# Innovation Fund

## Call for Large-Scale projects 2021

GHG Emission Avoidance – Michele Canova and Aikaterini Konti, JRC

# Agenda

## Afternoon

- 14:00 **Introduction to the afternoon session:** Roman DOUBRAVA
- 14:05 **Relevant costs calculation and methodology:** Christophe DEHOUT and Alexandre COBBAERT

**Q&A**

- 14:50 **GHG calculation and methodology:** Maria VELKOVA (CLIMA), Michele CANOVA and Aikaterini KONTI (JRC)

**Q&A**

- **Next steps and closing of the day** (17.00)

- Main principles of the GHG avoidance methodology and application process
- Energy Intensive Industries, including projects with CCS
- Renewable electricity and heat
- Energy storage
- Production facilities of components for renewable energy and energy storage
- Hybrid projects

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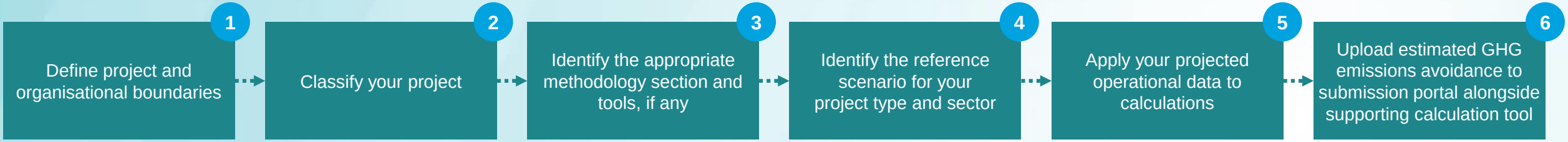
# The GHG emission methodology

## Main principles and application process

# Submitting an application
## Step by step

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# Application of the methodology

- To support applicants quantifying GHG emissions avoidance potential over the first 10 years of operation
- To form the basis of the scoring for the "GHG emission avoidance potential" criterion and cost efficiency
- To serve as KPI for project monitoring and disbursements of grants
- To inform on requirements for knowledge-sharing purposes

**Selection criteria**

Projects will be selected based on:

1. Potential of greenhouse gas emissions avoidance
2. *Degree of innovation*
3. *Project viability and maturity*
4. *Scalability*
5. *Cost efficiency (cost per unit of performance)*

# Absolute and relative GHG emission avoidance

Absolute GHG emission avoidance is the difference between:

- the **emissions that would occur in the absence of the project** (*Ref*), and
- the **emissions from the project activity** (*Proj*)

Timescale: 10-years. Forecasting: emission factor will be fixed for the 10 years of calculation

**Absolute GHG emissions avoidance**

$$\Delta GHG_{abs} = \sum_{y=1}^{10} (Ref_y - Proj_y)$$

**in tonnes $CO_2e$**

**Relative GHG emissions avoidance**

$$\Delta GHG_{rel} = \frac{\Delta GHG_{abs}}{\sum_{y=1}^{10} (Ref_y)}$$

**in %**

# Manifest and clerical errors

## In the context of the Innovation Fund

- Manifest errors are mistakes that can significantly influence the GHG emissions avoidance estimates and, consequently, the result of the evaluation and scoring. Such errors could derive from an incorrect application of the GHG emission guidance, omission or miscalculation. Manifest errors automatically fail the proposal.
- Clerical errors are minor errors, normally caused by inadvertent negligence in the application of formulas, or conversion of units, and that can be easily corrected. Their correction can lead to increasing or decreasing values.

# Boundaries

Boundaries vary depending on the sector of the project
Overall, the methodology is structured with the intention of capturing the most common emission sources, such as for example:

- Fuel combustion in stationary and on-site vehicles
- Fugitive emissions in geothermal power plants and CCS projects
- Emissions from the supply of biomass-based fuels

## Emissions generally excluded (source of manifest and clerical errors)

- Capital goods
- Extraction, processing, refining, distribution and storage of fossil fuel
- Fugitive emissions due to well testing and well bleeding in geothermal power plants
- Biogenic CO2 emissions from combustion of biomass, decomposition or degradation at EoL, processes
- Indirect land use change
- Decommissioning of the power plant and machinery at the end-of-life
- Employee commuting, business travels and waste generation at administrative offices
- Manufacturing process in the sector 'Manufacturing of components for production of renewable energy or energy Storage'.
- Transport in EII (with the exceptions of 1.1.5)

# Annex E Sector classification (1/3)

1. Define project and organisational boundaries
2. Classify your project
3. Identify the appropriate methodology section and tools, if any
4. Identify the reference scenario for your project type and sector
5. Apply your projected operational data to calculations
6. Upload estimated GHG emissions avoidance to submission portal alongside supporting calculation tool

| CATEGORY | SECTOR | PRODUCTS/SERVICES |
|---|---|---|
| **Energy Intensive Industries (EII) - 1/2** | Refineries | fuels (incl. e-fuels, bio-fuels) |
| | Iron & steel | coke<br>iron ore<br>steel<br>cast ferrous metal products<br>other ferrous metal products or substitute products, please specify |
| | 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 |
| | Cement & lime | cement<br>lime, dolime, sintered dolime<br>other cement or lime products or substitute products, please specify |
| | Glass, ceramics & construction material | flat glass<br>container glass<br>glass fibres<br>other glass products<br>tiles, plates, refractory products<br>bricks<br>houseware, sanitary ware<br>other ceramic products<br>mineral wool<br>gypsum and gypsum products<br>other construction materials or substitute products please specify |

# Annex E Sector classification (2/3)

1. Define project and organisational boundaries
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4. Identify the reference scenario for your project type and sector
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| CATEGORY | SECTOR | PRODUCTS/SERVICES |
|---|---|---|
| **Energy Intensive Industries (EII) - 2/2** | Pulp & paper | chemical pulp<br>mechanical pulp<br>paper and paperboard<br>sanitary and tissue paper<br>other paper products or substitute products, please specify |
| | Chemicals | organic basic chemicals<br>inorganic basic chemicals<br>nitrogen compounds<br>plastics in primary forms<br>synthetic rubber<br>other chemical products or substitute products, incl. bio-based products, please specify |
| | Hydrogen | hydrogen |
| | Other | electricity, incl. bio-electricity<br>heat, incl. bio-heat<br>other, please specify |
| **CCS** | choose an EII sector | Annex I product |
| | EII / Other | $CO_2$ Transport |
| | EII / Other | $CO_2$ Storage |

