or;
- Use data from or other similar values that the applicant could duly justify.

Table 1.4. GHG emissions (g CO_2e/(t*km)) from the transportation of biomass.

Pathway/Tractor			
Rail transport	**Road**	**Inland/coastal waterway**	**Sea**

Freight electric train Electricity: InnovFund assumptions for electricity consumption	40 t diesel truck (includes return trip) 60.03 g/(t*km)	1.2 kt diesel tanker 37.38 g/(t*km)	12.6 kt HFO tanker 9.29 g/(t*km)
Freight diesel train 18.68 g/(t*km)		8.8 kt diesel bulk carrier 24.10 g/(t*km)	26 kt HFO bulk carrier Handysize 15.48 g/(t*km)

Source: Internal elaboration of data from JEC WTW v5 Annexes, UBA ProBAS database, GEMIS v. 4.9

1.3.5 Combustion emissions

Emissions of greenhouse gases from combustion of fuels or other materials within the system boundary must be included in the emissions avoidance calculation. This must include a consideration of the amount of non-CO_2 greenhouse gases (in particular CH_4 and N_2O) that would be produced under the expected combustion conditions, on a CO_2 equivalent basis. CO_2 emitted from biomass combustion may be treated as having an emission factor of zero, but other greenhouse gases emitted in biomass combustion should be considered.

Where materials containing carbon atoms are used in or produced by projects it is sometimes required by the guidance to consider the 'stoichiometric combustion emissions' of CO_2 for that material. The stoichiometric emissions shall be calculated as the amount of CO_2 that would be produced if all of the carbon in the material were to be oxidised to CO_2. Where the guidance asks for stoichiometric combustion emissions to be included it is not necessary to consider the potential generation of other greenhouse gases under real-world combustion conditions.

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 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 transparent manner that enables the checking of performance achieved during the operation of the project. The details on the length of the monitoring and reporting period are in the section 1.1. Beneficiaries shall ensure that the operational data determination is neither systematically nor knowingly inaccurate[20] 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 Appendix 4 on MRV and KS provides an overview of the MRV legislation as well as details on the specific requirements for reporting for the purposes of disbursement and for knowledge-sharing for the different sections of the methodology.

[20] 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 substitute products, and carbon capture and use (CCU)

2.1 Scope

This section deals with the methodology to estimate GHG emission avoidance in the proposed projects concerning activities falling in the energy intensive industry sectors. The principal product(s) from the project (section 1.3) should reflect the main aim and innovation of the project. To fall in one of the energy intensive industry sectors, the principal product(s) **must be or must substitute a product whose conventional production is covered by Annex I of the EU ETS Directive**. Substituting a product may include **substituting the function** of a product.

Projects concerned with innovative processing of biomass feedstock to produce bio-based products and biofuels in bio-refineries also have to follow the principles described in this section.

Some guidance on cases where a sector choice might be difficult is given in Table 2.1.

Table 2.1. Examples of sector choices

Projects	Choice of sector
Bio-refineries	Depending on the final products, bio-refinery projects need to choose either: refineries if predominantly producing fuels; or chemicals if predominantly producing chemicals; or pulp and paper if predominantly producing pulp and paper products. In some cases (such as a bio-based substance with both fuel and chemical applications) applicants will be able to choose between refineries and chemicals.
Direct air capture (DAC) with CCS Waste to energy with CCS	EII / Other
DAC with CCU CCU	Such projects must result in substitute products for the products of Annex I of the ETS Directive. The sector to choose is the sector of the substitute product.
Wastewater treatment	Such a project can be eligible if using renewable energy, then the sector is "Use of renewable energy outside Annex I". If biofuels are produced, then refineries can be chosen.
Water desalination	Such a project can be eligible if using renewable energy, then the sector is "Use of renewable energy outside Annex I". Such a project can be eligible due to size, i.e. if using more than 20 MWh, then the sector can be EII / Other.
Electrofuel (production of hydrogen or other synthetic fuels from electricity)	Unless such projects are specifically designed to cope with the variability of renewable energy production, such projects fall under the EII category / refineries sector. If the electricity consumed is essentially limited to period of high renewable energy production, which result in a particularly low load factor, projects fall under the energy storage category / other energy storage sector.

Source: *European Commission internal elaboration.*

2.2 GHG emissions avoidance

2.2.1 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 1.1.1 and 1.1.2. The **absolute emissions** avoided by the project are the emissions of the reference scenario minus the emissions of the project scenario. The **relative emissions avoidance** is then calculated by dividing the absolute emissions avoided, by the emissions of the reference scenario.

In some cases, an innovative process element may be introduced that reduces the emissions of only a fraction of the overall throughput of an existing facility. In such cases, if the innovation could in principle be extended (i.e., be scaled up) to cover the entire throughput of such a facility then it is permitted to consider only the fraction of production when defining the project and reference scenarios. However, if the innovation cannot be scaled up to the full plant, then in the calculation of relative emission avoidance, the applicant should use the GHG emission avoidance of the whole existing plant as reference scenario, while for the project scenario, the applicant can take only up to the maximum fraction convertible to the new technology.

Applicants should justify the maximum fraction used in the calculation.

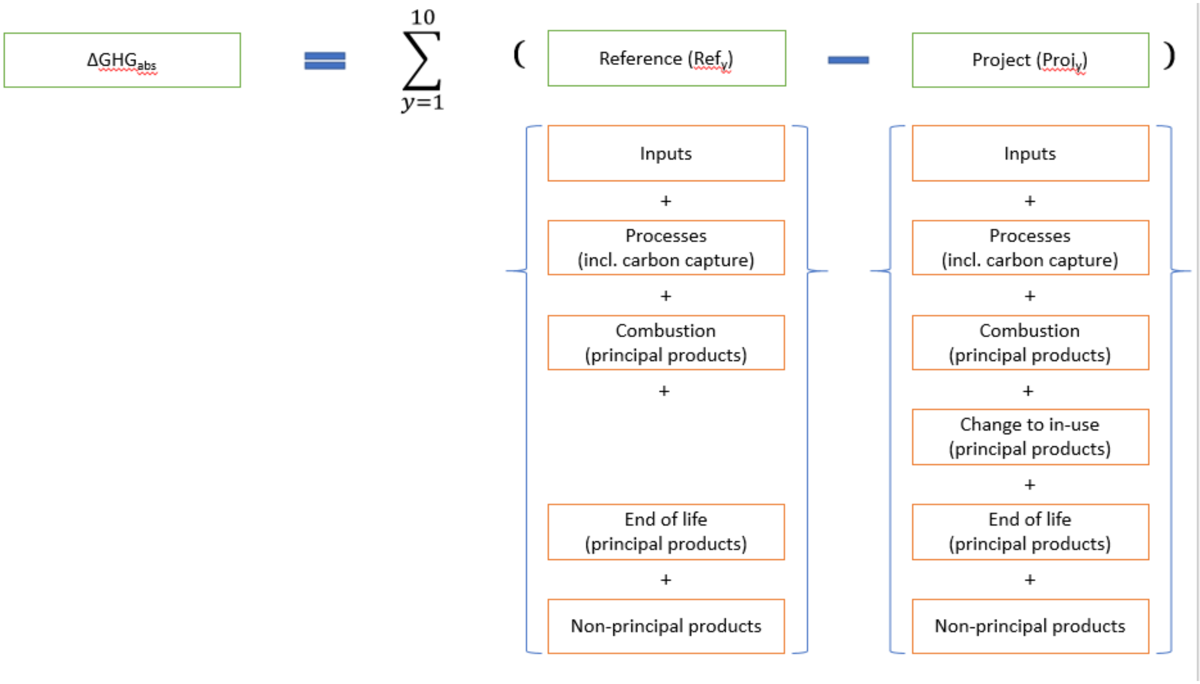
> *<u>Example</u>: an ammonia production plant that currently consumes 100 thousand tonnes of hydrogen per year may apply to the Innovation Fund for support to add an electrolysis unit (powered by electricity from RES) capable of producing 10 thousand tonnes of green hydrogen per year.*
>
> *The absolute GHG reduction will be the same whether the entire facility or only the fraction processing green hydrogen is included within the project boundary.*
>
> *The relative emission reduction, however, will be greater if only the part of the facility processing green hydrogen is considered.*
>
> *In principle it would be possible to add additional electrolysis units to move the entire facility to green hydrogen, and therefore it is permitted to treat the project as if green hydrogen was the only hydrogen input, and consider only that part of the existing process as reference scenario that corresponds to the hydrogen input. This is allowed even though it may not be possible (or may not be efficient) to physically segregate the hydrogen from conventional and innovative sources in the process. In such a case then the relative emission avoidance can be 100%.*
>
> *However, if there are technical limitations to ever substitute all the hydrogen with renewable hydrogen and for example, only 60% of the hydrogen could be substituted, then the relative emission avoidance would be 60%.*

2.2.2 Life-cycle stages

The GHG emissions for each life-cycle stages "box" should be included in the calculations for the reference scenario (i.e., the conventional way) and the project scenario, as illustrated in Figure 2.1.

The reference scenario provides the same functions as principal product(s) provide(s) in the project scenario. As explained in the section 1.2: the principal product(s) should reflect the main aim and innovation of the project; the reference scenario should reflect the current state-of-the-art in the given sector.

Figure 2.1. Diagram of GHG emission avoidance related to InnovFund projects.



Source: *European Commission internal elaboration.*

Both scenarios should include any relevant emissions in the boxes: corresponding to "inputs", "processes (incl. carbon capture (CCU or CCS))", "combustion (principal products)", "end of life (principal products)", and "non-principal products". The emissions sources (positive emission terms) and sinks (negative emission terms) to be considered in each life-cycle stage ("box") are explained in further detail in this section.

The "change to in-use (principal products)" emissions box appears only in the project scenario. If an innovative product reduces GHG in-use emissions compared to the reference scenario, then this change should be recorded only in the box for the project scenario with a negative term. The in-use emissions should not be reported in the reference scenario.

Applicants should differentiate "change to in-use (principal products)" box from the case of fuels or other combusted products, where combustion emissions are included in the "combustion (principal products)" box.

2.2.3 System boundary

In the context of the GHG emission calculations for an Innovation Fund project, the system boundary defines the set of processes to be assessed.

At the minimum the system boundary for the project scenario should include the parts of an installation at which **innovative practices** are being introduced by the project and any processes **downstream of those innovative practices** that are required to produce the principal products from the project. These processes must be included in the "processes" box of the project scenario (see section 2.2.5).

For processes **upstream of the innovative practices**, applicants may choose to either:

treat the outputs of those upstream processes as inputs to the project and include them in the "inputs" box (see section 2.2.6),

or, to expand the system boundary to include them within the "processes" box, providing that applicants have data available to do so (see section 2.2.5).

In general, where applicants control a process involved in the production of the principal products, that process should be placed within the system boundary and assessed in the "processes" box. Even where applicants do not control an **upstream** process, they are encouraged to expand the system boundary to include that process in the "processes" box provided that they are able to arrange with the process operator (i.e., a third party) to have access to the relevant GHG emissions data. There is no limit on how far upstream the system boundary may be drawn – if data is available then applicants may include primary **material extraction** in the "processes" box (for the emissions covered and excluded: see sections 1.1.3, 1.1.4).

> *Example: hydrogen used to produce a synthetic fuel*
>
> *If the hydrogen production is under the control of the applicant (e.g., the applicant owns and operates an electrolyser) then hydrogen production should be brought into the system boundary and treated as part of the process along with synthetic fuel production.*
>
> *If however hydrogen is produced by a third-party operated facility, and the applicant is not able to arrange access to data in order to bring this facility inside the system boundary, then the hydrogen will be treated as an input.*

The reference scenario is defined by the principal product(s) being produced by the project. The system boundary for the reference scenario may vary depending on the type of reference scenario that is appropriate to the project in question. The different cases for construction of a reference scenario are detailed in section 2.2.4.

Project proposals may be submitted jointly by more than one company that have formed a consortium. The methodology estimates the emissions savings for the project, not for each individual company within the project. Therefore there is no need to split the emission reduction between the project partners.

2.2.4 Choice and construction of a "processes" box in the reference scenario to match the function of the project's principal product(s)

The reference scenario includes emissions of conventional "processes" that would produce products that provide equivalent function(s) to the project's principal product(s). An "**equivalent function**" is usually the same quantity of an identical product(s) made in the conventional way. If the principal product is to be utilised to fulfil a function conventionally delivered in another way (i.e., by some combination of other products), then the reference scenario would be the production of the conventional product(s) that would fulfil the equivalent function. In cases where there is more than one possible reference scenario, the reference scenario should be based on the conventional products most likely to fulfil the function in the absence of the project. If the application is based on an inappropriate reference scenario (e.g., by choosing a reference scenario with higher emissions in preference to a reference scenario that would be more likely in the absence of the project) then this may affect the quality of the GHG calculation.

The sum of the reference scenarios: the full reference scenario will consist of the sum of the reference scenarios for each of the (multiple) principal products identified for an InnovFund project.

> *Example: A project with two principal products: hydrogen and synthetic diesel fuel. A reference scenario consists of the sum of both the EU ETS product benchmark for hydrogen production and the InnovFund fossil fuel comparator for diesel.*

One 'combined' reference scenario: in some cases, it may be possible to identify for two or more principal products in the project scenario just one 'combined' production process in the reference scenario provided that it is possible to match the quantity of each principal product of project scenario to the quantity of each product from the reference scenario.

> <u>Example</u>: *An innovative process produces ethylene and propylene as principal products. Ethylene and propylene are co-products of the conventional steam cracking process, for which there is an EU ETS benchmark. The EU ETS benchmark for steam cracking may be used as a combined reference providing the outputs of ethylene and propylene from the project are consistent with the benchmark specifications. The description of the benchmark (definition of products covered) reads: "Mix of high value chemicals (HVC) [...] with an ethylene content in the total product mix of at least 30 mass-percent and a content of HVC, fuel gas, butenes and liquid hydrocarbons of together at least 50 mass-percent of the total product mix".*

Nine basic cases for setting the reference scenario for a principal product:

The following nine cases are discussed in additional detail below.

1. If there is an EU ETS product benchmark corresponding to production of the principal product, that benchmarks should be the basis for the reference scenario.

2. If there is no EU ETS product benchmark available that directly corresponds to production of a principal product, it should be possible to construct an appropriate reference scenario by combining EU ETS heat, fuel and/or process sub-installations with an existing EU ETS product benchmark.

3. If the project is a modification to an existing production system the applicant may choose to use the existing (i.e. unmodified) production system as the reference scenario, subject to conditions detailed below.

4. If the principal product is a transport fuel substitute, then the reference scenario for that product should be based on the InnovFund fossil fuel comparator values.

5. If the principal product is a natural gas substitute, then the reference scenario should be based on the combustion emissions intensity of natural gas.

6. If the principal product can be synthesised from natural gas (e.g., methanol) and an emission value is available in the inputs data hierarchy (Appendix 1) for production of that principal product with natural gas as the primary feedstock[21], then the applicant should set the reference scenario emissions for that principal product based on that emission value, subtracting where appropriate 15% from the part of those emissions not associated with the carbon contained in the material (see section 2.2.6.3.3).

7. If the project is for CCS from direct air capture, the reference scenario is zero emissions.

8. If the project is to transport or store CO_2 captured outside the system boundary, the reference emission is the quantity of CO_2 entering the system boundary.

9. Where it is not possible to construct a reference scenario for production of all the principal products from a project in the ways identified above, then the applicant must propose an appropriate reference production system with clear justification and provide a robust characterisation of the emissions associated with that system.

Note that for projects with multiple principal products it is possible that reference scenarios for the individual principal products may fall under different sections below. In that case,

21 If it is not clear whether a pathway value contained in the data hierarchy assumes a natural gas feedstock, then the applicant should instead propose a reference scenario following the requirements of case 9.

the reference emissions for the project as a whole shall be the sum of the reference emissions for all principal products.

2.2.4.1 Case 1: A relevant EU ETS product benchmark (or benchmarks) exists

Simplification for PILOT topic **projects:** PILOT projects are allowed to base a reference on an LCA study from the literature in cases where a benchmark or benchmarks is/are available but additional information on inputs and non-principal products would be required.

For projects producing principal products for which an EU ETS product benchmark is defined in Annex I of the applicable Benchmarking Decision[22] at the time of the submission of the application, the reference scenario should be based on that EU ETS product benchmark. The EU ETS benchmark emissions **for the production of the relevant amount of the principal product** should be included in the "processes" box of the reference scenario. Benchmark value for 2021- 2025 is to be used for all the first 10 years of production. . For projects producing heat as a principal product, the EU ETS heat benchmark should be used in the "processes" box of the reference scenario. Please note that the benchmark values for refinery units and processes included in Annex II of Commission Delegated Regulation (EU) 2019/331 should not be used to set reference scenario emissions.

> *<u>Example</u>: hydrogen production at a new facility to be used in an industrial application*
>
> *The EU ETS benchmark value for hydrogen (2021 Benchmarking Decision: 6.84 tCO_2/tH_2) should be applied to all the hydrogen production as the reference.*

In some cases, the processes producing a principal product in the reference scenario may reflect **a combination of multiple EU ETS product benchmarks**.

> <u>Example</u>: A project producing hot metal. Constructing the appropriate reference scenario may require the applicant to combine the benchmarks for coke, sintered ore, and hot metal as all are part of the conventional hot metal production process. *It will be necessary to provide in the calculation a characterisation of the expected consumption per unit of output of the intermediate products (in this case coke and sintered ore) that are used in the production of the final product (hot metal), as the emissions from coke and sintered ore production are not included in the hot metal benchmark value.*

The reference scenario may need to include emissions in additional boxes that **the EU ETS product benchmark(s) do(es) not cover[23]**:

"Inputs". The EU ETS benchmarks do not include embedded emissions associated with inputs used. The applicant should identify the quantities of inputs that would be expected to be used in the conventional production system associated with the ETS benchmark in the reference scenario.

> *<u>Example</u>: the EU ETS benchmark for 'bottles and jars of colourless glass' does not include upstream emissions (primarily associated with energy used in production) for the material inputs to the conventional glass making process (sand, soda ash and limestone). The applicant should identify appropriate emission factors for sand,*

[22] The applicable EU act is Commission Implementing Regulation (EU) 2021/447 of 12 March 2021 determining revised benchmark values for free allocation of emission allowances for the period from 2021 to 2025 pursuant to Article 10a(2) of Directive 2003/87/EC of the European Parliament and of the Council, available at https://eur-lex.europa.eu/eli/reg_impl/2021/447. All the guidance documents are here: https://ec.europa.eu/clima/policies/ets/allowances_en#tab-0-1 (make sure to scroll down to 2021-2030).

[23] The processes and emissions covered by the EU ETS product benchmarks can be found in the "Guidance Document n°9 on the harmonized free allocation methodology for the EU-ETS post 2020 Sector-specific guidance" available at https://ec.europa.eu/clima/system/files/2019-07/p4_gd9_sector_specific_guidance_en.pdf

soda ash and limestone in the input data hierarchy and include the relevant input emissions in the "inputs" box or the reference scenario.

"Non-principal products" associated with the reference scenario. In some cases this may mean that the same non-principal products will be included in the "non-principal products" box of both the reference and project scenarios.

Example: the EU ETS benchmark for short fibre kraft pulp reflects a process that generates tall oil as a non-principal product. An emission credit associated with the production of the associated quantity of tall oil should be included in the "non-principal products" box of the reference scenario.

"Combustion (principal products)" in the reference scenario.

Example: A project will produce a coke substitute for use in iron production as a principal product. The reference scenario includes emissions in the "processes" box based on the EU ETS benchmark value for producing coke, and emissions in the "combustion (principal products)" box based on combustion emissions for the coke.

"End of life (principal products)".

Example: For a project producing ethylene glycol, emissions calculated using the EU ETS benchmark value will be included in the "processes" box of the reference scenario, but this does not include end of life emissions associated with the carbon contained in the product. The emissions from conversion of the carbon in the ethylene glycol to carbon dioxide at end of life should be included in the "end of life (principal products)" box.

2.2.4.2 Case 2: An appropriate reference scenario can be constructed from a combination of EU ETS product benchmarks and other benchmarks sub-installation

Simplification for PILOT topic **projects**: PILOT projects are allowed to base a reference on an LCA study from the literature in cases where it is not clear which sub-installations might need to be added.

Where the conventional processes required to provide the same functions as the principal product(s) do not correspond directly to an EU ETS product benchmark sub-installation, it may be possible to construct an appropriate reference scenario by combining the existing product benchmark sub-installation with other sub-installations. In other words, when the boundaries of the processes producing the principal product(s) in the project scenario do not coincide with an EU ETS product benchmark, other EU ETS sub-installations may be added to the "processes" box in the reference scenario to balance the scenarios.

There are three types of other EU ETS sub-installations[24]:

- heat benchmark sub-installations
- fuel benchmark sub-installations
- process emissions sub-installations.

In these cases the relevant EU ETS product benchmark plus additional sub-installation(s) should be added to the "processes" box in the reference scenario to properly reflect the set of processes required to provide the same or equivalent function(s).

[24] The applicable EU act is Commission Implementing Regulation (EU) 2021/447 of 12 March 2021 determining revised benchmark values for free allocation of emission allowances for the period from 2021 to 2025 pursuant to Article 10a(2) of Directive 2003/87/EC of the European Parliament and of the Council, available at https://eur-lex.europa.eu/eli/reg_impl/2021/447. All the guidance documents are here: https://ec.europa.eu/clima/policies/ets/allowances_en#tab-0-1 (make sure to scroll down to 2021-2030).

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

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.

> *Example: a project manufacturing cold drawn steel bars may be able to construct a reference scenario in which the "processes" box is based on combination of the product benchmark for hot metal and a fuel benchmark sub-installation reflecting additional fuel consumption for the drawing process.*

> *Example: a project manufacturing sodium bicarbonate may be able to construct a reference scenario in which the "processes" box is based on the combination of the EU ETS benchmark for soda ash and a fuel benchmark sub-installation reflecting additional fuel consumption for reacting soda ash with water and CO_2 to produce sodium bicarbonate.*

All assumptions made in the characterisation of these additional sub-installations (for example in determining whether to assume that additional energy is supplied as heat, fuel or **electricity**) should be clearly stated and justified, and should provide a reasonable characterisation of normal practice in the conventional production process. Where a decision must be made between two alternatives that are both equally common, the reference scenario should always reflect the lower GHG emissions option. Electricity consumption (see Table 1.3) is treated in the InnovFund as having zero GHG emissions in the "processes" box assessment and therefore any additional electricity consumption not covered by the EU ETS product benchmark sub-installations should be included with zero emission factor for transparency.

> *Example: if there is a choice between assuming that an additional process would be powered with electricity from the grid (zero emissions under the InnovFund calculation methodology) or by adding an additional fuel benchmark sub-installation, then it should be assumed that power would be taken from the grid.*

The reference scenario may need to include additional boxes that the EU ETS product and other benchmarks sub-installation do not cover: see explanation in section 2.2.4.1.

2.2.4.3 Case 3: Modifications to existing production systems

A project may be treated as a modification of an existing production system if emissions reductions are delivered by modifying one or more units or processes in that system in an innovative way, without simply replacing the main processes of the system and if the principal product that is used to determine the sector of the application is also produced by the unmodified system. If, however, the capex associated with the project is more than a third of the capex that would be required to develop a whole new production facility then the project cannot be treated as a modification. Projects that add carbon capture units to existing installations without changing the products from those installations **must be treated as modifications to the existing system**.

A project in which only inputs are changed does not qualify as a modification to an existing production system. Note, however, that the applicant may choose to bring the production of any input into the "processes" box (see 2.2.3 and 2.2.6) and assess the emissions directly. This requires that the applicant should be able to identify the source of that input and to cooperate with the producer of that input in order to obtain the necessary data for the calculation. In some cases, identifying a project as a modification will depend on the choice of principal product.

> *Example: if a steam methane reformer at an oil refinery is replaced with an electrolyser and the principal product is identified as hydrogen, this could not be treated as a modification as the main element of the hydrogen production system is entirely replaced.*
>
> *If, however, refined hydrocarbon fuels were treated as the principal product then the project could be treated as a modification in the context of this wider production system.*

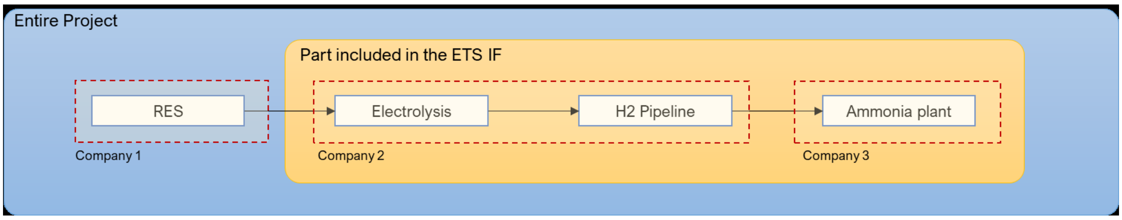
Applicants must provide justification of the decision to treat a project as a modification to an existing production system. If the evaluators determine that a proposal incorrectly identifies a project as a modification in order to allow the use of higher reference emissions, then this may affect the quality of the GHG calculation.

Rules for modified plants: When a project is identified as a modification to an existing production system, the applicant **may be permitted** to take the unmodified processes as a reference scenario (rather than the EU ETS benchmarks).

The objective is to allow improvements to existing plants without "locking in" high-emissions plants that emit more than the EU ETS benchmark. Therefore, there are the following conditions:

- The emissions of the project must be lower than the sum of emissions in the reference scenario, otherwise the modification would not make sense from the GHG emissions avoidance perspective.
- Where modifications are made to at least one sub-process of a process corresponding to an EU ETS product benchmark, then the total of emissions for that modified process should be lower than the respective EU ETS product benchmark emissions.[25]
- If a project produces only one principal product and it is associated with an EU ETS product benchmark value, then the GHG emissions from the modified production system must be below the EU ETS product benchmark emissions for the relevant quantity of that principal product.
- 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.

> *Example: In the diagram below Companies 2 and 3 jointly submit a project to use additional renewable electricity to produce hydrogen (the intermediate product) for making ammonia (the principal product), replacing hydrogen from an existing steam methane reformer in the existing ammonia plant. The project can be defined as a modification to the ammonia plant, as the hydrogen production unit is only part of the production system. Therefore the reference scenario may be taken to be the existing ammonia production plant, subject to the rules for modified plants detailed above.*



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

Alternatively, company 3 could propose the project alone. The hydrogen coming out of the pipe from the electrolyser (company 2) would now be treated as an input (from 'outside' the system boundary and not control over it). Company 3 would therefore not be permitted to treat this project as a modification to an existing production system unless there were other innovative changes being made to the ammonia production system. The reference scenario would be the EU ETS benchmark for ammonia (see case 1 in section 2.2.4.1 above).

However, if company 2 applied alone, then the principal product is hydrogen. In this case it would no longer be possible to treat the project as a modification, so the reference scenario would be the EU ETS benchmark for hydrogen (see case 1 in section 2.2.4.1 above).

- When comparing the "processes" emissions in a modification project to an EU ETS product benchmark, the benchmark must be chosen based on the modified plant, which may be different to the relevant EU ETS benchmark for the unmodified plant.

Example: the existing, unmodified facilities operate a blast furnace steel production. The project would replace the blast furnace capacity with electric arc furnace (EAF) capacity.

EAF processes only scrap steel, not iron ore, and therefore is a fundamentally less CO_2 intensive technology (hence the total of emissions for the modified process EAF has a much lower EU ETS benchmark than 'hot metal').

For the benchmark comparison: the project "processes" emissions should be below those for a benchmark EAF facility.

Note that this project modification would also cause a change in the inputs from iron ore to scrap steel. Scrap steel should be assessed as a rigid input (see section 2.2.6.2), which may result in additional emissions being assigned in the "inputs" box following the modification.

When assessing the reference based on an existing plant the applicant will normally need to identify inputs in the "inputs" box. The other boxes should be used as required.

2.2.4.4 Case 4: Transport fuel substitutes

For projects with a principal product that replaces (or provides an equivalent function to) a conventional transport fuel, the reference scenario shall be based on the "IF fossil fuel comparator"[29](emission factors) of the substituted fuel (or fuels) in Table 2.2. This would include projects producing novel transport fuels falling under the definition of biofuels, renewable fuels of non-biological origin (RFNBOs) or recycled carbon fuels (RCFs) under REDII and projects supplying electricity or hydrogen for use in road transport. The emissions for the equivalent quantity of substituted conventional (fossil-based) fuel shall be included in the "combustion (principal products)" box of the reference scenario based on the IF fossil fuel comparators[30]. In this case no emissions need to be included in the processes box of the reference scenario as the relevant processing emissions are already included in the fossil fuel comparators. This procedure also applies to projects producing synthetic crude oil as a principal product where the upgrading of the synthetic crude into transport fuels will take place outside the project boundary. For projects using a fossil fuel comparator as the reference scenario, the combustion emissions of the novel fuel (if any) must be included in the "combustion (principal products)" box of the project scenario[31].

This must include any CH_4 or N_2O emissions associated with combustion of the fuel in a relevant vehicle.

Table 2.2. "InnovFund fossil fuel comparators (FFC)" and the lower heating values = net calorific values for fossil fuels displaced by InnovFund projects producing RFNBOs or RCFs and biofuels. [26]

Substituted fossil transport fuel	InnovFund 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 oil	75.5	42.0

Source: JRC elaboration of data from JEC-WTW report v5.

The same values are introduced in the GHG-calculator, which is a part of the Application. Lower Heating Values (LHV) are used for the different fuels.

For fuels used only in highly-modified vehicles, such as hydrogen for fuel cell cars, the applicant should 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 "processes" box emissions for the distribution of the novel (unblended) fuel to the vehicles. 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, Appendix 1.

> *Example: A project produces hydrogen. Hydrogen is supplied to fuel cell vehicles. It substitutes the transport function of conventional cars running on fossil fuel. The reference scenario for the **substituted function** is the consumption of the fossil fuel required (fossil fuel comparators Table 2.2) for a comparable conventional car to transport **the same load an equal distance**. (The appropriate sector for the principal product hydrogen would be refineries).*
>
> *Applicants must convincingly establish that the hydrogen would be used for fuel cell cars. The project should include the hydrogen distribution to cars, or at least show contracts with such a distributor, and also include the distribution in the emissions calculation.*
>
> *Otherwise, the correct reference scenario would be 'generic' hydrogen production, and the reference scenario emissions would be based on the EU ETS hydrogen product benchmark. (The appropriate sector for the principal product hydrogen would be hydrogen).*

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

No inputs or non-principal products should be included in the reference scenario for this case. No additional emissions should be recorded in the "combustion (principal products)" or "end of life (principal products)" boxes of the reference scenario.

Simplification for PILOT topic **projects:** PILOT projects are not expected to submit letters of intent when claiming 'equivalent function'. However, operators would still need to be able to demonstrate that the product was supplied to a transport offtaker following project commencement in order to claim full credit.

2.2.4.5 Case 5: Natural gas substitutes

For projects producing natural gas substitute products (e.g., biomethane, synthetic methane, hydrogen for supply via the natural gas grid), where the ultimate disposition (i.e., use) 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 for the equivalent quantity of substituted natural gas, calculated as equal energy content on a lower heating value basis, shall be included in the "processes" box of the reference scenario based on the combustion emissions intensity (i.e., emission factor) of natural gas (56.1 gCO_2e/MJ).

If the disposition of the natural gas substitute is known (e.g., 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**.

> *Example:* *the project scenario: production of renewable gas fed into natural gas grid. The reference scenario:*
>
> *If there is no arrangement in place to supply to a specific market, then it has to be assumed that the reference for the natural gas fed into the gas grid would be the general combustion emissions intensity of 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.*
>
> *In the case that arrangements are made to have the produced gas supplied e.g., for heavy duty transport use then the diesel fossil fuel comparator would be the appropriate reference (80.4 gCO_2e/MJ, Table 2.2). The relative efficiency of natural gas and diesel heavy duty engines should be included in calculating the amount of diesel displaced. Applicants must convincingly establish that the renewable gas would be used for heavy duty transport. The project should include the renewable gas distribution to the vehicles, or at least show contracts with such a distributor, and also include the distribution in the emissions calculation.*

No inputs or non-principal products should be included in the reference scenario for this case. No additional emissions should be recorded in the "combustion (principal products)" or "end of life (principal products)" boxes of the reference scenario.

2.2.4.6 Case 6: The principal product can be synthesised from natural gas and a life-cycle emissions value is available in the data hierarchy

For projects where the principal product provides a function that replaces conventional carbon-based fuels or chemicals for which reference scenarios cannot be proposed under cases 1, 3, 4 or 5 [27] it is allowed to take as a reference scenario a life-cycle[28] emission factor drawn from the hierarchy of inputs data sources in Appendix 1, provided that the

[27] I.e., the principal product does not replace any of: natural gas; fuels with fossil fuel comparator values (such as gasoline or diesel); or products with EU ETS product benchmarks.

[28] A life-cycle emission factor includes emissions associated with the production of the product. The stoichiometric combustion emission factors given in IPCC 2006 Guidelines for National Greenhouse Gas Inventories do not constitute life-cycle emission values.

emission factor is based on a process with natural gas as the main feedstock (e.g., synthesis of methanol, formaldehyde, acetic acid). In general, emission factors from the data hierarchy may be expected to include the carbon contained within the product. If a value does not include carbon contained within the product then that amount of carbon should be added to the emission value on a stoichiometric basis. The resulting value may be used as an emission factor for production of the relevant principal product in the "processes" box of the reference scenario.

If the emission factor drawn from the data hierarchy includes upstream emissions from fossil fuel supply, then 15% for upstream emissions should be subtracted from the part of the emissions value not associated with the carbon content of the substance (see section 2.2.6.3.3). This adjustment should be made for the supply part of emissions intensity values taken from the REDII inputs data. For the particular case of **methanol**, the value to use in the reference scenario is 92.9 gCO_2e/MJ [29] (see example below).

> *Example: a project will produce methanol as a principal product. If the methanol would be used as a gasoline additive then a reference scenario could be based on the gasoline fossil fuel comparator, but this project expects to supply the methanol to the chemicals market rather than the fuel market. The document "Definition of input data to assess GHG default emissions from biofuels in EU legislation" is at the second level of the data hierarchy and provides a lifecycle GHG emissions intensity value of 97.1 gCO_2e/MJ for methanol, divided into 28.2 gCO_2e/MJ of supply emissions and 68.9 gCO_2e/MJ of combustion emissions. This value is referenced to "Larsen, H. H., 1998, Haldor Topsoe A/S, Lyngby, 'Denmark: The 2,400 MTPD Methanol Plant at Tjeldbergodden". This report is based on a process for synthesis of methanol from associated natural gas produced at Heidrun oil field – as it is a natural-gas-based lifecycle value, it is eligible for use under this case. The scope for the lifecycle values in the document "Definition of input data to assess GHG default emissions from biofuels in EU legislation" includes upstream emissions from fossil fuel supply, and therefore the supply element of the value should be reduced by 15% from 28.2 gCO_2e/MJ to 24.0 gCO_2e/MJ before being used to set a reference scenario. The resulting emissions intensity value is 92.9 gCO_2e/MJ.*

Several chemicals that can be produced by steam cracking of natural gas liquids fall on the 'high value chemicals' (HVC) list in ETS[30]. However, they may be produced in ratios that do not meet the HVC definition for use of the EU ETS HVC benchmark. In that case, the applicants should propose a reference scenario based on a lifecycle emission value for the relevant chemical from the input data hierarchy. Under case 6 the value proposed must be based on steam cracking of natural gas liquids – it is not permissible to propose a reference scenario under this case based on a lifecycle assessment for steam cracking of naphtha.

> *Example: A project will produce propylene as the sole principal product. The EU ETS benchmark for "Steam cracking (high value chemicals)" states that it applies to processes, "with an ethylene content in the total product mix of at least 30 mass-percent and a content of HVC, fuel gas, butenes and liquid hydro-carbons of together at least 50 mass-percent of the total product mix". As the project produces no ethylene, this benchmark may not be used as a reference. The applicant should look through sources in the data hierarchy to find a lifecycle emission value for propylene production from steam cracking of natural gas liquids and use that value (reducing the part of the emissions not associated with the carbon content of the substance by 15% if appropriate) as their reference scenario.*

Note that the reference scenario should consider the function of the principal products of the project and this may affect the correct choice of reference scenario – thus a fossil fuel

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

[30] Acetylene, ethylene, propylene, butadiene, benzene.

comparator value may still be the correct reference scenario even for a chemically distinct principal product, if that product is to be used as a transport fuel.

> *<u>Example</u>: if methanol from an InnovFund project was to be supplied for use as a transport fuel in heavy duty vehicles, the appropriate reference scenario would be based on the fossil fuel comparator for diesel, and not on methanol production. Applicants must convincingly establish that the methanol would be used for transport. The project should include the methanol distribution to the vehicles, or at least show contracts with such a distributor, and also include the distribution in the emissions calculation.*

No inputs or non-principal products should be included in the reference scenario for this case. No additional emissions should be recorded in the "combustion (principal products)" or "end of life (principal products)" boxes of the reference scenario, because release of the carbon contained in the product should already be included in the emission factor in the "processes" box.

2.2.4.7 Case 7: Direct air capture for CCS, and BECCS

Where a project consists solely of the installation of a direct air capture facility or of a carbon capture unit at a biomass power facility, with the captured CO_2 sent for permanent storage, then the reference scenario emissions for the project shall be set to zero. For such projects, it is not possible to calculate relative emissions reductions using equation 1.2 and therefore **the relative emission reduction shall be set to 200%**.

2.2.4.8 Case 8: Storage or transport of captured CO_2

For projects that involve only the storage or transport of CO_2 that is captured outside the system boundary for the project, the reference emissions shall be set as the quantity of CO_2 entering the system boundary. No distinction shall be made between CO_2 of fossil and biogenic origin in this case. If an applicant wishes to gain recognition within the GHG calculation for the transport or storage of biogenic CO_2, then the capture of that CO_2 must be brought within the system boundary and this reference case would not be applicable.

2.2.4.9 Case 9: The applicant proposes a reference scenario

For projects whose principal products cannot be given reference scenarios using any of the cases detailed above, the applicant may propose a reference scenario based on either a life-cycle analysis sourced from appropriate literature or a life-cycle analysis undertaken or commissioned by the applicants themselves. The applicant may consider sources in the inputs data hierarchy (Appendix 1) but is not limited to those sources. The applicant must justify an appropriate reference scenario which would deliver the **same quantity or function** as the principal product in the project scenario. The evaluators will check the validity of the arguments for the selection, the assumptions and data sources.

The specific reference should as far as possible be consistent with the principles of EU ETS benchmarking. 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)[31]. The derogations in Article 27(a) 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.

[31] 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.)

The emissions of biogenic CO_2 from combustion of biofuels is not counted, which is consistent with the EU ETS and REDII Directives.