# Annex E Sector classification (3/3)

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| CATEGORY | SECTOR | PRODUCTS/SERVICES |
|---|---|---|
| **Renewable energy** | Wind energy | electricity |
| | Solar energy | electricity<br>heating<br>cooling |
| | Hydro/Ocean energy | electricity |
| | Geothermal energy | electricity<br>heating<br>cooling |
| | Use of renewable energy outside Annex I | please specify |
| | Manufacturing of components for production of renewable energy | please specify |
| **Energy storage** | Intra-day electricity storage | electricity |
| | Other energy storage | electricity<br>heating<br>cooling<br>e-fuels<br>hydrogen |
| | Manufacturing of components for production of energy storage | batteries and their sub-components<br>recycling of materials for production of batteries<br>other, please specify |

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## Examples

| 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**<br>**Waste to energy with CCS** | EII / Other |
| **DAC with CCU**<br>**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”.<br>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”.<br>Such a project can be eligible due to size, i.e. if using more than 20 MWth, then the sector can be EII / Other. |

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**Energy-intensive industries**, including CCU and biofuels, substitute products

**Carbon capture** and **storage**: covered under section 3 but projects classified under relevant EII or RES sector

Production and use of **renewable electricity, heat and cooling**, including plants for the manufacturing of RES components

**Energy storage** including plants for the manufacturing of ES components

## Annex C

Includes:

- Scope
- System boundaries
- Absolute and relative GHG emissions avoidance
- Data and parameters: *default values to be used*
- In appendix: monitoring, reporting and verification of performance: *for disbursement and for knowledge-sharing purposes*

## Annex E

- Sector classification

+ GHG calculators

+ Examples

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# Choice of a sector

**The main aim of the project may determine the sector and the reference emissions**

2a) **if one principal product**: the choice is straightforward: e.g. wind energy or cement production
…but may be influenced by the use: e.g. ethanol can be used in chemicals or as a fuel (refineries)

2b) **if more than one principal product but all in the same sector**: also straightforward: e.g. different chemicals (chemicals) or fuels (refineries)

2c) **if principal products from 2 or more sectors**: choose one of the sectors of the principal products

*Example:* a project produces hydrogen with electricity: if the main aim of the project is
… **to store otherwise curtailed renewable electricity**, the sector is 'energy storage'
… **to produce as much hydrogen as possible**: then the sector is 'hydrogen' under EII and the reference is EU ETS benchmark for hydrogen
… **to produce hydrogen for transport applications**: sector still hydrogen under EII but reference is fossil fuel comparator for the transport fuel displaced
… if it is **combined with innovative renewable electricity**: then either 'renewable electricity' or 'energy storage' or hybrid project

# Hybrid projects – general indications

*Applicants may combine activities related to two or three eligibility categories (energy-intensive industry, renewable energy sources, energy storage), to be referred to as hybrid projects.*

*Projects with products under the EII eligibility category or producing energy under RES and capturing the $CO_2$ generated, combine the EII component following the section 2 or section 4 (RES) and the CCS component of the project following section 3, whilst removing any double counting. These would not be hybrid projects though as they would be classified under EII or RES.*

- **Absolute GHG emission avoidance**: calculate separately using respective sections of the methodology and add them up, while removing double counting of avoidance and/or emissions, if any.

- **Relative GHG emission avoidance**: calculate based on the added-up absolute emission avoidance and the added-up reference emissions

**source of manifest and clerical errors**

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$$\Delta GHG_{abs} =$$

**EII:**
$$= \sum_{y=1}^{10} \left( Ref_{inputs,y} + Ref_{processes,y} + Ref_{products,y} + Ref_{EoL} - (Proj_{inputs,y} + Proj_{processes,y} + Proj_{products,y} + Proj_{chnage\_use} + Proj_{EoL}) \right)$$

**CCS:**
$$= \sum_{y=1}^{10} \left( Ref_{release,y} - ( Proj_{capture,y} + Proj_{transport\ pipeline,y} + Proj_{injection,y} + Proj_{transport,y}) \right)$$

**RES:**
$$= \sum_{y=1}^{10} \left( Ref_{electricity\ or\ heat,y} - ( Proj_{bio,y} + Proj_{geo,y} + Proj_{on\text{-}site,y} ) \right)$$

**ES:**
$$= \sum_{y=1}^{10} \left( Ref_{energy,y} + Ref_{services,y} - ( Proj_{energy,y} + Proj_{on\text{-}site,y} ) \right)$$

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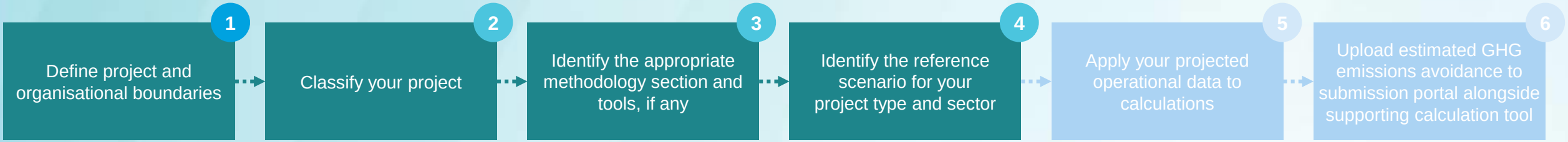
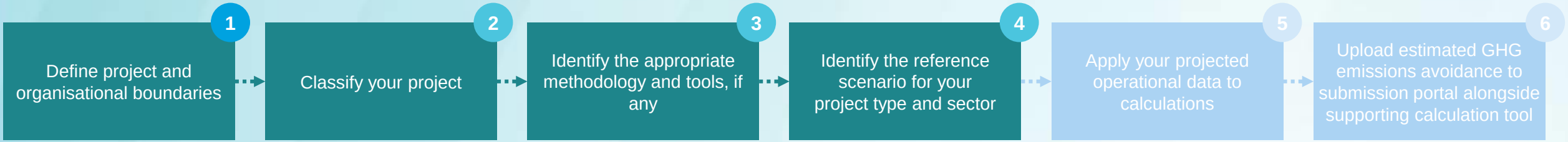