2.2.5 Emissions from processes (incl. carbon capture)

For the **project scenario**, the applicant must include in the "processes" box all the emissions expected within the system boundary of the project associated with the processes required to produce the chosen **principal product(s)** or delivering its (their) functions (section 1.3.3). The set of processes to be assessed in the "processes" box are defined by the system boundary (section 2.2.3). This includes all emissions of CO_2 or other greenhouse gases occurring due to fossil fuel combustion or chemical or biological processes within the project boundary (remembering that any emissions of biogenic CO_2 should be recorded but shall be treated as zero for the emissions calculation). **This includes any expected methane leakage within the project boundary.** Methane leakage should be predicted based on standard rates for the type of facility/equipment proposed. The processes box should also include any emissions credit associated with carbon capture and storage or utilisation. Where the principal product(s) in the project scenario is/are physically comparable to the principal product of the reference scenario, applicants do not need to include emissions associated with distribution or storage of the product. If, however, the principal product(s) from the project scenario replace(s) physically dissimilar principal products providing an equivalent function then emissions from distribution and storage should be calculated and included in the "processes" box.

> *Example: the principal product of a project is hydrogen and it will be supplied for transport use, distributed to fuel cell cars via a hydrogen refuelling station. The reference scenario is based on the gasoline fossil fuel comparator and so the principal product of the project (hydrogen) is physically dissimilar from the principal product of the reference scenario (gasoline). The applicant must calculate emissions associated with hydrogen storage and supplying the hydrogen to the hydrogen refuelling station, and include these as a term in the "processes" box.*

GHG emissions associated with any processes that produce the non-principal products from the project should also be included in the "processes" box, as they are within the system boundary. The credit for supplying non-principal products is dealt with separately in the "non-principal products" box (section 2.2.10).

The **reference scenario** includes in the "processes" box emissions from all processes associated with producing the same quantity of the principal product(s) or meeting the same functions as the principal product(s). This means that the principal products in the project and reference scenarios do not need to match exactly provided that the functions delivered do match.

Applicants should note that inputs from processes that are outside the system boundary are to be dealt with in the "inputs" box (section 2.2.6).

2.2.5.1 Changes in emissions from waste processing

If a process produces waste, emissions from the processing of waste – waste handling emissions (e.g., wastewater treatments) belong to the "processes" box.

> *Example: An innovative process (i.e., project scenario) may eliminate a waste stream that in the conventional way (i.e., reference scenario) required energy-intensive treatment.*

2.2.5.2 Emission avoidance from CO_2 capture and geological storage

A project that is eligible under the energy intensive industry sectors and has a CCS element capturing and storing **some or all** of its own process emissions (in accordance with Directive 2009/31/EC on the geological storage of carbon dioxide) can claim the emissions savings from the CCS component. The reference and project emissions should be assessed as for any EII project using the methodology as detailed in this section 2, and then a credit may be calculated using the methodology in section 3. In such cases**, the "processes" box of the project scenario should include the full amount of CO_2 generated even though some of this CO_2 is to be captured**. For fossil CO_2, this will be a positive emission term. For biogenic CO_2, this may be recorded with an emission factor of zero. The credit calculated according to the methodology in section 3 shall be included in the "processes" box as a negative emission term, thereby reducing the overall emissions in the project scenario.

In case that a third party carries out the transport or geological storage, the applicant should demonstrate the provision of the remaining services in the CCS supply chain by providing relevant contractual arrangements. It is not enough to simply state an intention to supply the captured CO_2 for geological storage since the InnovFund grant is dependent on verifiable emission reductions.

In the unusual case that the reference scenario includes an element of carbon capture and storage (this is possible in the case of modification of an existing facility) then a negative emissions term should similarly be included in the "processes" box of the reference scenario.

2.2.5.2.1 CCS from direct air capture (DAC)

Projects consisting only of CCS based on direct air capture with no other principal product, in which CO_2 is captured from the atmosphere rather than from an industrial process, should apply under category "EII" and sector "other" with the principal product identified as "storage". Such projects should include a CCS credit in the "processes" box calculated **according to section 3**. As atmospheric CO_2 emissions would remain unchanged in the absence of a DAC project, the reference scenario emissions for a DAC project shall be zero (Case 7).

However, if the CO_2 will be used rather than geologically stored, the applicant has to choose the respective sector of the principal product and apply the provisions for **CCU** (section 2.2.5.3).

2.2.5.2.2 Projects focusing on transport and/or storage or capturing CO_2 for geological storage without changing the existing products

Projects focusing on CO_2 transport for storage and/or storage by injection should apply under category "EII" and sector "other" with the principal product identified as "transport" and/or "storage".

For such projects, the emissions in the processes box of the reference scenario should be set according to Case 8 as the amount of CO_2 entering the project boundary (i.e. the reference scenario is set as if the CO_2 would be released in the absence of the transport/storage service.

2.2.5.2.3 CO_2 capture from biogenic sources

There is **no difference** in calculation of the CCS credit using the methodology in section 3 (CCS) between CO_2 captured **from fossil sources and from biogenic sources** – the emission saving *associated with* the CCS is calculated based solely on the quantity of CO_2 permanently stored, and is not affected by the origin of the CO_2.

For projects capturing **biogenic CO_2** the amount of CO_2 produced should be recorded in the "processes" box with an **emission factor of zero**. Any fossil CO_2 produced should also be recorded in the "processes" box. This applies to both the reference and the project scenarios, where relevant. Again, there is no difference in the calculation of the negative term for CCS under section 3 between fossil CO_2 sources and biogenic CO_2 sources.

If CCS is added to an existing biomass or waste to energy plant with or without increase in power generation capacity, the project must take the existing plant as reference. The absolute emission reduction for such a project will be determined by the amount of carbon captured, and any additional emission reductions delivered by plant modification. No emissions savings shall be included in the calculation simply based on continuing to operate the existing facility at its pre-existing capacity.

> *Example:* *A CCS unit is added to an existing biomass-fired power station without increasing power output or improving efficiency. The absolute emission savings shall be calculated as the amount of carbon stored, minus any additional emissions associated with the capture, transport and storage of the* CO_2*. No credit is given for the continued supply of renewable power from the facility. If a modification is also introduced in the plant increasing the power output, the absolute emission savings shall be calculated as the sum of the CCS part and the emissions resulting from the modification of the plant taking as a reference the existing plant.*
>
> *Example: a project aims to install a CCS facility in an existing waste-to-energy combined heat and power (CHP) plant with 60% of the waste being of biogenic origin. If the CCS installation was added without any changes in the CHP plant, the emission savings for the project would be calculated following only section 3 (CCS) claiming credit on the total amount of* CO_2 *captured and stored, regardless its origin (bio- and fossil).*
>
> *Assume, however, that the CCS installation is added alongside changes to increase the efficiency of the CHP plant by consuming 10% less waste to produce a unit of heat, with the same total heat output as before the modifications and no change in the biogenic fraction. The emissions must then be calculated combining the methodology sections 2 and 3 (EII and CCS) taking the existing plant as reference. As normal, the reference and project scenarios must be balanced so that the same quantity of the principal product (heat) is produced in both scenarios.*
>
> *In the* ***project scenario*** *a smaller amount of waste is being combusted. There is no net emissions change from the reduction in the combustion of biogenic waste because the emission factor is zero. The release of fossil carbon is reduced by 10% because the total amount of fossil waste combusted has been reduced by 10%. The* CO_2 *from combustion of the fossil part of the waste must be recorded as an emission even though most of that* CO_2 *will be captured by the CCS unit.*
>
> *An additional emission credit for CCS shall then be included as a negative emission term in the "processes" box of the project scenario following the methodology section 3 (CCS). This credit is based on the total amount of* CO_2 *captured and stored (accounting for any emissions associated with leakage in transit or energy use for the capture and storage) and is independent of the fraction of the captured* CO_2 *that is of biogenic origin.*
>
> *In the* **reference scenario** *60% of the* CO_2 *produced by waste combustion is biogenic and is recorded in the "processes" box with an emission factor of zero. The other 40% of the* CO_2 *is fossil and is recorded in the "processes" box with an emission factor of 1 tonne of* CO_2*/tonne.*

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

Projects that will use captured carbon by incorporating it in a product may include in the processes box an emission credit calculated in accordance with Chapter 3. The CO_2 may be captured within the system boundary of the project or brought in from outside the project.

An emission reduction by CCU can only be claimed by **projects that will demonstrate that the captured carbon will be used.** For the purposes of the GHG calculation the applicant must bring the CO_2 use within the system boundary of the project even if it occurs at a separate location and/or is operated by a third party. If the incorporation of CO_2 into a product takes place at a facility operated by a third party then the applicant must provide evidence that the destination facility represents an **additional** utilisation of CO_2. No CCU credit may be claimed for supplying CO_2 to a third-party facility that is already operational and where the CO_2 supplied would replace an alternative source of CO_2. Where the incorporation of the CO_2 occurs at a facility operated by a third party, the credit for that incorporation may only be claimed once under the Innovation Fund. The whole credit may be claimed in one Innovation Fund application or the credit may be split between applications, but in any case the sum of credits claimed should not exceed the total incorporated CO_2.

A project that does not include any additional use for captured CO_2 may not report an emission reduction because of CCU. This is because under present and medium-term market conditions, far more CO_2 is emitted, including 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.

If CO_2 is captured from processes within the system boundary of the project, the full amount of CO_2 produced within the project boundary should be recorded as an emission term in the "processes" box, **even though some of this CO_2 is to be captured and used**, as the credit for CO_2 use is recorded separately. Biogenic CO_2 produced within the system boundary shall be recorded with an emission factor of zero (see section 2.2.5.3.3). If CO_2 is not captured from processes within the system boundary, there is no need to include a positive emission term for CO_2 production. This means that **for CO_2 produced outside the system boundary it makes no difference to the calculation whether the source of the CO_2 is biogenic.** Applicants may always expand the system boundary to include the upstream facilities where CO_2 is captured if they have access to the necessary data.

In the unusual case that CO_2 capture and use occurs in the reference scenario (this is possible in the case of modification of an existing facility) this must also be taken into account by the inclusion of an appropriate negative emission term in the "processes" box of the reference scenario.

2.2.5.3.1 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, this may be treated as incorporation of CO_2 that was not generated by processes within the project boundary (see above).

If, however, 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 this must be treated as incorporation of CO_2 captured from processes that are within the project boundary, with the provoked CO_2 emission included as a positive emission term in the "processes" box (see above). This topic is also addressed is section 4 Renewable electricity, heat and cooling.

2.2.5.3.2 Combustion / end of life emissions of CCU fuels / products

If CCU fuels or other CCU products are to be combusted for energy, then the emissions from this combustion should be included in the project scenario just as they would be for non-CCU products. Credit for CO_2 use is given **once and only once by the inclusion of the CCU credit in the "processes" box**.

Similarly, if carbon in a CCU product would be released by combustion or decomposition at end of life, this should be counted as a CO_2 emission in the combustion or "end of life (principal products)" box just as it would be for a non-CCU product (see section 2.2.9).

Where the CCU product replaces a similar product produced conventionally this end of life term will be included in both the project and reference scenarios and be equivalent in the two scenarios. If the principal product replaces a different product with equivalent function then the emission term in the reference scenario "end of life (principal products)" box would be determined by the reference product.

2.2.5.3.3 CCU with CO_2 from biogenic sources

Just as in the CCS case (2.2.5.2.3) there is no difference in the calculation of the negative emission term for CCU between CO_2 captured from fossil sources and from biogenic sources. This credit is always based on the physical quantity of CO_2 incorporated in products, irrespective of origin. In the case that biogenic CO_2 generated within the project boundary is captured, when that CO_2 is included in the "processes" box it may be recorded with an emission factor of 0 tonnes CO_2/t. Similarly, any CO_2 generated from biogenic sources in the reference scenario should be reported with an emission factor of 0 tonnes CO_2/t.

Combustion/end of life emissions for CCU products are not affected by the original fossil or biogenic status of the captured CO_2, i.e. end of life emissions for CCU products may not be treated as zero even if the CO_2 was originally captured from a biogenic source. However, combustion and end of life emissions associated with carbon that enters the project boundaries in biogenic inputs other than captured CO_2 (e.g., biomass, biogas, biomethane, biofuels or bioliquids), are counted as zero as normal (as indicated in 1.1.4).

> *Example: a project aims to produce methanol using CO_2 captured from waste gasification, with a waste composition of 70% biogenic and 30% fossil. If the waste gasification facility is within the system boundaries, the CO_2 generated should be included as a term in the "processes" box. For the share of CO_2 generated from biogenic waste fermentation (70%) this term would be given an emission factor of zero, while for the share of CO_2 emitted from fossil waste fermentation (30%) this term would be identical to the quantity of CO_2 produced (emission factor of 1 tonne CO_2/t). If the biological waste gasification facility is outside the project boundary then the fraction of biogenic CO_2 has no bearing on the calculation. From this point of the calculation onwards, the treatment is identical irrespective of the CO_2 origin.*

2.2.6 Emissions from inputs

The applicant must specify the inputs that enter the system boundary (see 2.2.3) associated with the "processes" box of the project and the reference scenarios. This should include both **energy and material inputs**, with the exception of fuels combusted within the system boundary as emissions from combusted fuels are included in the **"processes" box** (see 2.2.6.4.2). Emissions factors for inputs used should be drawn from the data hierarchy in Appendix 1 (this is explained in more detail below). The **EU ETS benchmark emission factors may not be used for inputs** as the scope of the EU ETS benchmark calculation is not appropriate for this purpose. Where heat is used as a project input the emissions should be assessed based on the source of that heat following the requirements detailed below, the EU ETS heat benchmark may not be used for input heat in the project scenario.

Where the reference scenario under 'Case 1' (see 2.2.4.1) or 'Case 2' (see 2.2.4.2) is based on one or more EU ETS benchmarks, it includes the emissions covered by EU ETS direct emissions calculations but not embedded emissions associated with any inputs used in those benchmarked processes. The applicant should therefore identify inputs that would be used in the conventional production system and include them in the "inputs" box of the reference scenario. In general, the EU ETS benchmark documents do not specify the quantities of all inputs used in each process, in which case the applicant must provide a reasonable estimate. This estimate of inputs quantity may be based on engineering principles and/or appropriate sources taken from the data hierarchy. The applicant must explicitly detail the basis for assumptions on quantities of inputs used in the reference scenario and provide references.

For the project scenario, and for reference scenarios under 'Case 3: modifications to existing production systems' (see 2.2.4.3), the applicant may choose to bring the production of any input into the "processes" box and assess the emissions directly. This requires that the applicant should be able to identify the source of that input and to cooperate with the producer of that input in order to obtain the necessary data for the calculation (see 2.2.3).

The objective of the Innovation Fund is to support future breakthrough technologies that will help the EU to reach the climate neutrality in 2050. Therefore, for the purposes of the GHG emission avoidance calculation, where electricity is consumed from the grid by an energy intensive industries project, or where additional electricity is exported from the project to the grid, the quantity of electricity consumed or exported should be reported but assessed on the basis of a fully decarbonised electricity supply (the state of the sector after 2050), i.e., **the emission factor for the grid electricity consumed as an input is zero** and there is no credit under section 2 (EII) for exporting **net** electricity (see Table 1.3). If electricity exported from the project is renewable, the applicant may consider submitting a hybrid application including an EII and a 'Renewable electricity and heat' element in order to receive credit for the electricity export (see section 1.3.1.1).

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. In other words, any inputs from the reference scenario that the applicant chooses to ignore should not be included when assessing inputs in the project scenario as major / de minimis (see below).

The **emissions for water provision** as an input should be neglected provided that water provision does not involve (prior to provision) desalination, wastewater treatment or additional pumping.

2.2.6.1 RIGID inputs

The emission avoidance calculations take account of processes which **divert** materials from other uses. Therefore, 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 InnovFund project by **diverting** it from another use or **disposition**. Its emissions intensity considers the impact of diverting it from its existing use (rather than any emissions associated with the generation of the rigid input), and the emissions associated with any additional treatment and transport. 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 (i.e., additional GHG emissions) if the input was avoiding emissions in its existing use (for example by avoiding demand for other materials). A product that represents less than 10% of the value of the total products of the supplier shall be treated as rigid. This is discussed further in Appendix 2.

> <u>*Examples of rigid inputs include:*</u>
> *municipal waste, used plastics, used lubricating oil; e.g., taking municipal waste as an input will not affect the generation of municipal waste, and therefore it is considered a rigid input;*
>
> *intermediate streams from existing processes: e.g., blast furnace gas, black liquor; using industrial 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;*

process heat or waste heat[32] taken from an existing process; e.g., 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;

*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). 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'.). E.g., Hydrogen recovered from an existing chlor-alkali (Solvay) process is produced in a fixed ratio to the other products because of the stoichiometry of the reaction. It is considered a rigid source of hydrogen.*

2.2.6.1.1 Assessment: diversion emissions

When considering a rigid input, its emissions intensity should consider the impact of diverting it from its existing use based on one of the following four cases. The applicant should clearly and explicitly detail in the application the assumptions that have been made with regard to any rigid inputs.

1. **Case 1: The diversion of the rigid input is expected to increase demand for one or more elastic inputs**. In this case, the rigid input should 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.

   Examples:
   The project is diverting waste steel (scrap) from other recycling operators rather than identifying additional sources of scrap for recycling. Then the displacement impact of the use of steel scrap as a rigid input is the production of more steel from ore.

   A project uses heat recovered from an existing process, and as a result extra fuel needs to be burned to maintain the supply of heat to other processes. In this case, the emissions intensity of the heat used is determined by the emission factor of the additional fuel burned.

   A project is using municipal waste as an input, which is diverted from being burnt to provide district heating. The emissions avoided by the burning of the waste for district heating are offset by additional emissions incurred to replace that district heat, for example by using a natural gas boiler.

   A project includes a process that requires heat input. The emissions attributed to the heat input shall be the increase in the emissions of any other processes associated with the heat export (for example due to increased rates of fossil fuel combustion).

   *A project includes a process that requires heat input. The heat is recovered from "**waste heat**" as defined by Article 2 (9) of the RED II. This would be considered free of emissions.*

   A project takes as an input industrial off-gas that would otherwise be combusted to produce process heat. Then the applicant should estimate the emissions from the source of heat that replaces the heat lost by diverting the off-gas from its use to the project, and add these emissions to the project scenario. As emissions for

[32] REDII Directive, Article 2 (9):'waste heat and cold' means unavoidable heat or cold generated as by-product in industrial or power generation installations, or in the tertiary sector, which would be dissipated unused in air or water without access to a district heating or cooling system, where a cogeneration process has been used or will be used or where cogeneration is not feasible.

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

A project takes as an input hydrogen piped from an existing chlor-alkali plant, which previously sold it in cylinders on the general industrial gas market. The hydrogen is being diverted, 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. An emission factor for hydrogen use as an input must be taken from the input data hierarchy. Hydrogen formerly 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.

2. **Case 2: 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.

   <u>*Example:*</u>
   The project used sugar beet molasses as an input. The applicant determines that molasses should be considered a semi-elastic input (see section 2.2.6.3) as the value of the molasses is estimated by the applicant at 17% of the overall value from sugar beet processing. The input emission factor will therefore be calculated as a weighted average of the emissions of producing and processing additional sugar beet to molasses (elastic part) and the emissions of producing one or more substitutes (rigid part) in the ratio 7:33[33] *(see Appendix 2). The molasses are to be diverted from a yeast production facility controlled by the applicant and will be replaced by corn steep liquor. Corn steep liquor is a by-product of corn starch extraction, and is itself considered a rigid input. The applicant identifies glucose syrup as an elastic substitute for corn steep liquor, and so the final emission factor for the use of the molasses as an input is a weighted average of the emissions for molasses production from sugar beet and the emissions for production of glucose syrup, which should be sourced from the data hierarchy (see Appendix 1).*

3. **Case 3: 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.

   <u>*Example:*</u>
   If the existing fate of municipal waste was incineration without energy recovery, the emissions from the incineration are avoided. 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.*

In some projects, a material stream waste may be taken as an input and only partly utilised (for example if a project involved utilisation of some subset of plastics in a municipal waste stream with the remnant waste returned for other disposal). In such cases, the negative emission in the input box should be based on the change in emissions for only the fraction of the municipal waste actually utilised.

If municipal waste is diverted from landfill, the carbon emissions shall be assumed equal to those for incineration without energy recovery, meaning that the emission factor

[33] This ratio is derived as [17%-10%]:[50%-17%].

attributed to municipal waste at the point of collection will generally be **negative**. Although in practice landfill sequesters part of the carbon on a long-term basis, it is not desirable to encourage landfill for other environmental reasons (such as fugitive GHG emissions of methane (CH_4)), potential impacts on health and other environmental media, e.g. soil or water, and resource depletion). Note that the combustion emissions of any biogenic material must still be counted with an emission factor of zero, so municipal waste with only biogenic carbon content would be given an emission factor of zero when used as an input. Any additional avoided greenhouse gas emissions from avoided methane production due to diversion of material from landfill are considered **out of scope of the main GHG calculation**, but may be included in the calculation of other GHG savings.

Where municipal waste is diverted from either landfill or from incineration without energy recovery and used as an input for novel fuel production, this will result in a project scenario with a negative emission term for the municipal waste as a rigid input in the "inputs" box and a positive emission in the "combustion (principal products)" box. If the number of carbon atoms in the waste input is identical to the number of carbon atoms in the produced fuel, these terms would exactly cancel each other out. In such cases, the applicants should still include both terms in the calculations for transparency and to aid the evaluators in understanding the project.

> *Example:*
> *If a stream of industrial off-gas containing carbon monoxide (CO) 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.*

4. **Case 4: A combination of the first three outcomes**. In this case, the emissions implications associated with each outcome 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 should be specific to the nature of the source of the input and the location of the project.

Where a reference scenario includes use of 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 the 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.

2.2.6.1.2 Application of the Waste Framework Directive

Projects that involve the use of "waste" materials must respect the waste hierarchy in the Waste Framework Directive[34], which puts top priority on material recycling (e.g., recycling used plastic as plastic). Converting waste 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.

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

2.2.6.2 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 economic value of products from a process is considered rigid, any input that represents more than half of the economic value of products from a process is considered elastic, and **any input with a value from 10% to 50% of the economic value of products from a process is 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.

2.2.6.3 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 definition of an elastic input is given in the Appendix 2.

As explained in section 2.2.6.2.1, the emissions intensity of a rigid input is based on the elastic input that replaces the rigid input 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 for project and reference scenarios.

2.2.6.3.1 Fossil fuels inputs

The carbon content for inputs of fossil fuels appears either in the "processes" box emissions (for the part that is combusted as part of the production process) or in the "combustion (principal products)", "change to in-use (principal products)" or "end of life (principal products)" box emissions. 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 fuels inputs is needed**.

2.2.6.3.2 Biomass, biogas, biomethane, bioliquid and biofuels inputs

Any such fuels derived from biomass used in InnovFund projects must conform to the sustainability requirements of the REDII. The biomass feedstock must either be listed in Part A of Annex IX of the Directive or be certified as low indirect land use change (ILUC)-risk as defined by Commission Delegated Regulation (EU) 2019/807. Where available, the emissions for biomass, biogas, biomethane, bioliquid or biofuels are derived by summing the disaggregated default emissions tabulated in Annex V and VI of REDII, except the 'Transport' emissions and the 'Non-CO_2 emissions from the fuel in use'. Transport emissions for inputs should instead be considered directly based on the actual distance travelled and mode of travel if biomass feedstocks are transported more than 500 km to reach the first point of processing/treatment (see section 1.3.4), and non-CO_2 combustion emissions for any fuels that are combusted as part of the project should be included in the processes box or combustion (principal products) box as appropriate. If values are not available in the REDII then the data hierarchy should be followed.

Note that while the CO_2 emissions from the combustion of bio-based carbon are treated as zero in the "processes" box, the N_2O emissions from biomass combustion must be included as a non-zero term.

2.2.6.3.3 Other relevant 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 1. Applicants should not use ETS benchmark values for inputs because they do not generally have an appropriate scope.

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 often 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 CO_2 during use/end of life phases). Including stoichiometric CO_2 release in the emission intensity of the input as well as in the "combustion (principal products)" or "end of life (principal products)" boxes for the products would **result in double counting** of those carbon emissions. For carbon-containing inputs where the quoted emission factor includes the stoichiometric carbon content, 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 life-cycle emissions should be made by subtracting 15% from the emissions intensity result excluding the contribution to the emission intensity from carbon embedded in the substance. This adjustment should always be made in the case of lifecycle emissions values taken from the document *Definition of input data to assess GHG default emissions from biofuels in EU legislation.*

> <u>*Examples:*</u>
> *1) A project uses hydrochloric acid (HCl) as an input. An emissions intensity value of 1061.1 gCO_2e/kg is provided for HCl in the document* Definition of input data to assess GHG default emissions from biofuels in EU legislation*. As the lifecycle data in this document includes upstream emissions from the fossil fuel supply, this value should be adjusted downward by 15% to give a value of 901.9 gCO_2e/kg when used for an input in an Innovation Fund calculation.*
>
> *2) A project uses methanol (CH3OH) as an input. An emissions intensity value of 97.1 gCO_2e/MJ is provided for HCl in the document* Definition of input data to assess GHG default emissions from biofuels in EU legislation*, and this value is subdivided into supply emissions of 28.2 gCO_2e/MJ and combustion emissions of 68.9 gCO_2e/MJ. These combustion emissions represent the emissions associated with release of the carbon physically contained within the methanol. As the supply part of the emissions value includes upstream emissions from the fossil fuel supply, that part of the value should be adjusted down by 15% to 24.0 gCO_2e/MJ. The overall emission intensity for methanol is therefore 92.9 gCO_2e/MJ when used for an input in an Innovation Fund calculation.*

Where inputs are produced by electricity-consuming processes, life cycle and well-to-wheel databases and other similar sources in the data hierarchy (Appendix 1) should include a characterisation of CO_2e emissions associated with that electricity consumption. While electricity consumed within the system boundary is to be treated as having zero emissions,

this does not extend to electricity used to produce inputs. Input emission factors from the data hierarchy must not be adjusted to remove emissions associated with electricity use. If, however, there is data available to do so applicants may expand the system boundary of their projects to include the production of materials used as inputs to the main processes. In this case, electricity consumed shall be treated as zero emissions as for any other process within the system boundary.

2.2.6.3.4 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 the case that a major 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 should 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 3.

2.2.6.3.5 Electricity inputs supplied to industrial projects and EII electricity-saving projects

No emissions shall be ascribed to electricity either consumed or exported continuously or at times not correlated with grid emissions variations as explained in (section 1.3.2). However, for knowledge-sharing purposes, the actual electricity consumption and export for 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 (section 2.2.6.3.6), and in this case hourly electricity consumptions shall be reported for the reporting period.

An **exception to the above rule** is made for projects in energy intensive industries in which an existing production system is modified by means of specific innovative technologies that reduce electricity consumption, and this reduction in electricity consumption is the only change (i.e., there is no change to the products of the system, to the use of non-electrical energy or to the consumption of inputs other than those associated with the reduced electricity consumption). In this case the reference emissions from electricity consumption shall be obtained by multiplying the project electricity savings by the expected 2030 electricity grid mix emission factor (48.81 gCO_2e/MJ [0.1757 tCO_2e/MWh]).

The electricity-saving projects shall be submitted under the EII sector determined based on the principal product as normal. It is explicitly forbidden to combine electricity-saving projects with other innovative projects under any eligibility category or hybrid projects in a single InnovFund application.

2.2.6.3.6 Lowering grid electricity emissions by timing operations

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 grid electricity consumed 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.

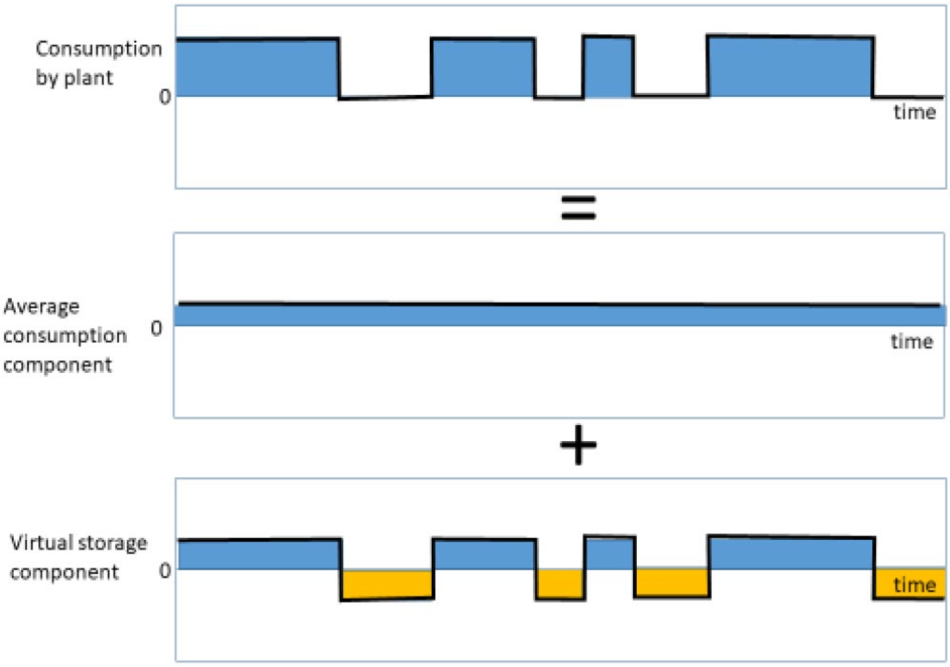
Virtual storage can only be claimed in the case that a project is **grid connected**. No virtual storage term shall be included if a project is directly connected to a renewable power facility without grid connection. The credit allowed for virtual storage in energy intensive industries recognises that while the long-term trajectory (2050) is for full grid decarbonisation, in the short-term the EU electricity grid still includes fossil power generation, and that additional climate benefit can be delivered if an electricity-consuming project times its operation to preferentially consume power when the GHG intensity of grid electricity is below average.

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 example diagram below (see Figure 2.2, please note that the "consumption by plant" therein could be above zero also during low power consumption periods, even though in the figure example they are set at zero for simplicity). In order to claim such a credit the applicant must provide details of the plan to manage grid electricity consumption to coincide with times when the emissions of the electricity supply are below average. Providing evidence of a power purchase agreement or similar arrangement by which a facility would operate only when a specific renewable power installation is generating **is not enough to claim a timed operation credit**, as output from a single installation may not be correlated with renewable power supply to the grid more generally. If a credible plan to time operation is not provided and the credit claimed is significant, this may affect the quality of the GHG calculation during the evaluation. 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 show negative reportable emissions for electricity consumed**. Such reportable negative emissions arise because the Innovation Fund offers credit for timed operation (which can deliver real emissions savings in the short-term) while requiring 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 / net carbon removals by consuming electricity (because the emissions from electricity production is currently not zero), but as being given extra credit for operating in the most climate friendly possible way already before 2050.

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 high GHG emissions electricity to the grid. This could include the instantaneous fraction of renewable power from intermittent sources 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 example of emissions from projects using electricity when marginal emissions are low



Source: *European Commission internal elaboration.*

2.2.7 Emissions from combustion (principal products)

Some projects will produce one or more principal products that will be combusted for energy purposes. This includes projects producing novel transport fuels, fuel additives, solid fuels and natural gas substitutes as principal products. In such cases the emissions from combustion of these principal products should be included in the "combustion (principal products)" box.

In the case of novel transport fuels, this will normally be done through the use of InnovFund fossil fuel comparators (Table 2.2) in the reference scenario and by including the combustion emissions for the novel fuel in the "combustion (principal products)" box of the project scenario (remembering that while CO_2 emissions from biomass combustion may be treated as zero, N_2O and CH4 emissions stemming from biomass combustion must be considered).

Where an InnovFund fossil fuel comparator is not available, then the combustion emissions for the reference product should be included in the "combustion (principal products)" box of the reference scenario, using combustion emission factors from the data hierarchy in Appendix 1.

In the case of fuels produced using captured or recycled carbon the combustion emissions must still be included in the "combustion (principal products)" box. Any emissions savings associated with the carbon capture or recycling will be characterised in the "process" box (captured carbon) or "inputs" box (recycled carbon).

> *<u>Example</u>: A project produces a drop-in diesel fuel substitute. The reference scenario will include emissions in the "combustion (principal products)" box based on the InnovFund fossil fuel comparator for diesel. The project scenario will include in the "combustion (principal products)" box combustion emissions for the novel fuel.*

2.2.8 Emissions from change to in-use (principal products)

The methodology does not require applicants to include all emissions associated with the use of principal products. However, in some cases **the characteristics of innovative products may save emissions in the use phase of the principal product**, for instance by allowing more efficient operation or by avoiding emissions of greenhouse gases other than CO_2. The "change to in-use" emissions box allows credit to be given in the project scenario for such emissions savings. Wherever such savings are claimed they must be well justified and based on a realistic use case.

> *Example: A project produces an innovative nitrogen compound to use as a fertiliser, and the applicant provides convincing evidence that its use will reduce nitrous oxide (N_2O) emissions compared to conventional nitrogen fertilisers when applied to the soil. Credit may be given in the "change to in-use (principal products)" box for the CO_2 equivalent emissions that can be avoided by use of the new compound.*

Applicants will need to demonstrate the delivery of the reported emission reductions: therefore they should propose appropriate monitoring arrangements.

Applicant may include in-use savings from the changed properties of the various materials to be produced with the principal product (analogous to the fuel cell car case 2.2.4.4).

> *Example: A project produces a new material that enables improved tire dynamics (e.g., light-weighting benefit and reduced rolling resistance) when the tires are in-use. Credit may be given in the "change to in-use (principal products)" box for the associated reduction in fuel use through the life of a tire.*

Savings from changes to in-use emissions may only be claimed where they are enabled directly by the properties of the produced product – it is not enough to state that the produced product may be used as an input for the production of a second product which would then deliver in-use emissions reductions.

> *Example: A project produces steel with an innovative process, but the steel itself has comparable properties to steel from conventional processes. The applicant states that the steel will be sold to another company and used to manufacture hydrogen tanks in a process that has a lower carbon intensity than the conventional process for carbon fibre hydrogen tanks. The use of the steel in hydrogen tank manufacture is not enabled by any particular property of the produced steel, and therefore no additional credit may be given. The applicant could consider partnering with the hydrogen tank producer to bring tank production within the system boundary -in this case, the hydrogen tanks would become the principal product.*

In some cases, the use of an innovative product will enable in-use emissions savings only when coupled with one or more additional innovative products of practices. In such cases, the applicant should record in the "change to in-use" emissions box a fraction of the emissions saved consistent with the fractional contribution of the cost of the innovative product to the entire innovative system.

> *Example: A project produces an innovative polymer that can be combined with a second innovative polymer (not produced by the project) and used to produce lightweight packaging material, allowing reductions in fuel consumption by delivery vehicles. If the costs of the two polymer components are equal, then the applicant may record a credit in the "change to in-use" emissions box equivalent to half of the expected emissions saving due to reduced fuel use by delivery vehicles.*

Unlike the other boxes, the in-use emissions in the project scenario are truly a change rather than a total use phase emissions. There is therefore no need to record in-use emissions in the reference scenario. This leaves the "change to in-use (principal products)" emissions box for project scenario only.

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 market within which 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.

Some emission reductions associated with use of the principal products are dealt with outside of the "change to in-use (principal products)" emissions box. If the use of a novel product replaces a larger quantity of a conventional product (for example 1 tonne of a novel product replaces 1.2 tonnes of a conventional product) this is dealt with by including 1.2 tonnes of conventional production in the reference scenario for every 1 tonne of novel production in the project scenario.

Attention: If a principal product replaces fossil fuels then the avoided combustion emissions are dealt with via the "processes" and "combustion (principal products)" boxes.

2.2.9 Emissions from end of life (principal products)

End of life emissions refer to the emissions associated with the disposal or recycling of a principal product after the end of its useful life. Applicants are not permitted to include end of life emissions for non-principal products, except in the case described in the section on the "non-principal products" box for non-principal products that do not replace a conventional product but provide long-term carbon storage. Innovation Fund applications are not required to provide full end of life emissions estimates, but should include end of life emissions in two cases:

1. If a principal product (either the innovative product from the project scenario or the conventional product performing the equivalent function in the reference scenario) **contains carbon,** then the applicant must include any emissions associated with the fate of that carbon in the "end of life (principal products)" box. These emissions must be included even if they are identical between the project and reference scenarios;

2. **Attention**: Failure to consider the fate of carbon at end of life would result in distortion of the relative emissions avoidance calculation and may affect the quality of the GHG calculation.

3. If the applicant believes that a principal product produced by the project scenario will **deliver reductions** in end of life CO_2e emissions compared to the equivalent conventional product in the reference scenario, then the calculated reduction in end of life emissions **may be** included as a credit (negative emission term) in the "end of life (principal products)" box of the project scenario.

These two cases are further explained below.

2.2.9.1 Principal product contains carbon

Where carbon is incorporated into principal products and is not released during product use (e.g. through combustion of those products as fuels), the applicant must consider the expected fate of this **carbon** at end of life. This fate may differ between project and reference scenarios, but any assumed differences should be well justified. In cases where the likely fate would be any combination of natural decomposition, incineration (with or without energy recovery) or landfilling, then an emission term should be included in the "end of life (principal products)" box based on CO_2e emissions from:

- CH_4 releases by the principal product(s) at the end of life, if any; and

- stoichiometric combustion of all remaining carbon (i.e., complete oxidation to CO_2 of all carbon atoms contained in the principal products). If some fraction of the carbon in the principal products is derived from biomass, then the stoichiometric combustion emissions for that fraction of the product may be treated as zero (section 1.1.4).

  <u>Example: methanol is produced as a principal product.</u>
  If the methanol is treated as a transport fuel ("processes" box) and the reference scenario is based on a fossil fuel comparator (sections 2.2.4.4 and 2.2.4.6), then no additional emissions need to be included in the "end of life (principal products)" box.

  If instead the methanol is treated as a chemical product and is expected to decompose, be landfilled or be incinerated after use the applicant should include stoichiometric combustion emissions for the produced quantity of methanol in the "end of life (principal products)" box for both the project and reference scenarios.

If the likely fate (expected for at least 90% of material produced) of the carbon in the product materials would be recycling into new products, then this term in the "end of life (principal products)" box shall be set to zero (this should still be explicitly recorded in the GHG calculation). If the likely fate is a combination of some recycling (< 90%) and some decomposition/landfilling/energy recovery, then an emission term should be included in the "end of life (principal products)" box based on CO_2 emissions from stoichiometric combustion of the fraction of carbon that is not recycled. If an applicant claims that the product of the project scenario will be recycled but the conventional product would not be recycled, then this assumption must be well justified by reference to the physical characteristics of the products (for instance replacing a plastic that is not normally recycled with one that is), or to actions within the power of the applicant (e.g., if the business model included collection of used items for recycling). Applicants may not take credit for assumed increases in recycling rates that are not directly related to the project. Recycling rates assumed for principal products in either scenario must be justified (e.g., an applicant would not be permitted to assume 100% recycling of a material that was recyclable in principle if it is not normally recycled in practice).

There is no additional credit permitted in the GHG emission calculation of the Innovation Fund for avoiding primary material use by enabling recycling. Any additional resource efficiency benefits from the project may be detailed by the applicant for consideration in the assessment of 'Quality of the calculation, minimum requirements, net carbon removals, other GHG savings'.