## Reference scenario: The GHG emissions that would occur in the absence of the project are calculated based on the assumption that the product would be delivered under the following circumstances (1/2): (source of manifest and clerical errors)

| Eligibility category / Sectors / products | Reference scenario |
|---|---|
| Energy intensive industry | Frequent cases are based on EU ETS benchmark(s) and/or fossil fuel comparators (FFCs).<br>If the reference cannot be constructed by combination of benchmarks and/or FFCs and/or other predefined references as indicated in the methodology, then applicants should build an appropriate reference scenario |
| EII / Refineries / Biofuels | Adapted fossil fuel comparators from REDII |
| EII with CCS | $CO_2$ is not captured, but released/available in atmosphere |
| RES / Renewable electricity; EII/bio-electricity; (non dispatchable) and EII electricity saving projects | Expected 2030 electricity mix (0.1757 $tCO_2e/MWh$) |
| RES / Renewable heat; EII/bio-heat | Natural gas boiler (0.202 $tCO_2e/MWh$) |
| RES / renewable cooling | Expected 2030 electricity mix (0.1757 $tCO_2e/MWh$) |




## Reference scenario: The GHG emissions that would occur in the absence of the project are calculated based on the assumption that the product would be delivered under the following circumstances (2/2): **(source of manifest and clerical errors)**

| Eligibility category / Sectors / products | Reference scenario |
|---|---|
| ES / Energy storage; RES / Dispatchable renewable electricity | Single-cycle natural gas turbine (used for peaking power) (140 $tCO_2e$/TJ or 0.504 $tCO_2e$/MWh) |
| ES / Electricity grid services | Combined-cycle natural gas turbine (partial load) |
| ES / Heat | ETS benchmark for heat (47.3 t $CO_2e$/TJ) |
| ES / Hydrogen storage | ETS benchmark for hydrogen production (48.2 t $CO_2e$/TJ or 6.84 t $CO_2e$ / tonne H2) |
| Energy storage in vehicles | Diesel-fuelled internal combustion engine (222.3 $tCO_2e$/TJ or 800 $tCO_2e$/MWh) |

# Emission factors for the production, use and/or storage of grid electricity (Table 1.3)

| | 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** | 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 $tCO_2e/MWh$] $EF_{electricity,ref}$ |
| **Timed electricity demand (see section 2.2.6.4.7):** | 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 $gCO_2e/MJ$ |
| **Renewable electricity (non-dispatchable), heat and cooling** | Net amount of electricity generated by the renewable technology and fed into the grid | 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 $gCO_2e/MJ$ $EF_{electricity,proj}$ |
| **Energy storage Dispatchable renewable electricity** | Net amount of 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 $gCO_2e/MJ$ $EF_{in}$ |

* *Electricity is treated as zero carbon assuming full decarbonisation of the electricity mix by 2050*

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## Tools have been made available to support the calculation in the various sectors

Summary

This is a Pivot Table. As such, changes you make to the data set are not automatically picked up by it.

To update the pivot table with the applied changes to the text or numbers in your data set, you need to refresh it: (1) Click any cell inside the pivot table. (2) Right click

| Row Labels | Sum of t CO2e |
|---|---|
| Refinputs | |
| Refprocesses | |
| Refproducts | |
| Refuse | |
| RefEoL | |
| Grand Total | |

**Reference emissions calculation**

**Note: for many projects the reference emissions for processes will be based on an EU ETS benchmark, fossil fuel comparator or other natural-gas-base disaggregate process emissions, and may be no emissions in the inputs, products, use or end of life boxes. Note that there may still be input emissions**

| | | | | | | | Projected operational data | | |
|---|---|---|---|---|---|---|---|---|---|
| Source | Plant / Unit | Process | Input | Output | Parameter monitored | Description of parameter | Data unit | Year 1 | Year 2 |
| **Inputs** *[add rows and column, as needed]* | | | | | | | | | |
| $Ref_{inputs}$ | | | | | | | | | |
| $Ref_{inputs}$ | | | | | | | | | |
| $Ref_{inputs}$ | | | | | | | | | |
| **Processes** *[add rows and column, as needed]* | | | | | | | | | |
| $Ref_{processes}$ | | | | | | | | | |
| $Ref_{processes}$ | | | | | | | | | |
| $Ref_{processes}$ | | | | | | | | | |
| **Products** *[add rows and column, as needed]* | | | | | | | | | |
| $Ref_{products}$ | | | | | | | | | |
| $Ref_{products}$ | | | | | | | | | |

## ETS benchmarks and other relevant emission factors already part of the database

| GHG emission factors, and other conversion factors for calculation of reference emissions | | | | |
|---|---|---|---|---|
| **Type of data** | **Description** | **Fuel / Feedstock / Product** | **Proposed value** | **Data unit** |
| **Default factors** | | | | |
| ETS Product benchmarks | Coke-oven coke (obtained fro | Coke | 0.217 | tCO2e / t |
| ETS Product benchmarks | Agglomerated iron-bearing pro | Sintered ore | 0.157 | tCO2e / t |
| ETS Product benchmarks | Liquid iron saturated with carb | Hot metal | 1.288 | tCO2e / t |
| ETS Product benchmarks | Anodes for aluminium electroly | Pre-bake anode | 0.312 | tCO2e / t |
| ETS Product benchmarks | unwrought non-alloy liquid alu | Aluminium | 1.464 | tCO2e / t |
| ETS Product benchmarks | Grey cement clinker as total cl | Grey cement clinker | 0.693 | tCO2e / t |
| ETS Product benchmarks | White cement clinker for use a | White cement clinker | 0.957 | tCO2e / t |
| ETS Product benchmarks | Quicklime: calcium oxide (CaC | Lime | 0.725 | tCO2e / t |
| ETS Product benchmarks | Dolime or calcined dolomite as | Dolime | 0.815 | tCO2e / t |
| ETS Product benchmarks | Mixture of calcium and magne | Sintered dolime | 1.406 | tCO2e / t |
| ETS Product benchmarks | Float/ground/polish glass (as t | Float glass | 0.399 | tCO2e / t |
| ETS Product benchmarks | Bottles of colourless glass of a | Bottles and jars of colourless g | 0.290 | tCO2e / t |
| ETS Product benchmarks | Bottles of coloured glass of a r | Bottles and jars of coloured gla | 0.237 | tCO2e / t |
| ETS Product benchmarks | Melted glass for the productior | Continuous filament glass fibre | 0.309 | tCO2e / t |
| ETS Product benchmarks | Facing bricks with a density > | Facing bricks | 0.106 | tCO2e / t |

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# Transport emissions

- Transport emissions should be considered in the following cases:
  - CO2 transport associated emissions in projects including a CCU or CCS element.
  - Reference scenario for one or more of its principal products is based on a physically different product that is used for a comparable function => the project emissions must include any emissions associated with distributing that principal product to the point of use.
  - Biomass or waste materials are used 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. Applicants may use actual values or values given in the methodology