> *<u>Example</u>: A project produces recyclable plastic bottles as a principal product, and they will replace conventional plastic bottles that are not recyclable. The applicant provides evidence that the typical disposition of non-recyclable bottles in their region is to be sent to landfill, but that 95% of recyclable bottles are sent for recycling. Landfilled material may be treated as if it would be combusted without energy recovery, therefore the applicant includes emissions term in the "end of life (principal product)" box of the reference scenario based on stoichiometric combustion emissions for 100% of the conventional bottles, and an emission term in the "end of life (principal product)" box of the project scenario based on stoichiometric combustion emissions for only 5% of the innovative bottles (the 5% that it is assumed are not sent for recycling).*

In cases where the applicant can show that most of the carbon in the principal product(s) will remain usefully incorporated in the material on a long-term basis, defined as a useful lifetime of 50 years or more[35], then the applicant shall **include in the "end of life**

[35] I.e. it is not enough to claim that carbon will remain incorporated in the principal product after disposal to landfill.

(principal products)" box only 50% of the CO_2 emissions from stoichiometric combustion of that product. This may be appropriate in the case of **building materials**, for example. It is the responsibility of the applicant to convincingly demonstrate to the evaluators that it is reasonable to assume that the carbon will normally remain incorporated for at least 50 years. The applicant must be consistent in the consideration of long-term carbon utilisation in the reference and project scenarios. In general, if physically similar products are produced in the two scenarios then the assumptions about long-term carbon utilisation should be identical. Applicants are not permitted to treat more than 50% of the carbon as long-term incorporated. This provides recognition that the best guarantee of long-term carbon storage is geological storage (2.2.5.2) following the requirements of Directive 2009/31/EC, and that even where products provide potentially long-term carbon incorporation it may be expected that in some cases products will experience an abbreviated useful life. Applicants must treat carbon incorporated in the principal products in the project and reference scenarios equally when considering the potential for long-term incorporation.

> <u>Example</u>*: A project produces polystyrene beads from fossil resources as a principal product, and the material will be used in building insulation. The product from the project is chemically identical to conventionally produced polystyrene beads (the reference product) but produced in a more efficient manner. The applicant shows that the insulation can be expected to remain in place for at least 50 years. The applicant therefore includes an emission term in the "end of life (principal products)" box in both the project and reference scenarios equivalent to the emissions from stoichiometric combustion of 50% of the carbon from the material. This does not affect the absolute emission saving from the project as the terms are the same in both scenarios. The end of life emissions are lower in both scenarios than they would be for a project producing polystyrene for short term use, so because the reference scenario emission will be lower this will result in a higher reportable relative GHG emission reduction than if the material were used in an application where it was expected to go to landfill immediately after use.*

In the case that some amount of the carbon treated as remaining usefully incorporated in the product or as being recycled is of biogenic origin (i.e. derived from biogenic inputs to the project or from biogenic CO_2 captured within the system boundary) then the term in the end of life for stoichiometric emission of this carbon will already be set to zero, and therefore the project emission score is unaffected by setting the end of life emission term to zero (recycled products) or reducing it by 50% (long-term carbon utilisation). Recognition may therefore be given to projects delivering recycling or long-term utilisation of carbon of biogenic origin through the inclusion of a credit (negative emission term) in the "end of life (principal products)" box for the extended useful life of that biogenic carbon. This credit should be equivalent to 50% of the stoichiometric combustion emissions for the amount of biogenic carbon that will remain in use.

> <u>Example</u>*: A project produces biochar as a principal product which is to be used as a soil improver. The applicant provides convincing evidence that the application of biochar to the soil can improve nitrogen retention and thereby reduce nitrogen fertiliser use, and therefore the reference product is set as nitrogen fertiliser, in the sector chemicals, on an equivalent function basis. The quantity of nitrogen fertiliser in the reference is calculated as the reduction in nitrogen fertiliser consumption to be delivered over the ten year period from commencement of biochar production. The applicant provides references to support the claim that the biochar will remain incorporated in the soil for a period of more than 50 years. This would normally allow the applicant to discount the end of life emissions from carbon release by 50%, but because biochar is a biogenic product the end of life emissions are zero whether or not the biochar remains in the soil. The applicant therefore includes a credit in the "end of life (principal products)" box equivalent to the stoichiometric combustion emissions for 50% of the carbon in the biochar.*

> *<u>Example</u>***:** *A project produces bio-PET bottles to replace conventional fossil PET bottles. Both types of bottle are recyclable and the applicant shows that the recycling rate in the relevant region is over 90%. A zero emission term is included in the "end of life (principal product)" box of the reference scenario, while an emission credit (negative emission term) is included in the "end of life (principal product)" box of the project scenario equivalent to 50% of the stoichiometric combustion emissions for the carbon in the PET.*

Where carbon in a principal product is derived from **captured CO_2** this shall not be treated as biogenic carbon at end of life, even if the CO_2 was captured from a biogenic source. The credit for the biogenic characteristics of the captured carbon is given in the "processes" box where appropriate (2.2.5.2.3 and 2.2.5.3.3).

2.2.9.2 Applicant wishes to claim other reductions in end of life emissions

If a project **delivers** further **reductions** in "end of life" emissions compared to the reference scenario, then these changes **may** also be included in the calculation. This could be relevant in cases where a principal product replaces a chemically different conventional product and can be **disposed of in a more energy efficient way**, or if an innovative product **avoids decomposition-related** GHG emissions (expressed as CO_2e).

> *<u>Example</u>: Innovative refrigerants could replace conventional refrigerants with higher global warming potential. This could avoid emissions associated with potential leakage of the conventional refrigerants at "end of life" (some leakage could occur during proper disposal of refrigerators, and some fraction of refrigerators may not be properly disposed of).*

Furthermore, some projects may enable more efficient recycling due to **changes in the physical characteristics of products**. In such cases, changes in "end of life" emissions should be estimated and added to the emissions avoidance calculations. 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).

2.2.10 Emissions from non-principal products

The processes in both the project and reference scenarios should produce the same **quantity** of the principal products ("processes" box) or deliver an equivalent **function**. However, there may be changes in non-principal product(s) (i.e., co-products of the principal products that are supplied for use outside the project system boundary) associated with the adoption of innovative processes. To balance the scenarios, the emissions attached to non-principal products must be considered, **but only in the scenario in which they are produced**.

The project's emission avoidance will generally be increased by the production of non-principal products in the **project scenario**. A credit (negative emission term) proportional to the quantity of each non-principal product produced should be included in the "non-principal products" box.

Similarly, if non-principal products are produced in the **reference scenario**, a credit (negative emissions term) should be included in the "non-principal products" box of the reference scenario. This will reduce the overall reference emissions.

The credit should be based on an emission factor for a 'conventional replacement product' that could be replaced from the market by the non-principal product. In many cases, the appropriate conventional replacement product will be a physically identical product produced in a conventional way. In some cases, however, the appropriate conventional replacement product will be a physically different product that serves a like function. The choice of a conventional replacement product is discussed further below.

The emissions factors needed for this calculation are to be taken from the data hierarchy in Appendix 1 following the method in the section on other relevant inputs (section 2.2.6.3.3), with the exception of natural gas as a conventional replacement product for which specific rules are stated below. **Allocation approaches should not be used** to deal with the emissions attached to non-principal products.

It is important when accounting for non-principal products to ensure that any carbon embedded in the product and/or its conventional alternative is properly accounted for. This affects the way that the emission factor for the conventional replacement product should be chosen. There are two cases:

1. The non-principal product is physically the same as its conventional replacement and all of the carbon in the non-principal product is non-biogenic. **In this case, the emission factor should exclude the carbon contained in the conventional replacement product.** The carbon released through use/end of life of the non-principal product is the same as would be released through use/end of life of the conventional replacement product.

   *Example: methanol is produced as a non-principal product using captured carbon, which is not biogenic. The conventional replacement product is conventionally produced methanol, which is physically similar. The document "Definition of input data to assess GHG default emissions from biofuels in EU legislation" from the data hierarchy states that the emissions associated with methanol use are 28.2 gCO_2e/MJ for methanol supply and 68.9 gCO_2e/MJ for methanol combustion. The combustion emissions **should not** be included, so the correct emission factor for the conventional replacement product is calculated as the supply emissions minus 15% for the upstream part (see 2.2.6.3.3), which gives 24.0 gCO_2e/MJ.*

2. The non-principal product is physically different to its conventional replacement and/or some of the carbon in the non-principal product is biogenic. In this case, the carbon released through use/end of life of the non-principal product **may not be the same** as would be released through use/end of life of the conventional replacement product, and therefore any difference must be calculated. The emission factor for the conventional replacement product should be calculated as its supply emissions plus its carbon content (converted to CO_2 on a stoichiometric basis, equivalent to the combustion emissions for that material), minus the non-biogenic carbon content of the non-principal product.

   *Example 1: methanol is produced as a non-principal product using biogenic carbon. The conventional replacement product is conventionally produced methanol, which is physically similar. The document "Definition of input data to assess GHG default emissions from biofuels in EU legislation" from the data hierarchy states that the emissions associated with methanol use are 28.2 gCO_2e/MJ for methanol supply and 68.9 gCO_2e/MJ for methanol combustion. The combustion emissions **should** be included. There is no non-biogenic carbon in the non-principal product methanol so no further term needs to be subtracted. The correct emission factor for the conventional replacement product is calculated as the supply emissions minus 15% plus the combustion emissions, which gives 92.9 gCO_2e/MJ.*
   *Example 2: methanol is produced as a non-principal product using carbon from waste gasification that is 40% biogenic. The conventional replacement product is conventionally produced methanol, which is physically similar. The document "Definition of input data to assess GHG default emissions from biofuels in EU legislation" from the data hierarchy states that the emissions associated with methanol use are 28.2 gCO_2e/MJ for methanol supply and 68.9 gCO_2e/MJ for methanol combustion. The combustion emissions **should** be included. The non-*

principal product methanol has 60% fossil carbon content carbon in the non-principal product methanol so a term equal to 60% of methanol combustion emissions must be subtracted (41.3 gCO_2e/MJ). The correct emission factor for the conventional replacement product is calculated as the supply emissions minus 15% plus the combustion emissions for the conventional replacement product minus the non-biogenic combustion emissions for the non-principal product methanol. This gives:

$$(28.2 * (1 - 0.15) + 68.9 - 41.3) = 51.6\ gCO_2e/MJ$$

For **both scenarios**, the term in the "non-principal products" box shall be calculated as: (-1) * (quantity of non-principal product) * (emission factor of replaced conventionally produced product).

In some cases, it may not be obvious what the appropriate conventional replacement product is and therefore what **emission factor** from the data hierarchy should be used to calculate the credit for a non-principal product. This is especially likely in cases: where a non-principal product is itself innovative so that there is no data in the data hierarchy to characterise 'conventional' production of that material; where a non-principal product could equally replace one of a number of conventional products; or where the non-principal product is to be used in an innovative way. The following principles should be followed in choosing appropriate emission factors for non-principal products in the data hierarchy:

Where several possible conventional products could be considered functionally interchangeable with a non-principal product, the applicant should use **the lower** of the associated emission factors. The applicant must not inflate the emission credit from non-principal products by cherry picking an alternative product with very high associated emissions.

If a non-principal product is expected to be combusted for energy, then in general the conventional replacement product should be taken to be **natural gas** even if the non-principal product is more physically similar to other fossil fuels. In this case the supply emission for natural gas shall be treated as zero and the stoichiometric combustion emissions as 56.1 gCO_2e/MJ for consistency with the natural gas comparator value in section 2.2.4.5. An exception may be made to this principle if the applicant can demonstrate that a non-principal product is likely to be used to substitute a known fuel other than natural gas in a specific application in which a higher--carbon-content fuel is required for physical reasons, for example replacing fossil coke used in steel manufacture.

<u>Example</u>: if biochar[36] *is produced as a non-principal product and expected to be used as a fuel then the credit in the "non-principal products" box should generally be calculated taking natural gas as the conventional replacement product rather than a solid fuel such as coal. The emission factor for the replacement product is calculated as the supply emissions (taken to be 0 gCO_2e/MJ) plus the combustion emissions (56.1 gCO_2e/MJ) minus the non-biogenic carbon content of the biochar (0 gCO_2e/MJ), which gives 56.1 gCO_2e/MJ.*

If a non-principal product containing biogenic carbon will not be combusted and will not replace the function of a conventional product but is expected to provide storage of its constituent carbon on a long-term basis (50 years or more expected lifetime, other than in landfill) then the applicant may calculate a negative emission terms for medium term carbon storage calculated as 50% of the biogenic carbon content.

<u>Example</u>: if biochar is produced as a non-principal product and will be sold as a soil improver with the primary purpose of storing its constituent carbon in the soil (i.e.,

[36] "Char" is the general product of the slow pyrolysis, "charcoal" is the product of the woody biomass slow pyrolysis, "biochar" is char produced from biomass sources that is used for example in soil application, beware of contaminants (tar) generated in certain quick industrial processes.

not directly replacing the use of conventional products such as compost or fertilisers). The applicant is able to provide evidence that the expected carbon storage time is 50 years or more. A credit (negative emission term) may be included in the "non-principal products" box equivalent to 50% of the CO_2 emissions from stoichiometric combustion of the biochar.

If the non-principal product will not be combusted and will be used for an innovative function that will enable more efficient use of other materials, then the emissions factor should be determined based on the materials used more efficiently.

If the non-principal product will not be combusted and will enable other emissions reduction, the applicant may propose (with justification) a calculation of the avoided emissions and include these additional avoided emissions as a credit (negative emission term) in the "non-principal product box". In such cases, the applicant should be careful not to overstate the potential benefits. If the applicant does not convincingly justify the calculation of such a credit then this may affect the quality of the GHG calculation.

Example: A non-principal product from a biorefining process is to be used as a cattle feed additive, and the applicant is able to provide evidence that this will reduce the formation of methane through enteric fermentation. A credit may be calculated based on the amount of methane emissions to be avoided by use of the feed additive.

2.3 Data and parameters

Each project will present the parameters that will remain 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.

3 Credit for Carbon Capture and Storage or Use

This chapter of the methodology explains how a negative emission term (credit) may be calculated for inclusion in the emissions of the project scenario for an InnovFund application where the project involves carbon capture with storage or use. The calculation shall reflect the overall CCS/CCU efficiency by taking into account the leaked, vented, fugitive and incidental emissions occurring in the system as described in detail in sections 3.2 and 3.3.

Where projects will capture CO_2 from a point source, that point source must be included within the system boundary of the GHG calculation even if it is not part of the project facility and **it must be included as an emission term** even though the CO_2 is being captured (for EII projects, in the processes box of the project scenario see also section 2.2.5.2; for renewable energy projects within either the $Proj_{geo,y}$ or $Proj_{bio,y}$ term as appropriate). In the case of biogenic CO_2, the emission factor for the point source will be set to zero gCO_2e/MJ. This emission term will then be offset by the credit term calculated following the rules in this chapter.

3.1 Carbon Capture and Storage (CCS)

Some projects within the Energy Intensive Industries or Renewable Energy eligibility categories may contain an element of carbon capture and storage (CCS). The CCS element of the project may be the only innovative element or may be operated alongside other innovative elements. CCS is characterised by the capture of CO_2 in 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. This captured CO_2 will then be transported (e.g. by road tankers, ships, rail and/or pipelines) to 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.

Where projects will capture CO_2 for storage from point sources the eligibility category, sector and product is determined by the nature of the facility from which the CO_2 is captured. In the case that this facility falls within the EII eligibility category and produces more than one product then the normal rules shall be followed for identifying the principal product (see section 1.3).

<u>Example 1</u>: CO_2 capture from a fossil power installation (gas, coal, etc.) shall apply under EII/other/electricity.

<u>Example 2</u>: CO_2 capture from a geothermal power installation shall apply under Renewable energy/geothermal energy/electricity.

<u>Example 3</u>: CO_2 capture from a biomass power installation shall apply under EII/other/bio-electricity.

<u>Example 4</u>: CO_2 capture from a steel plant shall apply under EII/iron & steel/steel.

Some projects with a CCS element will not include CO_2 capture from an industrial point source – either the CO_2 is captured from the atmosphere or is captured outside the project boundary. In the case of direct air capture (DAC) plants that capture CO_2 directly from the atmosphere, the application should be made under EII/other/direct air capture. If the project does not include any CO_2 capture within its system boundary but aims to store CO_2, it shall apply under EII/other/CO_2 storage. If the project aims to only transport CO_2 then it shall apply it shall apply under EII/other/CO_2 transport.

Applications for projects with a CCS element can be submitted by any players in the CCS supply chain, including 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 use letters of intent or draft contracts to demonstrate the provision of the remaining services in the CCS supply chain by third parties, since the InnovFund grant is dependent on verified emission reductions, i.e., the amount of CO_2 stored in a site permitted under Directive 2009/31/EC. Copies of contracts will have to be submitted once the project has entered into operation to ensure the intended emissions saved are indeed taking place. If only one project of the CCS supply chain is applying to the InnovFund, the applicant can claim the full credit. If more than one project of the same CCS supply chain is applying to the InnovFund separately, the credit for the CO_2 capture and storage should be split between the different parts (entities) and the sum should not exceed the total CO_2 captured.

In the case that following the rules below for the assessment of the GHG emissions credit would result in double counting of any GHG source or sink already included in the assessment of project scenario emissions following the rules for EII or RES projects, this double counting should be removed.

Project emissions from the CO_2 capture activity, 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.

3.2 Carbon Capture and Use (CCU)

Some projects in the Energy Intensive Industries eligibility category may include an element of carbon capture and use. CCU is characterised by the capture of CO_2 in exhaust gases from point sources in industrial processes or power generation, or directly from ambient air, followed by a separation of that CO_2 and incorporation of that CO_2 into a product by means of chemical reaction.

3.3 CO2 capture from biogenic sources

There is **no difference** when calculating the credit for CCS/CCU between CO_2 captured from fossil sources and from biogenic sources. When adding a CCS/CCU element to a project in the EII or RES eligibility categories that involves CO_2 from biogenic sources, any additional benefit to the project from the use of biogenic resources is assessed under the EII or RES component by using a zero emission-factor for the point source CO_2 emission that is captured, with no difference in the CCS credit component.

3.4 Scope

This section applies to project activities that involve capturing CO_2 from point sources or directly from the ambient air for injection in storage sites permitted under Directive 2009/31/EC on the geological storage of CO_2 or for incorporation in products.

This section is applicable to CCS/CCU project activities such as but not exclusive to:

3.4.1 Plant of origin

- Energy intensive industries
- Bio-refineries
- Power generation facilities, using fossil fuels or bioenergy
- Natural gas processing.
- The capture of CO_2 that is produced as a by-product of hydrocarbon extraction (such as CO_2 produced from natural gas wells) **is not eligible** for consideration within the calculation of a CCS/CCU credit under the Innovation Fund.
- The capture of CO_2 that is produced intentionally for the purpose of capturing it (for example through extraction from a natural CO_2 reservoir or through additional

combustion of fuels) **is not eligible** for consideration within the calculation of a CCS/CCU credit under the Innovation Fund.

3.4.2 Technologies

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

3.4.3 Storage sites

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

3.5 Calculation of credit

The equation to be applied for the calculation of the emission reduction credit for CCS and CCU projects is described in the following.

GHG emission credit	**=**	**Sinks**	**-**	**Sources**	
$CC_{credit,y}$	=	$\sum_{y=1}^{n} (CC_{storage,y} + CC_{use,y})$	-	$\sum_{y=1}^{n} (CC_{capture,y} + CC_{injection,y} + CC_{EHR,y} + CC_{pipeline,y} + CC_{transport,y})$	[3.1]

Where:

y = year of operation

n = 10th year following the start of operation

$CC_{credit,y}$ = Emission credit (negative emission term) that may be included in the project scenario[37] for year y.

$CC_{storage,y}$ = Amount of CO_2 that is injected for permanent storage in year y, in tonnes CO_2, 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. This excludes any CO_2 expected to be lost to fugitive emissions, leakage or venting between the point of capture and the point of permanent storage.

[37] Or in the reference scenario for the unusual case of a project modifying an existing plant where CCS is practiced.