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| Key indicators | Description | Value | Data unit | |
|---|---|---|---|---|
| Absolute GHG emission avoidance (ΔGHGabs) | Net absolute GHG emissions avoided thanks to operation of the project during the first 10 years of operation | 0 | tCO2e | Application Form B |
| Relative GHG emission avoidance (ΔGHGrel) | Relative GHG emissions avoided due to operation of the project during the first 10 years of operation | 0 | % | |
| GHG emissions in reference scenario (Ref) | GHG emissions that would occur in the absence of the project during the first 10 years of operation | 0 | tCO2e | Application Form C |
| GHG emissions in project scenario (Proj) | GHG emissions associated with the project activity and site during the first 10 years of operation | 0 | tCO2e | |
| Average GHG emissions intensity of the installations to produce a unit quantity of principal product in the reference scenario, or EU ETS | Principal product 1 | | tCO2e / unit quantity of principal product 1 *[Please replace with adequate unit]* | Knowledge Sharing |
| | Principal product 2 | | tCO2e / unit quantity of principal product 2 *[Please replace with adequate unit]* | |
| | Principal product 3 | | tCO2e / unit quantity of principal product 3 *[Please replace with adequate unit]* | |
| Average GHG emissions intensity of the installations to produce a unit quantity of the principal product in the project scenario | Principal product 1 | | tCO2e / unit quantity of principal product 1 *[Please replace with adequate unit]* | |
| | Principal product 2 | | tCO2e / unit quantity of principal product 2 *[Please replace with adequate unit]* | |
| | Principal product 3 | | tCO2e / unit quantity of principal product 3 *[Please replace with adequate unit]* | |

**Best practices**: a structured and tidy summary table is expected to facilitate transferring results to the forms, and reduce mistakes in the calculation of reference emissions for projects with multiple products

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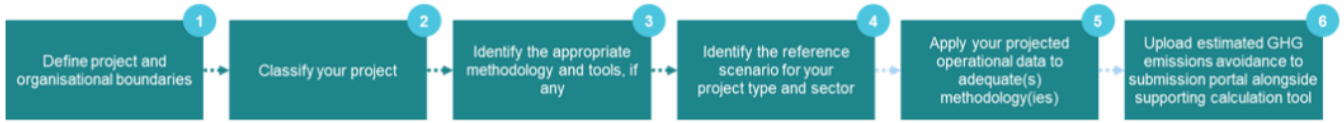
# Examples | Hypothetical examples are available to illustrate the use of the tool for each project category

**Large Scale projects: Example of calculation of GHG emission avoidance (EII) - methanol (Version 1.0 - 18 March 2021)**




**Context of project and organisational boundaries**

The project foresees the construction of a biomass gasifier and electrolyser to feed a methanol synthesis unit. The plant will use biomethane as the main gasifier feed, plus grid electricity and a fossil natural gas boiler for heat. The syngas from the gasifier will be complemented in the methanol synthesiser fee
The projected production is 100,000 t methanol per year once the facility reaches full capacity (projected for year 3).
The reference scenario for methanol production is given in the GHG avoidance methodology - an emission factor of 82.5 gCO2e/MJ may be used.
The project scenario includes several inputs, several processes, and end of life emissions from disposal of the methanol. There are no additional non-principal products or changes in in-use emissions.

**Classification**

Category: Energy Intensive Industry
Sector: Chemicals
Product: organic basic chemicals (methanol)

**IF Methodology**

EII, Section 2 of IF LSC GHG Methodology

**Reference scenario**

**As stated in the GHG avoidance methodology for the energy intensive industries, the reference scenario for methanol may be based on the estimated GHG intensity of production of methanol from natural gas, given in the methodology as 82.5 gCO2e/MJ.**
**There is no ETS benchmark for standalone methanol production. The ETS refinery benchmarks include methanol production units but these refinery sub-units are not relevant for the IF.**

**Application of projected operational**

**Tab "Reference emissions":**

| | Sum of t CO2e |
|---|---|
| Refinputs | - |
| Refprocesses | 1,518,618.8 |
| Refproducts | - |
| Refuse | - |
| RefEoL | - |
| **Grand Total** | **1,518,618.8** |

| Projected operational data | | | | | | | | | | | | | | | | | | GHG emissions due to production in the reference | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Source | Plant / Unit | Process | Input | Output | Parameter monitored | Description of parameter | Data unit | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Type of data | Value | Unit / t product | t CO2e / [unit] | t CO2e | C |
| Processes *[add rows and column, as needed]* | | | | | | | | | | | | | | | | | | | | | | | |
| $Ref_{processes}$ | Methanol plant | Methanol production | Natural gas | Methanol | Methanol output | Tonnes of methanol produced | tonnes | 50,000 | 75,000 | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 | Other natural-gas-based fossil defaults | 19.90 | GJ | 0.0825 | 1,518,619 | Th all en hi ref |

# Monitoring Plan

| Projected operational data | | | | | | | | | GHG emissions due to production in the reference scenario | | | | | Data traceability<br>Provide a brief description of your monitoring plan. It may include procedures for data collection procedures (information on how the parameters are measured/calculated, aggregated, recorded, calculated, checked/reviewed and reported), as well as roles and responsibilities. You may include diagrams showing all relevant monitoring points. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Source | Plant / Unit | Process | Input / Output | Parameter monitored | Description of parameter | Data unit | Year 1 | Year 10 | Type of data | Value | Unit / t product | t CO2e / [unit] | t CO2e | Area / Department for collection and archiving | Data source | If applicable, equipment used for monitoring, including details on accuracy and calibration | Monitoring frequency | QA/QC Procedures | Additional description of the monitoring system | Reliability |
| Inputs *[add rows and column, as needed]* | | | | | | | | | | | | | | | | | | | | |
| $Ref_{inputs}$ | | | | | | | | | | | | | | | | | | | | |
| $Ref_{inputs}$ | | | | | | | | | | | | | | | | | | | | |
| $Ref_{inputs}$ | | | | | | | | | | | | | | | | | | | | |
| Processes *[add rows and column, as needed]* | | | | | | | | | | | | | | | | | | | | |
| $Ref_{processe}$ | | | | | | | | | | | | | | | | | | | | |

**Data traceability**

**Provide a brief description of your monitoring plan. It may include procedures for data collection procedures (information on how the parameters are measured/calculated, aggregated, recorded, calculated, checked/reviewed and reported), as well as roles and responsibilities. You may include diagrams showing all relevant monitoring points.**

| Area / Department responsible for collection and archiving | Data source | If applicable, equipment used for monitoring, including details on accuracy and calibration | Monitoring frequency | QA/QC Procedures | Brief description | Reliability |
|---|---|---|---|---|---|---|

- Applicants have been advised to fill in the columns for data traceability information under the Reference & Project emissions of the respective tools with detailed, complete and transparent documentation of the parameters used in calculations and data sources

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# Assumptions | Applicants are required to document quantitative and qualitative assumptions used in the calculations

Quantitative assumptions

| Data / Assumption | Proposed value | Data unit | Description | Basis or source of the assumption | Hyperlink to the original source, if applicable | Brief description of the monitoring plan | Area / Department responsible |
|---|---|---|---|---|---|---|---|
| *Example: Share of organic waste in the MSW incinerated in project* | *0.00%* | *%* | *Solid waste composition* | *Conservative assumption by the applicant to avoid possible overestimation of GHG emission avoidance claims* | | | |
| | | | | | | | |
| | | | | | | | |

[add or exclude rows and columns, as needed]

Qualitative assumptions

| Data / Assumption | Description | Basis or source of the assumption | Hyperlink to the original source, if applicable | Brief description of the monitoring plan | Area / Department responsible |
|---|---|---|---|---|---|
| *Example: No demand for offshore service vessels* | *No demand for offshore service vessels as O&M will be performed using drones* | *Based on project planning, and best practices in year 2020.* | Project Planning_O&M | | |
| | | | | | |
| | | | | | |

[add or exclude rows and columns, as needed]

**Best practices**: a transparent documentation of methods and secondary data used to extrapolate/estimate the operational data allow for a more effective review of the robustness of data adopted, e.g., check whether the characteristics of the proposed plant are credible and in line with basic engineering principles, or whether these have these been selected in a conservative yet accurate manner, i.e., to avoid under/over estimation

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# Checklist | Applicants shall prepare their submission in line with the best practices

The document has been built based on the experience gathered from previous calls, the common mistakes identified as well as the best practices followed by applicants. This tab is made available to applicants to self-assess whether they are following the best practices in calculating and presenting GHG emission avoidance in order to eliminate possible mistakes.

Checklist for self-assessment of accordance with best practices

| | | | Yes / No / NA |
|---|---|---|---|
| 1 | Alignment with the methodology | Have the GHG calculations been submitted in an excel sheet that mirrors the GHG methodology, using the same terminology for GHG emission sources and activities within the scope of the given sector? (Please note that an excel template now exists also for energy intensive industries.) Any deviations are explained clearly and justified. | |
| 2 | Alignment with the methodology | Have ONLY emissions inside the scope of the IF GHG avoidance criteria been considered for the final emissions calculation? (GHG savings that could be claimed under Net carbon removals and other GHG savings should be indicated separately, see next point.) | |
| 3 | Alignment with the methodology | In case the project presents benefits which are out of the scope of the IF GHG emission avoidance criterion, has an excel-based calculation of these additional benefits with respect to GHG emission avoidance been provided? Does the calculation of the additional GHG emission avoidance follow the logic of the IF GHG emission avoidance methodology? Have you presented the additional calculations in the separate tabs 'Other GHG emission avoidance' and "net carbon removals"? Have you referred to the excel file/tabs, when presenting the additional benefits under "Net carbon removals, other GHG savings" in Application Form B? | |
| 4 | Alignment with the methodology | Have sufficient data and explanations to fully explain the project, its boundaries and its interactions with other installations been provided? Have the data used and methods adopted to estimate the GHG emissions and emission factors been documented in a transparent manner, creating a clear verification trail? Have you provided information sources and hyperlinks to the original reference in the application files? | |
| 6 | Alignment with the methodology | Have the principal product(s) and the reference products they substitute been identified? Do the principal product(s) represent the main objective of the project? Are the principal product(s) all in the same sector? | |
| 7 | Alignment with the methodology | For projects with multiple products, have ONLY the GHG emissions attributed to the chosen “principal products” been considered in the reference emissions when calculating the RELATIVE GHG emission avoidance? (please note that whilst all emissions in the reference scenario shall be considered for the absolute avoidance calculation, ONLY emissions of PRINCIPAL PRODUCTS in the reference scenario shall be considered for the relative avoidance calculation) | |
| 8 | Alignment with the methodology | In case an EU ETS benchmark is used, are these values up to date? The EU ETS benchmarks have been updated in Implementing Regulation 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. | |

# Differences between the 1st and 2nd calls – 1/2

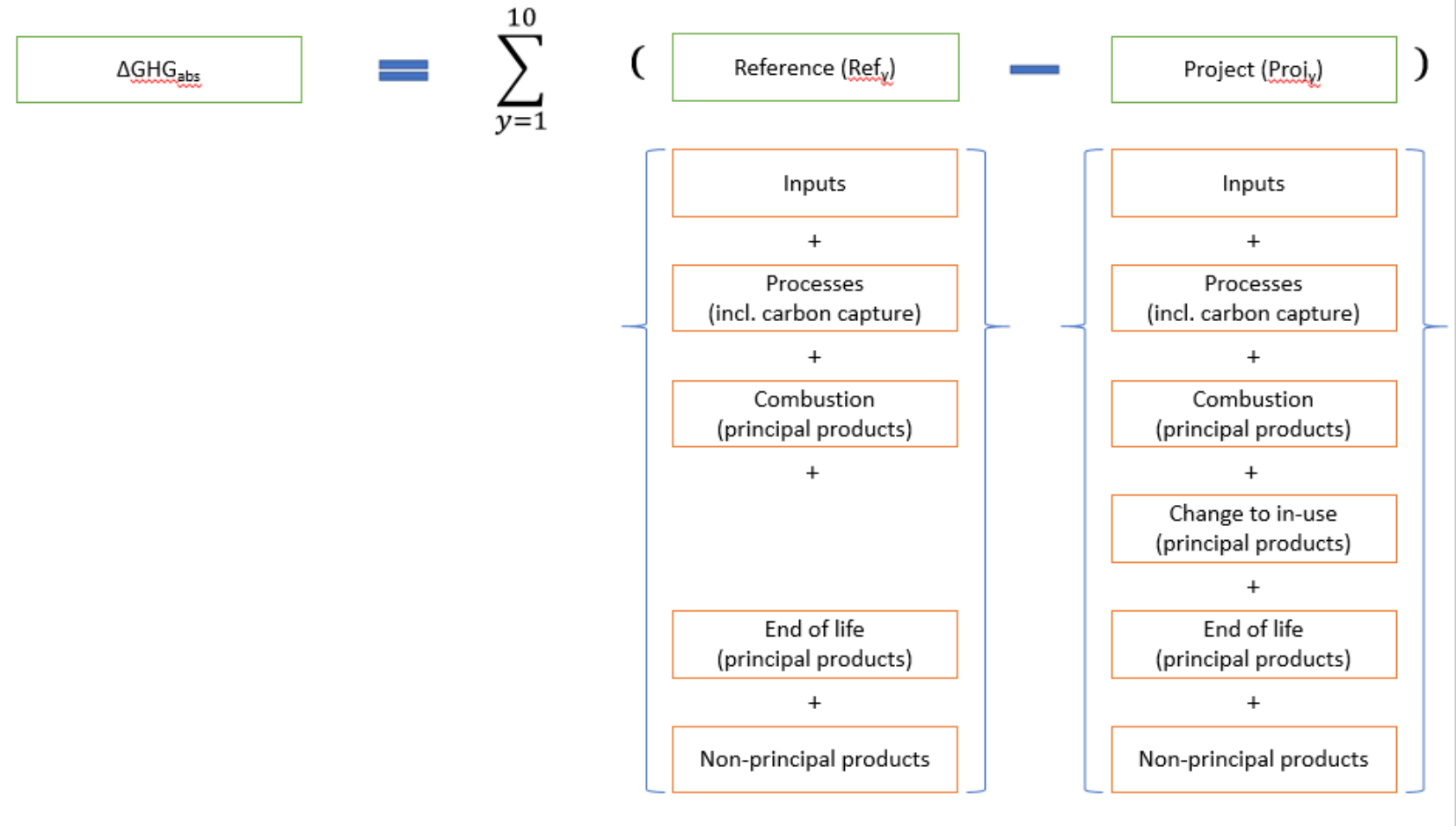
- Classification of sectors is now placed as a separate Annex E, see previous slides, including with the following changes:
  - Deletion of CO2 transport and storage, Bio-electricity, Bio-fuels and bio-refineries and Renewable heating and cooling sectors (but no change in the calculations).
  - All CCS projects have to choose an EII or RES sector;
  - Bio-electricity and bio-heat projects choose EII/Other (but their calculation approach still follows section 4)
  - Biofuels projects choose Refineries, Bio-refineries choose Refineries, Chemicals, Paper or Pulp depending on principal product(s)
  - Renewable heating and cooling choose Renewable energy sector depending on the source.