$CC_{use,y}$ = Amount of CO_2 that is incorporated into products in year y, in tonnes CO_2e. This amount may be calculated as 44/12 multiplied by the mass of carbon atoms from captured CO_2 incorporated in the products. This excludes any CO_2 lost to fugitive emissions or venting between the point of capture and the point of permanent storage.

$CC_{capture,y}$ = 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 or for incorporation in a product in year y, in tonnes CO_2e. This includes emissions from fuel and input material use for compression and liquefaction of the CO_2. It shall be calculated according to Regulation (EU) 2018/2066, Annex IV, Section 21. 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 capture and transport must be included by the project applicant based on appropriate referenced sources.

$CC_{injection,y}$ = For CCS projects, 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.

$CC_{EHR,y}$ = For projects in which CO_2 injection and storage is associated with enhanced hydrocarbon recovery, emissions consistent with stoichiometric combustion of the associated fraction of the produced hydrocarbons. This is to be calculated as $CC_{EHR,y} = (CC_{storage,y} / EHR_{storage,y}) * HC_y * \%C_y * 44/12$, where $EHR_{storage,y}$ is the total amount of CO_2 stored at the EHR location in year y, HC_y is the total mass of hydrocarbons in tonnes produced at the EHR location in year y, and $\%C_y$ is the carbon fraction in the produced hydrocarbons.

$CC_{pipeline,y}$ = GHG emissions from transport of CO_2 by pipelines for the purpose of 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. It shall be calculated according to Regulation (EU) 2018/2066, Annex IV, Section 22.

$CC_{transport,y}$ = 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 based on distance travelled, type of modal and load according to Equation [3.2] and sub equations, in tonnes CO_2e. This methodology assumes the transportation of the CO_2 will be done through heavy goods vehicle (HGV) when via road, and by sea tankers for maritime journeys.

For projects submitted to the InnovFund in a small scale call: 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 travelled between the point of capture and the point of storage is less than 5,000 kilometres.

Parameter	=	Equation	
$CC_{transport,y}$	=	$CC_{transport,road,y} + CC_{transport,rail,y} + CC_{transport,maritime,y}$	[3.2]
$CC_{transport,road,y}$	=	$\sum_{L=1}^{T} (K_{road,L} * CO_{2road,L} * EF_{road} * 10^{-3})$	[3.3]
$CC_{transport,rail,y}$	=	$\sum_{L=1}^{T} (K_{rail,L} * CO_{2rail,L} * EF_{rail} * 10^{-3})$	[3.4]
$CC_{transport,maritime,y}$	=	$\sum_{L=1}^{T} (K_{maritime,L} * CO_{2maritime,L} * EF_{maritime} * 10^{-3})$	[3.5]

Parameter	=	Equation	

Where:

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

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

$CC_{transport,maritime,y}$ = 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_2e / tonne.km. The EF presented in Parameters not to be monitored (fixed ex-ante) 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_2e / tonne.km. The EF presented in 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_2e / tonne.km. The EF presented in shall be applied.

L = outbound trip by the modal.

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

Applicants should 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 $CC_{transport,y}$. Therefore, if applicants' data is available per trip, applicants 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.

3.6 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 $CC_{capture}$, $CC_{pipeline}$ and $CC_{injection}$.

Table 3.1 presents the parameters that will be deemed as constant throughout the duration of the project for the calculation of $CC_{transport}$. Should applicants 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 consumed for injection and/or capture shall be zero.

Table 3.1. 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 pressurised cryotank. Includes empty return trip.
EF_{rail}	0.065	kg CO_2e / tonne.km	Emission factor for freight by rail 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 of CO_2
$EF_{maritime}$	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 and empty return trip.

Source: see the column "Source data".

4 Renewable energy

This section describes the calculation of GHG emission avoidance from innovative renewable energy projects such as bioelectricity, bio-heat (i.e., bio-thermal), solar, geothermal, wind, and hydro/ocean energy. Emission avoidance from projects whose principal products are biofuel or biomaterials for use in bio-refineries, are more complex to calculate, necessitating the use of the rules in section 2, based on the procedures for industrial projects. The possible principal products for renewable electricity, heat and cooling projects are: dispatchable grid electricity; non-dispatchable grid electricity; heat; cooling.

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 (principal products), despite the regional differences that will invariably be observed in real life. For the purpose of the InnovFund, if one of the principal products is non-dispatchable grid electricity, the emissions attributed to grid electricity in the reference scenario corresponds to the typical EU grid emissions in 2030 according to the Commission's EU Reference Scenario 2020 , i.e., $EF_{electricity,ref}$ = 48.81 g CO_2e/MJ (0.17570 tonnes CO_2e/MWh). Where one of the principal products is dispatchable grid electricity, the reference scenario corresponds to the emissions from dispatchable power generation by a single cycle gas turbine plant with 40% electrical efficiency, i.e. 140 g CO_2e/MJ (0.504 tonnes CO_2e/MWh). For all projects generating renewable heating, a natural gas boiler with 90% LHV efficiency shall be adopted as the reference scenario, i.e. 62.3 g CO_2e/MJ.

For projects submitted to the InnovFund in a small-scale call: 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. See also section 1.3.1.

In terms of the project emissions, sources of GHG emissions depend on the technology and supporting infrastructure for the operation of the plant. Normally, emissions from wind, solar and ocean energy generation are relatively minor. However, the same is not true for other renewables, such as geothermal, waste to energy, where emissions could include, for instance, fuel combustion in the plant and in on-site machinery, as well as fugitive losses.

Therefore, for the purpose of the InnovFund large scale call (i.e., not applicable for the small scale call since $Proj_{on-site}$ are disregarded for small scale call (SSC) projects), the applicant shall quantify at a minimum the emissions from all the direct sources (Scope 1), indirect emissions from the generation of purchased electricity and/or steam (Scope 2) and other indirect emissions that occur across the value chain (Scope 3), as per definition of the GHG Protocol Corporate Standard.[38] Although this approach does not require the

[38] The GHG Protocol Corporate Standard classifies a company's GHG emissions into three 'scopes'. Scope 1 emissions are direct emissions from owned or controlled sources (e.g., fuel combustion on site such as in

quantification of all cradle-to-grave emissions, it intends to capture the main emissions sources within the project boundaries and control.

For projects that include physical or virtual storage of renewable electricity at times when there is an excess of it in the grid, e.g., smart grid applications, should be considered as hybrid projects. They should split their feed-in of renewable electricity generated by the project 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 (i.e., consume electricity when its emissions are low”). 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 for components of innovative technologies that will generate renewable energy, when implemented.

4.1 Scope

This section applies to innovative renewable energy projects for the purpose of generating electricity and heating/cooling, including electricity and/or heat produced from biomass, fuels derived from biomass, or heat pumps, and for the use of renewable energy outside the activities falling within Annex I of the ETS. Note that while **projects producing renewable energy from biomass should apply using the calculation rules in this Chapter**, they should be classified under the category/sector EII/other with the product dispatchable electricity and/or bio-heat.

Projects involving the installation of carbon capture units for permanent CO_2 storage at existing renewable power facilities should apply under the category/sector/product EII/Other/Storage and follow the EII methodology, using Case 7 (BECCS) or Case 3 (any projects other than BECCS) for reference emissions.

Projects for the use of renewable energy outside Annex I must consume solely energy that is wholly renewable. In the case of electricity, this must be through procurement of additional renewable electricity, for example: electricity supplied by a direct connection to a dedicated renewable source; wind electricity delivered by the grid, that would otherwise be curtailed; hydroelectricity that has insufficient demand in the region and will probably be insufficiently connected to the rest of the grid even in 2030 to allow all of it to be used; renewable electricity supplied under a PPA with additional renewable power plants.

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

This section 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

boilers, fleet vehicles and air-conditioning leaks). Scope 2 emissions are indirect emissions from the generation of energy purchased and used by the organisation. Scope 3 emissions are all other indirect emissions that occur across the value chain of the organisation, in sources that the organisation does not own or control, such as business travel, raw material production, waste degradation.

- Components for renewable energy installations (e.g., production of innovative heat pumps, photovoltaic modules and wind turbines).
- Use of renewable energy outside Annex I.

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
- Construction of a manufacturing plant for components of innovative renewable technologies
- Installation of innovative drivetrains

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 for components for innovative technologies, applicants shall demonstrate the existence of one or several buyers (i.e., companies that will use the innovative technology to generate renewable electrical or thermal energy) through provisional contract agreements to ensure accountability over the intended GHG emission avoidance,

For information on how GHG emission avoidance will be calculated for such projects, please refer to section 4.2.3.

4.1.3 System boundary

The emission sources that shall be included within the boundaries of the calculations for projects involving the production of electricity, heat or cooling using wind, ocean, solar, geothermal and bio-based fuels ([39]) 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 in LSC**	**Included in SSC**
Reference (Ref)	GHG emissions for the generation of electricity ($Ref_{electricity}$), heating (Ref_{heat}) or cooling (Ref_{cool}) in fossil fuel power plants, which will be replaced due to the project activity	Yes	Yes
Project (Proj)	GHG emissions due to consumed electricity and fossil fuel in stationary machinery and on-site vehicles at the project site(s) ($Proj_{on\text{-}site}$)	Yes	No
	GHG emissions due to leakage during the operation of geothermal power plants, ($Proj_{geo}$) and from the production and supply of biomass-based fuels ($Proj_{bio}$)	Yes	Yes

Source: European Commission internal elaboration.

4.2 Absolute GHG emission avoidance

The equations to be applied for the calculation of the absolute GHG emissions avoidance are described in the following sections. For a manufacturing plant that produces renewable

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

energy systems or components, the absolute GHG emission avoidance shall be calculated according to Equation [4.3a].

Project type	GHG emission avoidance	=	Reference scenario emissions	-	Project scenario emissions	
Delivered electricity from wind, hydro, ocean, solar, geothermal energy and from biogenic sources.	$\Delta GHG_{abs,RES\text{-}to\text{-}electricity\ y}$	=	$\sum_{y=1}^{n}$ $Ref_{electricity,y}$	-	$\sum_{y=1}^{n}$ $(Proj_{on\text{-}site,y} + Proj_{geo,y} + Proj_{bio,y} - CC_{credit,y})$	[4.1]
Delivered heat from solar, geothermal/ambient energy and from biogenic sources.	$\Delta GHG_{abs,\ RES\ to\ heat,y}$	=	$\sum_{y=1}^{n}$ $Ref_{heat,y}$	-	$\sum_{y=1}^{n}$ $(Proj_{on\text{-}site,y} + Proj_{geo,y} + Proj_{bio,y} - CC_{credit,y})$	[4.2]
Delivered cooling from solar, and geothermal energy and from biogenic sources.	$\Delta GHG_{abs,\ RES\ to\ cool,y}$	=	$\sum_{y=1}^{n}$ $Ref_{cool,y}$	-	$\sum_{y=1}^{n}$ $(Proj_{on\text{-}site,y} + Proj_{,geo,y} + Proj_{bio,y} - CC_{credit,y})$	[4.3]
Manufacturing plants	$\Delta GHG_{abs,\ RES\ manufacturing,y}$	=	$\sum_{y=1}^{n}$ $(N_y \times CS_{component} \times Ref_{energy,y})$	–	$\sum_{y=1}^{n}$ $(N_y \times CS_{component}) \times (Proj_{on\text{-}site,y} + Proj_{geo,y} + Proj_{bio,y} - CC_{credit,y})$	[4.3a]
Renewable energy used outside annex I	$\Delta GHG_{abs,RES\text{-}outside\text{-}AnnexI,y}$	=	$\sum_{y=1}^{n}$ $(Ref_{energy\ used,y})$	-	$\sum_{y=1}^{n}$ $(Proj_{energy\ used,y} - CC_{credit,y})$	[4.3b]

For projects submitted to the InnovFund in a small scale call: The equations are identical with the difference that Project emissions do not include "$Proj_{on\text{-}site,y}$ ".

Where:

$Ref_{electricity,y}$ = GHG emissions for the generation of electricity in fossil fuel 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 [4.4].

$Ref_{heat,y}$ = GHG emissions for the generation of heating in fossil fuel 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 [4.6].

$Ref_{cool,y}$ = GHG emissions for the generation of cooling in fossil fuel 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 [4.8].

$Ref_{energy\text{-}used,y}$ = GHG emissions associated with the energy source that is to be displaced by renewable energy use. This shall be calculated according to Equation [4.9a].

$Proj_{on\text{-}site,y}$ = GHG emissions due to fuel and electricity consumption at the project site in year y, in tonnes CO_2e. Calculated according to Equation [4.10].

$Proj_{geo,y}$ = GHG emissions from the operation of the geothermal power plant in year y, in tonnes CO_2e. Calculated according to Equation [4.14].

$Proj_{bio,y}$= 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 [4.17].

$Proj_{energy\ used,y}$ = GHG emissions associated with the production of renewable energy to be used outside of Annex I. Calculated according to Equation [4.18].

$CC_{credit,y}$ = GHG emissions credit for projects including a CCS element, calculated in accordance with Chapter 3.

$CS_{component}$ = innovative components' cost as a fraction of the total capital cost of the relevant facility or retail price of the consumer product. The total capital cost for a facility is the sum of the cost of an innovative component plus standard costs of the remaining components constituting a typical operational renewable energy facility using the innovative component. For components used in consumer products, the retail price should be based on a typical use case for the component, and may exclude sales taxes. Applicants must provide appropriate references to justify this cost assessment.

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

y = year of the operation.

n = 10th year following the start of operation.

4.2.1 Reference emissions sub-equations

Parameter	=	Equation	
$Ref_{electricity,y}$	=	$EG_{electricity,y}$ * $EF_{electricity,ref}$	[4.4]
$EG_{electricity,y}$	=	P_{elec} * PLF * T_y	[4.5]
$Ref_{heat,y}$	=	$EG_{heat,y}$ * $EF_{NG,ref}$ / 0.90	[4.6]
$EG_{heat,y}$	=	P_{heat} * PLF * T_y	[4.7]
$Ref_{cool,y}$	=	$EG_{cool,y}$ * $EF_{electricity,ref}$	[4.8]
$EG_{cool,y}$	=	P_{cool} * PLF * T_y	[4.9]
$Ref_{energy\text{-}used,y}$	=	$EC_{energy\text{-}used,y}$ * $EF_{energy\text{-}used,ref}$	[4.9a]

Where:

$EG_{electricity,y}$ = Net[40] amount of electricity to be generated by the renewable technology in year y, in MWh. Calculated according to Equation [4.5].

[40] 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 shall 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

$EG_{heat,y}$ = Net amount of heat to be delivered by the renewable technology in year y, in MWh. Calculated according to Equation [4.7].

$EG_{cool,y}$ = Net amount of cooling to be delivered by the renewable technology in year y, in MWh. Calculated according to Equation [4.9].

$EC_{energy\text{-}used,y}$ = Net amount of renewable energy to be consumed outside Annex I by the project in year y, in a unit consistent with the units for the emission factor for that type of energy in Table 4.2 Parameters not to be monitored.

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.

$EF_{electricity,ref}$ = EU electricity emissions factor in the reference period, in tonnes CO_2e/MWh, for either dispatchable or non-dispatchable electricity: the appropriate EF presented in Table 4.2. Parameters not to be monitored should be applied. It is assumed that while non-dispatchable electricity replaces the EU average grid electricity (estimates for 2030), dispatchable electricity replaces the peak load plant that is most commonly used to stabilise the EU power grid, i.e. single cycle natural gas turbine[41].

$EF_{NG,ref}$ = 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. Parameters not to be monitored should be applied.

$EF_{energy\text{-}used,ref}$ = Emission factor for the relevant reference energy source as presented in Table 4.2 Parameters not to be monitored. y = year of operation.

4.2.2 Project emissions sub-equations

Parameter	=	Equation	
$Proj_{on\text{-}site,y}$	=	$Proj_{FF,stat,y} + Proj_{FF,mob,y} + Proj_{elect,y}$	[4.10]
$Proj_{FF,stat,y}$		$Q_{FF\_stat,y} * EF_{FF}$	[4.11]
$Proj_{FF,mob,y}$		$Q_{FF\_mob,y} * EF_{FF}$	[4.12]
$Proj_{elect,y}$		$EC_y * EF_{electricity,proj}$	[4.13]

Where:

$Proj_{FF,stat,y}$ = GHG emissions from fossil fuel consumption in stationary machinery at the project site in year y, in tonnes CO_2e. This should include fuel consumed for generation of electric power and heat, and from auxiliary loads.

$Proj_{FF,mob,y}$ = GHG emissions from fossil fuel consumption from on-site vehicles and other transportation at the project site, in year y, in tonnes CO_2e. This includes vehicles used for regular maintenance.

situations where the project involves retrofit/capacity added to an existing plant, only the surplus shall be accounted for.

41 See https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/JRC_107769_LCPBref_2017.pdf, Section 2

$Proj_{elect,y}$ = GHG emissions due to the electricity imported from the grid and consumed at the project site, in year y, in tonnes CO_2e.

$Q_{FF\_stat,y}$ = Quantity of fossil fuel type FF combusted in stationary sources at the project site in year y, in litres or m^3.

$Q_{FF\_mob,y}$ = Quantity of fossil fuel type FF combusted in mobile sources at the project site in year y, in litres.

EF_{FF} = Emission factor due to the combustion of the fossil fuel type FF, in tonnes CO_2e/litre or tonnes CO_2e/m^3. The applicable EF presented in Table 4.2 Parameters not to be monitored should be applied.

EC_{y} = Amount of electricity imported from the grid and consumed at the project site in year y, in MWh.

$EF_{electricity,proj}$ = Average EU electricity emissions factor in the project scenario, in tonnes CO_2e/MWh. The appropriate EF presented in Table 4.2 Parameters not to be monitored should be applied.

y = year of the operation

Parameter	=	Equation	
$Proj_{geo,y}$	=	$Proj_{dry\_flash,y} + Proj_{binary,y}$	[4.14]
$Proj_{dry\_flash,y}$	=	0.00544695[42] * $M_{steam,y}$	[4.15]
$Proj_{binary,y}$	=	$(M_{inflow,y} – M_{outflow,y}) * 0.00544695 + M_{working\ fluid,y} * GWP_{working\ fluid}$	[4.16]

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 to use 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, if available.

Parameter	=	Equation	
$Proj_{bio,y}$	=	$\sum_{y=1}^{n}$ $EC_{bio.f,y} * EF_{bio,f} * 0.85$[43]	[4.17]

42 Based on IPCC AR5 and CDM benchmarks. Assumes: Average mass fraction of methane in the produced steam = 0.00000413 tonnes CH_4/ tonne steam; Average mass fraction of CO_2 in the produced steam = 0.00533144 tonnes CO_2/tonne steam.

43 To deduct 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.

Parameter	=	Equation	
$Proj_{energy\ used,y}$	=	$\sum_{y=1}^{n}$ $(EC_{bio.f,y} * EF_{bio,f} * 0.85 + Proj_{geo,y})$	[4.18]

Where:

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

$EF_{bio,f}$ = GHG emissions from the transport and supply of bio-based fuel '*f*' used to make heat and/or electricity, produced, in tonnes CO_2e /MJ of the bio-based fuel. Calculated according to REDII, Annexes V and VI, by summing, where available, the disaggregated default emissions tabulated therein, except the 'Transport' emissions and the 'Non-CO_2 emissions from the fuel in use'. If values are not available in the REDII then the data hierarchy should be followed. As detailed in section 1.3.4, if biomass feedstocks are transported more than 500 km to reach the first point of processing/treatment then transport emissions should be included based on the actual distance travelled and mode of travel.

y = year of operation

4.2.3 Construction of a manufacturing plant of innovative technologies components

General applicable indication on manufacturing of component is given in section 1.2.2. For the situations where funding will be used to finance the construction of a manufacturing plant for innovative technologies components, the same equations presented above 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,
- Operating hours

during the first ten years of operation of the manufacturing plant.

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.