# Differences between the 1st and 2nd calls – 2/2

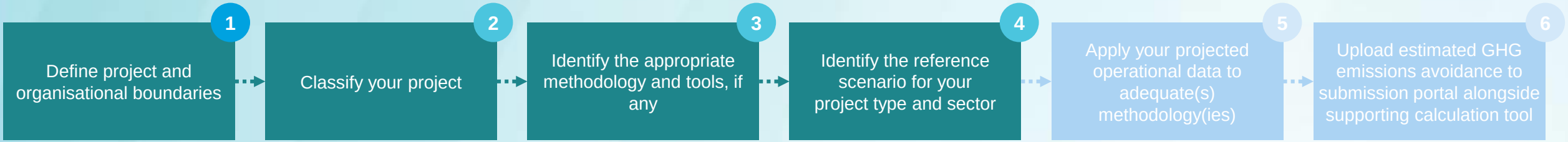
- New sectors (as for classification): Manufacturing of components for production of renewable energy or energy storage and Use of renewable energy outside Annex I.
- Net carbon removal projects: clarification added, a specific slide with explanations included in the tool:
  - negative total project emissions;
  - credit for timed operation does not count;
  - non-principal products are not allowed to be the only source of negative emissions.

# Energy-intensive industries, incl. substitute products, bio-refineries and CCU

# Energy-intensive industries

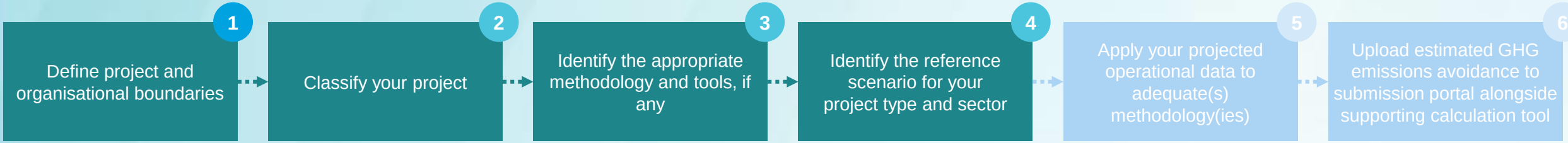



Note that the diagram is different from previous versions of the methodology




## Seven basic cases:

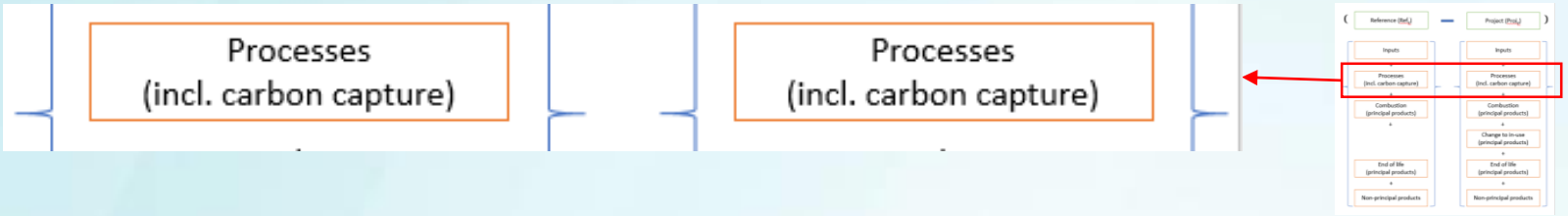
1. An EU ETS product benchmark corresponding to production of the principal product exists => **benchmarks should be the basis for the reference scenario**.
2. Possible to construct an appropriate reference scenario **by combining EU ETS heat, fuel and/or process sub-installations with an existing EU ETS product benchmark**.
3. 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). Manifest error example: Replacing a SMR with an electrolyser does not qualify as a modification of an existing plant. The EU ETS benchmark should be used as a reference and not the existing plant.
4. Principal product is a transport fuel substitute =>reference scenario should be based on the **IF fossil fuel comparator values**.




## Seven basic cases:

5. Principal product is a natural gas substitute => reference scenario should be based on the **combustion emissions intensity of natural gas**.
6. In the reference scenario the principal product is 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 => **this value should be the reference scenario emissions for the principal product (subtracting 15% for upstream emissions)**
7. 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.