Project emissions (Proj) shall be estimated based on the fractional emission avoidance due to the use of the component, the industry benchmarks and assumptions for the projected leakage emissions and fuel usage at the power plant, which will use the innovative technology(ies) or component(s).

4.3 Relative GHG emission avoidance

Please refer to section 1.1.2 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 4.2 Parameters not to be monitored 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 1.

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	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_{NG}	56.1	tonnes CO_2/TJ	Emission factor for combustion of natural gas	Ibid	
$EF_{heavyoil}$	3.12	tonnes CO_2/ tonne	Emission factor for combustion of heavy fuel oil	Based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories.	
EF_{NG}	0.00215	tonnes CO_2e / m^3	Emission factor for combustion of natural gas	Commission Delegated Regulation (EU) 2018/2066, Annex VI	Assumes density of 800 g / m^3
$EF_{gasoline}$	0.00228	tonnes CO_2e / litre	Emission factor for the combustion of gasoline	Ibid	No biofuel blend. Motor gasoline. Assumes density of 742 g / litre gasoline EF is 69.3 gCO_2/MJ LHV is 44.3 MJ/kg
$EF_{gasoline}$	69.3	tonnes CO_2e /TJ	Emission factor for the combustion of gasoline	Ibid	LHV = 44,3 TJ/tonne or MJ/kg
EF_{diesel}	0.00268	tonnes CO_2e / litre	Emission factor for the combustion of diesel	Based on EF and NCV from 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Energy	No biofuel blend. Diesel oil. Assumes density of 840 g / litre

Data / Parameter	**Value to be applied**	**Data unit**	**Description**	**Source of data**	**Assumption / Comment**
EF_{diesel}	74.1	tonnes CO_2e /TJ (=gCO_2e/MJ)	Emission factor for the combustion of diesel	Commission Delegated Regulation (EU) 2018/2066, Annex VI	
$EF_{electricity,ref}$	For non-dispatchable electricity: 0.1757	tonnes CO_2e / MWh	Emissions of electricity production in 2030	EU Reference Scenario 2020	Base year 2030. Combustion only.
	For dispatchable electricity: 0.504	tonnes CO_2e / MWh	Emissions of electricity production with single cycle natural gas turbine	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%.
$EF_{electricity,proj}$	0.000	tonnes CO_2e / MWh	Emissions of electricity production in 2050	By assumption	Base year 2050. Combustion only.

Source: see the column "Source data".

5 Energy storage

GHG emission avoidance of an energy storage project is calculated as a difference of the project emissions and the emissions in a reference scenario (i.e., 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. **For projects submitted to the InnovFund in a small scale call**: on-site emissions of fugitive GHG and from energy use other than energy storage will not be considered but have to be reported for knowledge sharing purposes.

If the services delivered by the project are useful from a system perspective, additional emissions associated with the input to the storage unit may be disregarded under certain conditions. In this respect, the methodology distinguishes various services that contribute to the GHG emission avoidance delivered by energy storage units, among others short-term electricity storage, auxiliary services to electricity grids, the avoidance of renewable energy curtailment, and longer-term energy storage. Stacking of services and multiple outputs are considered.

For projects submitted to the InnovFund in a small scale call: auxiliary services to electricity grids are not considered under the GHG emission avoidance criterion. If the project delivers also auxiliary services, this may be considered under 'other GHG savings'. Applicants should demonstrate this through additional calculation of the emissions avoided through these services and also argue their case in the specific part of the Application Form.

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 should 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.

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 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 section 5 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. In the case of projects converting electricity into fuel, such as hydrogen or other synthetic fuels, the application should generally be made under the Energy Intensive Industries eligibility category. Such projects may only fall under this section if the utilisation of excess renewable energy is a primary aim of the project. For such projects, the electricity consumed will be limited to period of high renewable energy production that result in a particularly low load factor.

This section is also to be used to calculate emissions savings from timed operation in EII projects as detailed in section 2.2.6.3.6.

If a project includes an element of energy storage alongside industrial production or renewable energy generation then the main sector should be determined following the principles in section 1.3.1. on hybrid projects.

This section 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);

Auxiliary services to electricity grids (among others reactive power, synchronous inertia, or example from the list hereunder). **For projects submitted to the InnovFund in a small scale call**: not applicable.

Avoidance of renewable energy curtailment;

Other energy storage;

Manufacture of components for energy storage, such as batteries.

5.1.2 Constructing a reference for auxiliary services

The reference scenario for auxiliary services is more complicated to identify than the reference scenario for e.g. intra-day electricity storage, because the reference scenario for auxiliary services may involve a change in the efficiency at which another service is delivered rather than in the quantity of that service delivered. Applicants must propose appropriate reference scenarios for their projects that take account of the details of the auxiliary service provided and the local context for providing it. This is explained in additional detail in relation to equation [5.4] below.

> *Example: A project provides reactive power services with a rating of* **X** *MVAr. For the reference, it is assumed that an equivalent reactive power service could be delivered by running combined cycle gas turbines (CCGTs) below optimal efficiency (e.g. running two turbines at 45% thermal efficiency instead of a single turbine at 55% thermal efficiency). The applicant identifies that* **Z** *MW of power generation would need to run in this lower efficiency mode to provide the* **X** *MVAr of reactive power, and that the reactive power service will be used by the grid for* **Y** *hours per year. The additional natural gas consumption by CCGTs in the reference scenario, expressed in MWh of natural gas, is equal to (55%-45%)/55%* x **Z** x **Y***, and the reference emissions in tonnes* CO_2e *would therefore be (55%-45%)/55%* x **Z** x **Y** x 0.202 *(the natural gas emission factor 56.1* gCO_2e/MJ *is equivalent to 0.202* tCO_2e/MWh*).*

5.1.2.1 Construction of a manufacturing plant of innovative technologies' components

Where funding will be used to finance the construction of a manufacturing plant of components for innovative technologies, applicants shall demonstrate the existence of one or several buyers (i.e., companies that will use the innovative technology to store energy) through provisional contract agreements to ensure accountability over the intended GHG emission avoidance.

Specific guidance is given in section 1.2.2 and throughout section 5 how to calculate GHG emission avoidance for such projects.

5.1.3 Technologies

- Electricity storage technologies
- Heat and cold storage technologies

- Hydrogen storage technologies
- Gaseous fuel storage technologies
- Liquid fuel storage technologies
- Combinations of the above, including smart grid technologies.

5.1.4 Energy sources

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

5.1.5 Energy sinks

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

5.2 System boundary

The spatial extent of the system boundary includes the project energy storage plant/unit and all facilities that the InnovFund 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 system boundary are shown in Table 5.1.

Table 5.1. Emission sources included in the system boundary

Source		**Included in LSC**	**Included in SSC**
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, and from transmission losses associated with the transport network.	Yes	Yes

Source		**Included in LSC**	**Included in SSC**
	$Ref_{services}$: Emissions related to the provision of auxiliary services to the grids in the absence of the project activity. This includes <u>direct</u> emissions from the use of fossil fuels and generation of heat, in particular from inefficient operation of fossil-fuelled plants, <u>indirect</u> emissions from the use of grid electricity and grid heat and from transmission losses associated with the grid transport.	Yes	No
Project (Proj)	$Proj_{energy}$: Emissions related to the provision of energy caused by the project activity. This includes <u>direct</u> emissions from the use of fossil fuels and generation of heat, <u>indirect</u> emissions from the use of grid electricity and grid heat, process-related emissions from the production of hydrogen and from transmission losses associated with the energy transport.	Yes	Yes
	$Proj_{on\text{-}site}$: On-site emissions of fugitive GHG 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.	Yes	No

Source: European Commission internal elaboration.

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.

The 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 market. See also section 1.2.2 for other calculation indications specific to the case of manufacturing plants.

GHG emission avoidance	**=**	**Reference scenario emissions**	**–**	**Project scenario emissions**	
ΔGHG_{abs}	=	$\sum_{y=1}^{10}(Ref_{energy,y} + Ref_{services,y})$	–	$\sum_{y=1}^{10}(Proj_{energy,y} + Proj_{on-site,y})$	[5.1]
ΔGHG_{abs}	=	$\sum_{y=1}^{10} N_y \times CS_{component} \times (Ref_{energy,y} + Ref_{services,y})$	–	$\sum_{y=1}^{10} N_y \times CS_{component} \times Proj_{energy,y}$	[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 energy transport. It shall be calculated according to Equation [5.3] below.

$Ref_{services,y}$ = Auxiliary-services-related GHG emissions present in the reference case 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, in particular from inefficient use of primary energy, indirect emissions from the use of grid electricity and grid heat as well as from transmission losses associated with the energy transport. It shall be calculated according to Equation [5.4] below. In the case that a service could alternatively be delivered by running some amount of power generation with CCGTs at reduced efficiency (45% rather than 55%) then Equation [5.4a] may be used.

$Proj_{energy,y}$ = 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 energy transport. It shall be calculated according to Equation [5.5] below.

$Proj_{on\text{-}site,y}$ = Emissions from storage of energy carriers and their transport by pipelines, road or maritime modals in year *y,* in tonnes CO_2e. 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. It shall be calculated according to Equation [5.6] below.

$CS_{component}$ = innovative components' cost as a fraction of the total capital cost of the relevant facility or retail price of the relevant consumer product. The total capital cost is the sum of the cost of an innovative component plus standard costs of the remaining components constituting a typical operational renewable energy or energy storage facility using the innovative component. For components used in consumer products, the retail cost should be based on a typical use case for the component, and may exclude sales taxes. Applicants must provide appropriate references to justify this cost assessment.

N_y = number of energy storage units supplied to markets by the proposed manufacturing plant of energy storage units, cumulatively until 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. Parameters not to be monitored 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. Given the high interconnectivity of the European electricity markets, it does not apply to grid electricity.

$E_{out,x,y}$ = 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. Parameters not to be monitored 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. Given the high interconnectivity of the European electricity markets, it does not apply to grid electricity.

θ_x = mean losses from transport of energy type *x*, in percent. As long as no regulation prescribes the use of certain values for transport losses, the EU default values presented in Table 5.2. Parameters not to be monitored should be applied.

Parameter	**=**	**Equation**	
$Ref_{services,y}$	=	$\sum_{a=1}^{A} \Delta EF_{service,a} * T_{services,a,y} * R_{services,a,y}$	[5.4]
$Ref_{services,y}$	=	$\sum_{a=1}^{A} EF_{out,\text{ natural gas}} * (0.1/0.55) * CCGT_{services,a} * T_{services,a,y} * R_{services,a,y}$	[5.4a]

Where:

A = number of services considered.

$\Delta EF_{service,a}$ = mean increase of the emission intensity of grid electricity due to the need for the auxiliary service *a*, in tonnes CO_2e per hours of service delivery and per unit of service (MW, Mvar, GVAs). This is to be estimated by the applicant based on the local grid conditions. The reference case to be considered is the provision of the auxiliary service *x* by running fossil fuel plants at a less-than-optimal efficiency.

$T_{services,a,y}$ = the amount of hours that the provision of the auxiliary service *a* is required in year *y*, in hours (h). This is to be estimated by the applicant based on the local grid conditions and the current local grid regulation. 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 operating hours that the innovative technology(ies) or component(s) will be able to generate when implemented.

$R_{services,a,y}$ = rating of the energy storage plant with respect to the service *a*, in year *y*, in a unit depending on the service (MW, Mvar, GVAs). This is to be provided by the applicant based on the technical documentation of the foreseen energy storage plant. 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 total rating that the innovative technology(ies) or component(s) will be able to generate when implemented.

$CCGT_{services,a}$ = MW of CCGTs required to run at 45% instead of 55% efficiency per unit of service *a*.

Parameter	=	Equation	
$Proj_{energy,y}$	=	$\sum_{x=1}^{X} EF_{in,x,y} * E_{in,x,y} / (1 - \Theta_x)$	[5.5]

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.

$EF_{in,y,x}$ = 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. Parameters not to be monitored 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.

$E_{in,x,y}$ = 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.

Θ_x = mean losses from transport of energy type *x*, in percent. As long as no regulation prescribes the use of certain values for transport losses, the EU default values presented in Table 5.2. Parameters not to be monitored should be applied.

Parameter	=	Equation	
$Proj_{on\text{-}site,y}$	=	$Proj_{stat,y} + Proj_{mob,y} + Proj_{fug,y}$	[5.6]
$Proj_{stat,y}$	=	$\sum_{x=1}^{X} EF_{in,x} * E_{stat,x,y}$	[5.6a]
$Proj_{mob,y}$	=	$\sum_{x=1}^{X} EF_{in,x} * E_{mob,x,y}$	[5.6b]
$Proj_{fug,y}$	=	$\sum_{z=1}^{Z} M_{fug,z,y} * GWP_{fug,z}$	[5.6c]

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.

Z = number of GHGs considered (see section 1.1.3).

$Proj_{stat,y}$ = GHG emissions from energy consumption in stationary machinery (except for the energy storage units) at the project site in year y, in tonnes CO_2e. This should include fuel consumed for processing of materials, generation of electric power and heat, and from auxiliary loads. It shall be calculated according to Equation [5.6a] above.

$Proj_{mob,y}$ = GHG emissions from energy consumption from on-site vehicles and other transportation at the project site, in year y, in tonnes CO_2e. This includes vehicles used for regular maintenance. It shall be calculated according to Equation [5.6b] above.

$Proj_{fug,y}$ = GHG emissions from fugitive greenhouse gas emissions at the project site in year y, in tonnes CO_2e. It shall be calculated according to Equation [5.6c] above.

$E_{stat,y,x}$ = Quantity of energy type *x* used in stationary sources at the project site in year y, in TJ. 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 energy use that the innovative technology(ies) or component(s) will require when implemented.

$E_{mob,y,x}$ = Quantity of energy type *x* used in mobile sources at the project site in year y, in TJ. 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 energy use that the innovative technology(ies) or component(s) will require when implemented.

$EF_{in,x}$ = Emission factor due to the use of the energy type *x*, in tonnes CO_2e/ TJ. The applicable EF presented in Table 5.2. Parameters not to be monitored should be applied.

$M_{fug,y,z}$ = Amount of the fugitive emissions of greenhouse gas *z* at the project site in year y, in tonnes. 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 fugitive emissions that the innovative technology(ies) or component(s) will result in when implemented.

$GWP_{fug,z}$ = Global Warming Potential of the fugitive greenhouse gas *z* (see section 1.1.3).

Simplification for PILOT topic **projects:** For PILOT projects expected emissions from mobile machinery and fugitive emissions ($Proj_{mob}$ and $Proj_{fug}$) can be excluded from the calculation.

<u>For projects submitted to the InnovFund in a small scale call:</u>

The equations to be applied for calculating absolute GHG emission avoidance by an energy storage plant are described below.

The absolute GHG emission avoidance by an energy storage plant shall be calculated according to Equation [5.7]. **For a manufacturing plant** that produces energy storage units, the absolute GHG emission avoidance shall be calculated according to Equation [5.8]. 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 market.

GHG emission avoidance	=	Reference scenario emissions	–	Project scenario emissions	
$\Delta GHG_{abs,storage}$	=	$\sum_{y=1}^{10} Ref_{energy,y}$	–	$\sum_{y=1}^{10} Proj_{energy,y}$	[5.7]
$\Delta GHG_{abs,storage}$	=	$\sum_{y=1}^{10} N_y \times CS_{component} \times Ref_{energy,y}$	–	$\sum_{y=1}^{10} N_y \times CS_{component} \times Proj_{energy,y}$	[5.8]

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 energy transport. It shall be calculated according to Equation [5.3] above.

$Proj_{energy,y}$ = 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 energy transport. It shall be calculated according to Equation [5.5] above.

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

$CS_{component}$ = innovative components' cost as a fraction of the total capital cost of the relevant facility or retail price of the relevant consumer product. The total capital cost is the sum of the cost of an innovative component plus standard costs of the remaining components constituting a typical operational renewable energy or energy storage facility using the innovative component. For components used in consumer products, the retail cost should be based on a typical use case for the component, and may exclude sales taxes. Applicants must provide appropriate references to justify this cost assessment.

y = year of operation.

5.4 Relative GHG emission avoidance

Parameter	=	Equation	
$Proj_{energy,y}$	=	$\sum_{x=1}^{X} EF_{in,x,y} * E_{in,x,y} / (1 - \Theta_x)$	[5.9]

Please refer to section 1.1.2 for Guidance on the calculation of ΔGHG_{rel}.

5.5 Data and parameters

The Table 5.2 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
$EF_{in,H2,y}$ / $EF_{out,H2,y}$	48.2 (6.84)	gCO_2e/MJ (tCO_2e/tH_2)	Emission benchmark for generating hydrogen under the ETS in year *y*	Commission implementing regulation (EU) 2021/447 of 12 March 2021	Benchmark value for 2021- 2025 to be used for all the first 10 years of production

Data / Parameter	**Value to be applied**	**Data unit**	**Description**	**Source of data**	**Comment**
$EF_{in,heat,y}$ / $EF_{out,heat,y}$	47.3	gCO_2e/MJ (tCO_2e/TJ)	Emission benchmark for generating heat under the ETS in year *y*	Commission implementing regulation (EU) 2021/447 of 12 March 2021	Benchmark value for 2021- 2025 to be used for all the first 10 years of production
$EF_{in,natural\ gas}$ / $EF_{out,natural\ gas}$	56.1	gCO_2e/MJ (tCO_2e/TJ)	Combustion emissions of natural gas	COMMISSION DELEGATED REGULATION (EU) 2018/2066, annex VI	
$EF_{in,diesel}$/ $EF_{out,diesel}$	74.1	gCO_2e/MJ (tCO_2e/TJ)	Combustion emissions of diesel fuel or gasoil	Ibid	
$EF_{in,heavy\ fuel\ oil}$ / $EF_{out,heavy\ fuel\ oil}$	77.4	gCO_2e/MJ (tCO_2e/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	gCO_2e/MJ (tCO_2e/TJ)	Combustion emissions many fossil fuels	Ibid	If not in that table, use the literature hierarchy in Appendix 1
$EF_{in,electricity,y}$	0	gCO_2e/MJ (tCO_2e/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	gCO_2e/MJ (tCO_2e/TJ)	Emissions for electricity production 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.

Data / Parameter	Value to be applied	Data unit	Description	Source of data	Comment
$EF_{transport,y}$	222.3	gCO_2e/MJ (tCO_2eq/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	Use default only, if no country-specific prescription exists
θ_{heat}	8.54	%	Mean losses due to transport of heat to consumers via heat networks in the EU in 2018	EUROSTAT 2020	Use default only, if no country-specific prescription exists
θ_{gas}	0.43	%	Mean losses due to transport of gaseous fuel s to consumers via the grid in the EU in 2018	EUROSTAT 2020	Use default only, if no country-specific prescription exists
$\Delta EF_{service,a}$	Individual calculation by the applicant	t CO_2e per unit depending on service (MW/GVAs/MVAr)	mean increase of the emission intensity of grid electricity due the need for the auxiliary service a	No source available	Where relevant the reference case shall consider the provision of the service by a CCGT plant running at a less than optimal electrical efficiency of 45% instead of 55%.

Source: see the column "Source data".

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Appendix 1

Hierarchy of data sources for inputs and products in industrial projects, including projects with CCS

The GHG emissions intensity and combustion emissions of inputs or products, **that is not specified elsewhere in the section on energy intensive industry,** and need to be found from literature (which never includes heat or electricity), will be taken from the following sources in the order from the top to bottom of the "hierarchy". If using values from several sources at the same level of the hierarchy, the application should explain why this was necessary; cherry-picking favourable values is not allowed.

> *Example: a producer cannot claim that industrial hydrogen bought from an indeterminate source has the emission factor derived from a chlor-alkali plant, because that production is fixed by the demand for chlorine and soda; an increase in hydrogen demand would presently be supplied by steam reforming of natural gas.*

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 combustion emissions and also all the "upstream" emissions from the supply chain extraction of raw materials, all steps in the processing, transport and distribution.