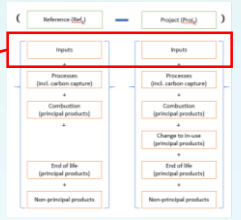
# Processes




- Process emissions within the project boundaries in both scenarios to produce the same quantity of the principal products or deliver an equivalent function.
- Projects with CCS: the full amount of CO2 generated by the project should be included as a positive emission term or as zero (biogenic CO2), even though some of this CO2 is to be captured. The CCS credit calculated according to the methodology in section 3 shall be included as a separate negative emission term.
- Projects with CCU: Need to demonstrate that the captured CO2 will be used. As for CCS, the full amount of CO2 generated by the project should be included as a positive emission term or as zero (biogenic CO2), even though some of this CO2 is to be captured. All emissions associated with capture, transport and incorporation of the CO2 (negative term) into a product should also be fully accounted as a separated term in this box.
- Possible manifest error: identifying as co-principal products, non-principal products and calculating process emissions in the reference scenario

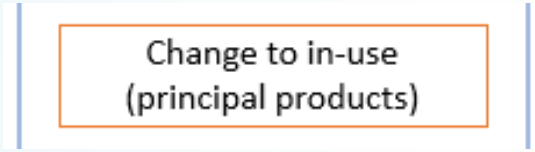
Possible manifest error: identifying as co-principal products, non-principal products and calculating process emissions in the reference scenario

# Inputs

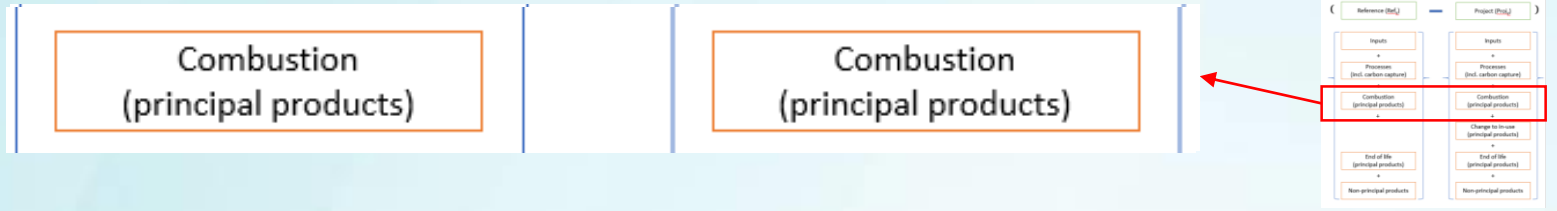
- Include the inputs that enter the system boundary associated with the processes boxes. Include both energy and material inputs.
- Use emission factors from **data hierarchy**. Do not use EU ETS benchmarks for inputs emissions or own estimated EF which inflate the reference emissions (manifest errors).
- EU ETS benchmarks do not generally include inputs emissions→ add them in inputs box of reference scenario.

# Change to in-use



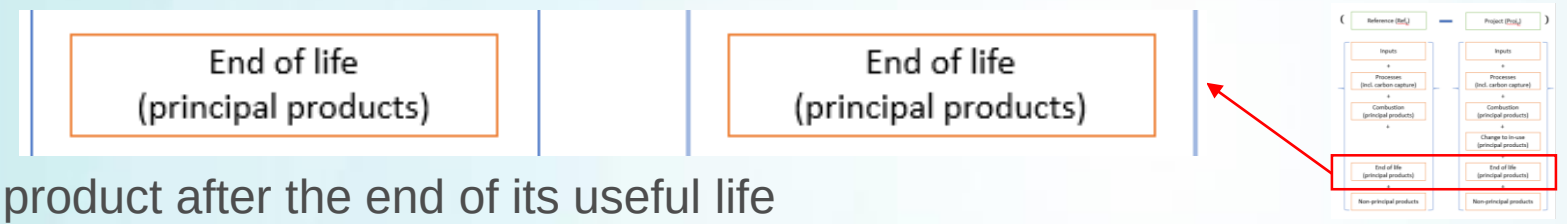

- Allows to claim credit when the characteristics of innovative products may save emissions in the use phase of the principal product (e.g.: innovative nitrogen compound to use as fertilizer that reduce $N_2O$ emissions compared to conventional nitrogen fertilizers).
- Need to be **well justified** and based on a realistic use case.
- Savings must be **enabled directly by the properties of the produced product** (not used as input for a second product that will deliver the in-use savings)

# Combustion




- If principal products are combusted for energy purposes (e.g.: novel transport fuels, fuel additives, solid fuels and natural gas substitutes), include combustion emissions in this box.
- Novel transport fuels: the IF fossil fuel comparator includes already combustion emissions for the reference scenario. In the project scenario, include the stoichiometric combustion emissions in the combustion box.

# End of life




- Disposal or recycling of a principal product after the end of its useful life
- If carbon is incorporated in the material on a long-term basis (≥ 50 years), 50% of the $CO_2$ emissions from stoichiometric combustion may be included in this box.
- Combustion/end of life emissions for CCU products are not affected by the source of the captured $CO_2$. However, combustion and end of life emissions associated with carbon that enters the project boundaries in biogenic inputs other than captured $CO_2$ are counted as zero as normal.

Possible manifest error: include a credit for the avoided primary polymer production due to increased recyclability

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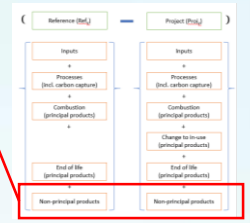

# Non-principal products

- Co-products produced when producing the same quantity of principal products or deliver an equivalent function in the reference and project scenarios. Non-principal products are outside the project boundaries.
- Only claimed in the scenario, in which they are produced.
- Use emission factors from data hierarchy. Frequent error: use of combustion only EF
- A credit (negative emissions term) should be included in this box calculated as:

= ( -1) * (quantity of non-principal product) * (emission factor of that product)