Where emissions values are taken from the data hierarchy applicants are not permitted to make alternative assumptions about the upstream emission fraction. The applicant does, however, have the option of expanding the system boundary to include the production of any given input and assessing the associated emissions directly (see section 2.2.3), in which case the grid electricity consumed by an energy intensive industries project to produce an input should be treated as zero emissions.

The EU ETS benchmark emission factors may not be used for inputs as the scope of the EU ETS benchmark calculation is not appropriate for this purpose.

> *Example: The applicant should use the following assumptions for coke: a factor of 3.169 tCO_2e taken from the IPCC 2006 Guidelines.*
>
> *It would be incorrect to use the EU ETS benchmark for coke (0.217 tCO_2e) which does not include e.g., the carbon content of coke combustion, upstream emissions for coal extraction.*

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.[44]

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).[45] The same values are intended to be shown also in a revised version of the BIOGRACE tool.[46] 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

[44] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf.
[45] https://ec.europa.eu/jrc/en/publication/definition-input-data-assess-ghg-default-emissions-biofuels-eu-legislation.
[46] www.biograce.net.

are approximately coherent with the emissions calculated in EU ETS from combustion of fossil fuels, first 15% is subtracted from the part of these values labelled as 'supply' to account for the upstream (etc.) emissions, leaving (where relevant) the part of the emission value identified as 'combustion' unchanged.

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[47], which shares the same input database as the calculations in Annex V of REDII.

4. Calculations using input data from ECOINVENT 3.5. (or more recent versions) Calculations in ECOINVENT should use the "cut-off system model". An equivalent calculation may also be made in proprietary software packages (e.g., GABI, open LCA) 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 life-cycle emissions should be made by subtracting 15% from the part of the emissions intensity result not associated with carbon contained in the product. If the calculation calls for allocation of emissions between multiple products, allocation by economic value 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 lifecycle emissions intensity).

6. Other reviewed sources of data, such as E3 database, GEMIS database.

7. Peer-reviewed publications. The applicant should properly reference the source used so that the evaluator is able to check against it, but does not have to provide a review of the methodology of the chosen source (the GHG methodology is not prescriptive about specific LCA decisions when peer reviewed sources are used). Note that it is not acceptable to simply take a value without developing the GHG emission avoidance calculations in full alignment with the methodology.

8. Duly documented own-estimates.

9. "Grey literature": unreviewed sources, such as commercial literature and websites.

[47] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC119036/jec_wtt_v5_119036_annexes_final.pdf.

Appendix 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 (principal products, non-principal 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 all the products produced by the process".

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 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 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 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:

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

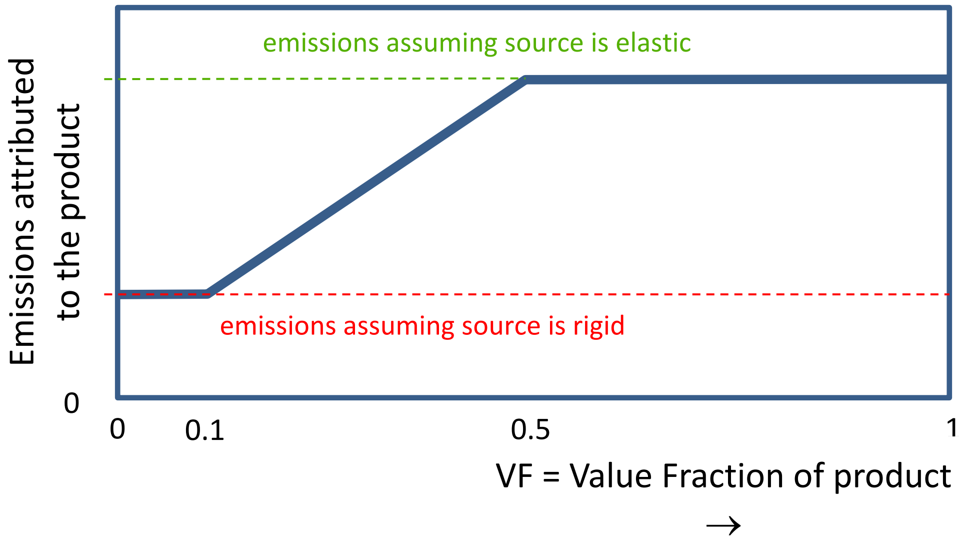
…where *VF* = Value Fraction of the product =

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

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 6.1. Determining emissions for semi-elastic inputs.



Source: *European Commission internal elaboration.*

In practice, it is expected that the great majority of inputs fall into either the "elastic" or "rigid" category, so the simplification is considerable in most cases.

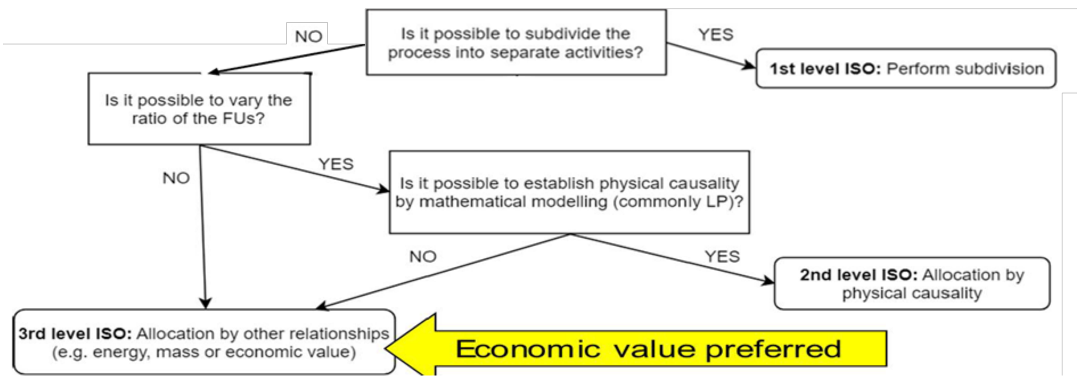
> *Example: The chlor-alkali process produces sodium hydroxide, chlorine and hydrogen in a ratio that is fixed by stoichiometry. Here, we consider the case where all three are sold as inputs to a process in InnovFund project.*
>
> *By contrast, if hydrogen is not sold, but is being burnt for process heat, then the emissions of the plant are 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 3

Attribution of emissions to co-products in emissions calculations for InnovFund projects

In some cases, it may be necessary to attribute emissions associated with production of an input between the input and its co-products. This will generally only be necessary if a source in the data hierarchy provides a characterisation of the production process but does not provide disaggregated emission factors for the co-products. In such cases, a simplified version of the ISO 14044 (2006) multifunctionality framework is used to attribute emissions to co-products.

Figure 6.1. Simplification of the ISO 14044 (2006) hierarchy for sharing emissions between co-products [48]



Source: *European Commission internal elaboration.*

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 should 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.

If any installation involved in the process to produce the input treats only one input and no other co-products, then obviously the emissions from that installation can be ascribed entirely to the input. Similarly, if any installation treats only the other co-products, then its emissions may be disregarded.

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 it 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

[48] 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.

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[49] 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.

[49] 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 4

Overview of the Monitoring Reporting and Verification requirements for InnovFund projects

Legislation Overview

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 monitoring plan should be in line with the 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 as it has been amended by Regulation 2020/2085. The present Appendix constitutes an overview of the MRV legislation supplemented with specific requirements under the Innovation Fund. It should be noted that by no means does it intend to substitute the detailed provisions included in the relevant legal documents.

Available methodologies

Under the MRV Regulation (Articles 21 and 22) the following methodologies are available for monitoring the GHG emissions:

Calculation based approaches:

- *Standard methodology (distinguishing combustion and process emissions);*
- *Mass balance;*

Measurement based approaches;

Methodology not based on tiers ("fall-back approach");

Combinations of approaches.

It is highlighted that the calculation based approaches also require measurements. However, the measurement here is usually applied to parameters such as the fuel consumption, which can be related to the emissions by calculation, while the measurement based approach always includes measurement of the GHG itself.

Classification of installations

Under the MRV Regulation (Article 19(2)), installations included in Annex I of the EU ETS Directive are classified into three categories based on their average annual emissions:

Category A: ≤ 50 000 tonnes of CO_{2e};

Category B: > 50 000 tonnes of CO_{2e}, and ≤ 500 000 tonnes of CO_{2e};

Category C: > 500 000 tonnes of CO_{2e}.

The derogations in Article 27(a) of the EU ETS Directive and Article 47(2) of the MRV Regulation relating to installations with low emissions (less than 25000 tonnes of CO_{2e}) are not relevant in the context of the Innovation Fund. The classification of an installation in each category implies a different level of accuracy required with stricter monitoring rules applying to bigger emitters.

Classification of source streams

Within an installation the greatest attention is and should be given to the bigger source streams. For minor source streams, lower requirements are applicable. The operator has to classify all source streams for which the operator uses calculation based approaches according to Article 19(3). For this purpose, the operator must compare the emissions of the source stream with the "total of all monitored items". The following steps have to be performed:

4. Determine the "total of all monitored items", by adding up:

5. The emissions (CO_{2e}) of all source streams using the standard methodology:

    - *The absolute values of all CO_2 streams in a mass balance (i.e., the out-going streams are also counted as positive)*

    - *All CO_2 and CO2e which is determined using a measurement based methodology*

    - *Only CO_2 from fossil sources is taken into account for this calculation. Transferred CO_2 is not subtracted from the total.*

6. Thereafter the operator should list all source streams (including those which form a part in a mass balance, given in absolute numbers) sorted in descending order.

7. The operator may then select source streams which the operator wants to classify "minor" or "de-minimis" source streams, in order to apply reduced requirements to them. For this purpose, the thresholds given below must be complied with.

The operator may select as **minor source streams**: source streams which *jointly* correspond to less than 5000 tonnes of fossil CO_2 per year or to less than 10% of the "total of all monitored items", up to a total maximum contribution of 100000 tonnes of fossil CO_2 per year, whichever is the highest in terms of absolute value.

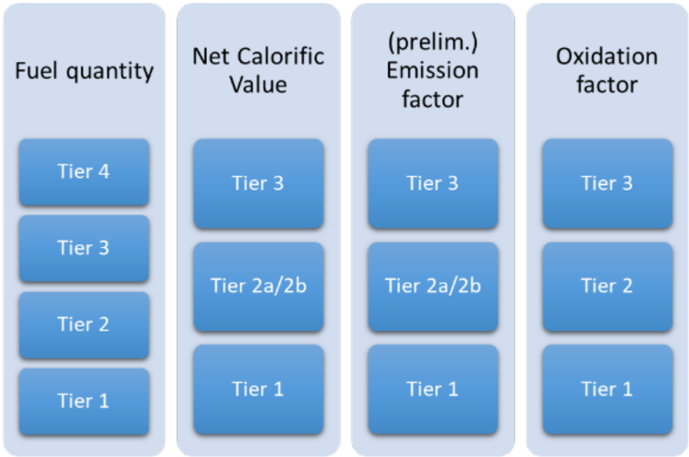
The operator may select as **de-minimis source streams**: source streams which *jointly* correspond to less than 1000 tonnes of fossil CO_2 per year or to less than 2% of the "total of all monitored items", up to a total maximum contribution of 20000 tonnes of fossil CO_2 per year, whichever is the highest in terms of absolute value. Note that the de-minimis source streams are no longer part of the minor source streams.

All other source streams are classified as **major source streams**.

The Tier System

The EU ETS system for monitoring and reporting provides for a building block system of monitoring methodologies. Each parameter needed for the determination of emissions can be determined by different "data quality levels". These "data quality levels" are called "tiers". For each Annex I activity and for each parameter (e.g., fuel quantity, emission factor), Annex II of the MRV Regulation lists all the available tiers. Annex IV of the MRV Regulation describes some Annex I activity specific derogations from those tiers. In general, it can be said that tiers with lower numbers represent methods with lower requirements and being less accurate than higher tiers. Tiers of the same number (e.g., tier 2a and 2b) are considered equivalent. Figure 6.3 summarizes the tiers which can be selected for determining the emissions of a fuel under the calculation based methodologies.

Figure 6.1. Illustration of the tier system for calculation based approaches (combustion emissions)



Source: *European Commission internal elaboration.*

The combination of the category of one installation with the classification of each source stream defines the level of accuracy required for the monitoring of each parameter. Detailed guidelines are provided in Article 26.

Table 6.1 summarizes the full system of tier selection requirements for calculation based approaches. Unreasonable costs which prevent the application of the preferred Tier according to the category of installation and the classification of source streams are defined in Article 18.

Table 6.1. Summary of tier requirements for calculation approaches. Note that this is only a brief overview.

Source stream level	**Category A**	**Category B**	**Category C**
Major	Annex V	Highest	Highest
Major, but technically not feasible or unreasonable costs	up to 2 tiers lower with a minimum of tier 1	up to 2 tiers lower with a minimum of tier 1	1 tier lower with a minimum of tier 1
Major, but still technically not feasible or unreasonable costs; improvement plan (max. 3 year transition)	Minimum tier 1	Minimum tier 1	Minimum tier 1
Minor		highest tier technically feasible and without unreasonable costs (minimum tier 1)	
De-minimis		Conservative estimation, unless a defined tier is achievable without additional effort	

Source: European Commission internal elaboration.

For measurement-based approaches, Article 41 of MRV Regulation describes the analogous tier requirements for emission sources.

MRV specific provisions for InnovFund projects

The general legislative framework concerning the MRV requirements has been outlined in the previous section of the present Appendix. However, it is understood that some elements of the ETS MRV requirements may not be applicable during the planning stage of the installation development and thus may be ignored. For applicants' convenience, indications on the minimum requirements a monitoring plan should contain are included in the GHG calculators. At the reporting stage, all measurements should be conducted with calibrated measurement equipment according to industry standards and in line with relevant EU ETS MRV requirements. Each parameter monitored shall be accompanied with the following information:

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

Specific MRV provisions for the different InnovFund sectors are given below.

1. Energy Intensive Industries

The documentation should include the following elements:

Process diagrams for the "project" and "reference" 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 2.2.4.

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, identification of "de minimis" and "major inputs" following section 1.1.5.

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.

Due to the high heterogeneity of the sector a detailed list of the parameters required to be monitored is not provided here; the applicants are referred to Annex IV of the MRV Regulation. It is also noted that 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.

Further details on the parameters to be monitored for knowledge-sharing purpose are provided in the Knowledge sharing report template available on the Funding and Tenders Portal.

2. Carbon Capture and Storage

Table 6.2 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.

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

Table 6.2. Parameters for monitoring in CCS projects

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 ("L") travelled by road modals
$CO_{2road,L}$	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

Source: European Commission internal elaboration.

In addition to the parameters listed above, further parameters will be monitored for knowledge-sharing purposes: check the Knowledge sharing report template available on the Funding and Tenders Portal.

3. Renewable electricity, heat and cooling

Table 6.3 presents the parameters that, at minimum, shall be monitored throughout the project and be part of the project's monitoring and reporting plan.

Table 6.3. Parameters for monitoring for a renewable electricity, heat and cooling project

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
EG_{cool}	MWh	Net amount of cooling to be generated by the renewable technology	Alternatively, derived from: P_{cool}, PLF, Ty
QFF_stat,	litres or m^3	Quantity of fossil fuel type FF combusted in stationary sources at the project site	
QFF_mob,	litres	Quantity of fossil fuel type FF combusted in mobile sources at the project site	
EC	MWh	Amount of electricity imported from the grid and consumed at the project site	
$M_{steam,}$	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'	

Source: European Commission internal elaboration.

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.

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 use the innovative renewable energy technology).

In addition to the parameters listed above, further parameters will be monitored for knowledge-sharing purposes: check the Knowledge sharing report template available on the Funding and Tenders Portal.

4. Energy Storage

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

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 use the innovative energy storage technology).

Table 6.4. Parameters for monitoring for an energy storage project

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
$R_{services,var}$	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
Estat,x	TJ	Energy of type x used in stationary sources (except	

Data / Parameter	Data unit	Description	Comment
		in the energy storage units) at the project site	
Emob,x	TJ	Energy of type x used in mobile sources at the project site	
Tservices,a	h	Duration of delivery of service a by the project	
Mfug,z	tonnes	Amount of the fugitive emissions of greenhouse gas z at the project site	All six types of GHGs from the Kyoto basket to be included

Source: European Commission internal elaboration.

In addition to the parameters listed above, further parameters will be monitored for knowledge-sharing purposes: check the Knowledge sharing report template available on the Funding and Tenders Portal.

Appendix 5

Definitions [50]

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) '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.

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

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

(13) 'calculation factors' means net calorific value, 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

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

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 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.

(16) 'carbon intensity' is the sum of the stoichiometric carbon content and all emissions from processes in the supply chain.

(17) 'CO_2 capture' means the activity of capturing from gas streams CO_2 that would otherwise be emitted.

(18) 'CO_2 transport' means the transport of CO_2 for use or storage.

(19) 'CO_2e' means the 100 year global-warming potential of a quantity of greenhouse gas emissions, including CO_2 and any other greenhouse gases listed in Annex II to Directive 2003/87/EC (i.e.,CH_4, N_2O, HFCs, PFCs, SF_6), expressed as the equivalent mass of CO_2 emissions.

(20) 'combustion emissions' means greenhouse gas emissions occurring during the exothermic reaction of a fuel with oxygen. Used for calculating the direct carbon emissions for processes in *EU ETS* benchmarks.

(21) '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.

(22) 'emissions direct' from the use of fossil fuels and generation of heat.

(23) '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.

(24) emissions for transport and distribution of products

(25) 'emissions indirect' from the use of grid electricity and grid heat.

(26) 'emissions intensity' is also known, for transport fuels, as well-to-wheels emissions, or complete life-cycle emissions: it comprises combustion emissions, and also all the "upstream" GHG emissions from the supply chain that supplies the product: extraction of raw materials, all steps in the processing, transport and distribution.

(27) 'emissions process-related' from the production of hydrogen, and from transmission losses associated with the grid transport.

(28) 'emission sink'

(29) emissions upstream for the provision (extraction, processing, refining, transport) of fossil fuels

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

(31) '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.

(32) '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 characterised 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.

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

(34) '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.[51] The relevant benchmarks are those applicable at the time of the deadline of submission of the application.

(35) '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.

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

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

(38) '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.

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

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

(41) '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.

(42) '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

[51] 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 10(a) of Directive 2003/87/EC of the European Parliament and of the Council.

provide at nominal conditions. The inertia capability of an energy storage plant is the sum of the inertia capabilities of its energy storage units.

(43) '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.

(44) '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

(45) '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.

(46) '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.

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

(48) '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.

(49) 'modification' see 'retrofit'

(50) '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.

(51) '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

(52) '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

(53) '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.

(54) '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.

(55) '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.

(56) ‘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 plants/units.

(57) ‘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.

(58) ‘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.

(59) ‘reporting period’ means a calendar year during which emissions have to be monitored and reported.

(60) ‘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.

(61) ‘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. Retrofits include measures that involve capital investments and not regular maintenance or housekeeping measures.

(62) ‘Smart grids’ for the purpose of the Innovation Fund include a number of applications which generally involve a self-sufficient electricity network system based on digital automation technology for monitoring, control, and analysis within the supply chain. However, in most use cases they refer to a specific component such as a smart sub-station, an appliance or a communications solution. The reference scenario of proposals should therefore refer to the specific use case.

(63) ‘storage site’ means storage site as defined in Article 3(3) of Directive 2009/31/EC.

(64) ‘substitution’ see ‘replacement’

(65) ‘tonnes of CO_2e’ means metric tonnes of CO_2 or CO_2e.

(66) ‘transport network’ means transport network as defined in Article 3(22) of Directive 2009/31/EC.

(67) ‘vented emissions’ means emissions deliberately released from an installation by provision of a defined point of emission.

(68) ‘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.