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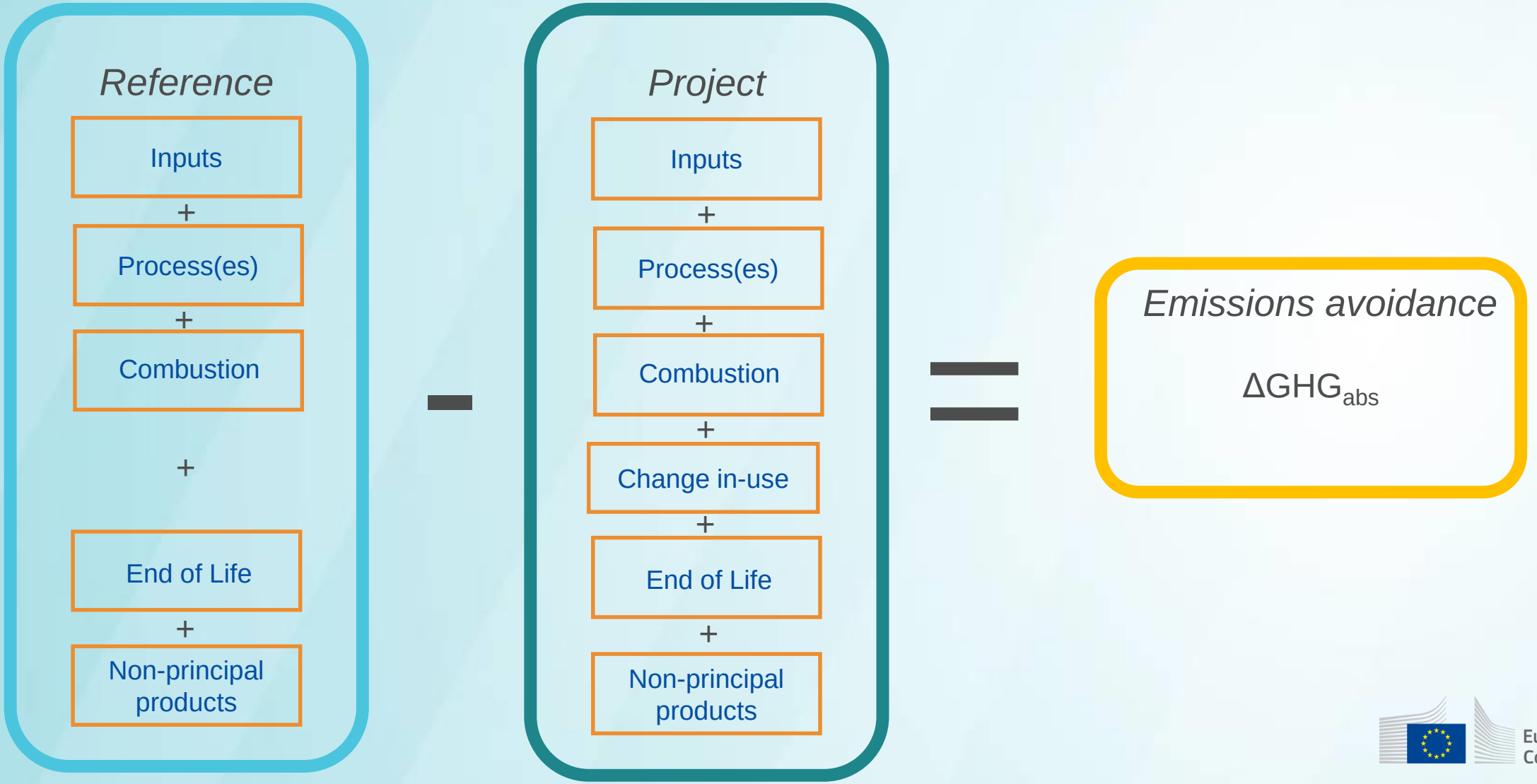
# Energy-intensive industries Calculation examples

# Example: Green Hydrogen

- The following example intends to show important aspects of how the methodology works in practice. The slides are included purely for illustrative purposes
  - Consider a project to produce Green Hydrogen. Note this;
    - Falls within Energy Intensive Industry
    - Hydrogen as the only (and therefore principal) product
    - The sector (Annex E) is hydrogen
    - Assume hydrogen is supplied for industrial use
- Based around NREL model for “Future Central Hydrogen Production from Solid Oxide Electrolysis” (B. James, D. DeSantis, J. Moton, G. Saur; http://www.hydrogen.energy.gov/h2a_production.html)

# GHG Avoidance Schematic

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# Identify Processes and Inputs

*Reference*

- Inputs
- \+
- Process(es)
- \+
- Combustion
- \+
- End of Life
- \+
- Non-principal products

| Process(es) | Inputs |
|---|---|
| **ETS benchmark for hydrogen** | None |

*Project*

- Inputs
- \+
- Process(es)
- \+
- Combustion
- \+
- Change in-use
- \+
- End of Life
- Non-principal products

| Process(es) | Inputs |
|---|---|
| electrolysis | power (if not a process)<br>water<br>heat (for high temperature electrolysis) |

Power generation?

Renewable power production could be placed within the project boundary as a process, or outside the boundary as an input

Emission factor for electricity consumed is zero either way (assumed 2050 grid electricity GHG intensity)

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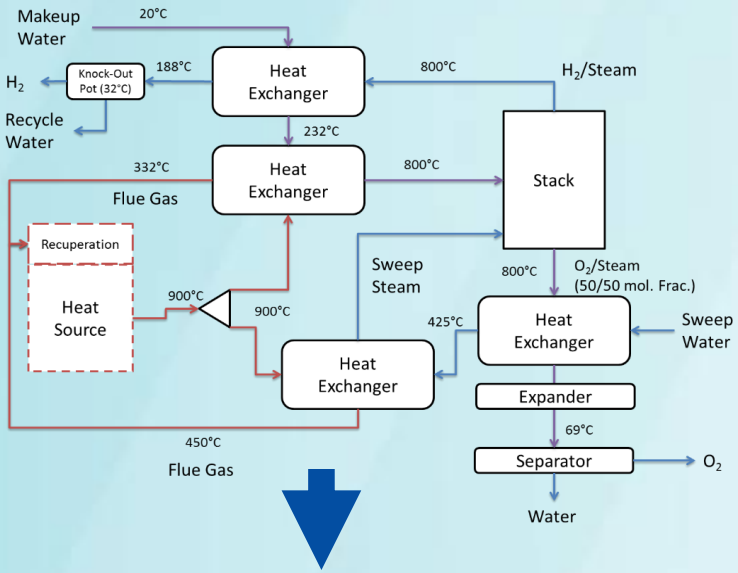
# Focus on Heat

- Heat is required for high temperature electrolysis. Options:
  - Heat generated by direct fossil fuel combustion -> include those combustion emissions as part of electrolysis process -> no heat as an ‘input’
  - Heat supplied from outside the project unit -> identify source and assess as an input
    - Heat as by-product from other process -> treat as rigid input, identify any emissions due to diversion
    - Otherwise, treat heat as elastic input, assess actual GHG emissions of heat generation

# Process(es) Boxes

## Project




Input 1: power

Input 2: water

Input 3: heat

installation 1: electrolyser

Product 1: hydrogen

## Reference

installation 1: ETS benchmark for hydrogen

Product 1: hydrogen

## Emissions avoidance

$$\Delta GHG = GHG_{ETS\ H2} - GHG_{electrolyser}$$

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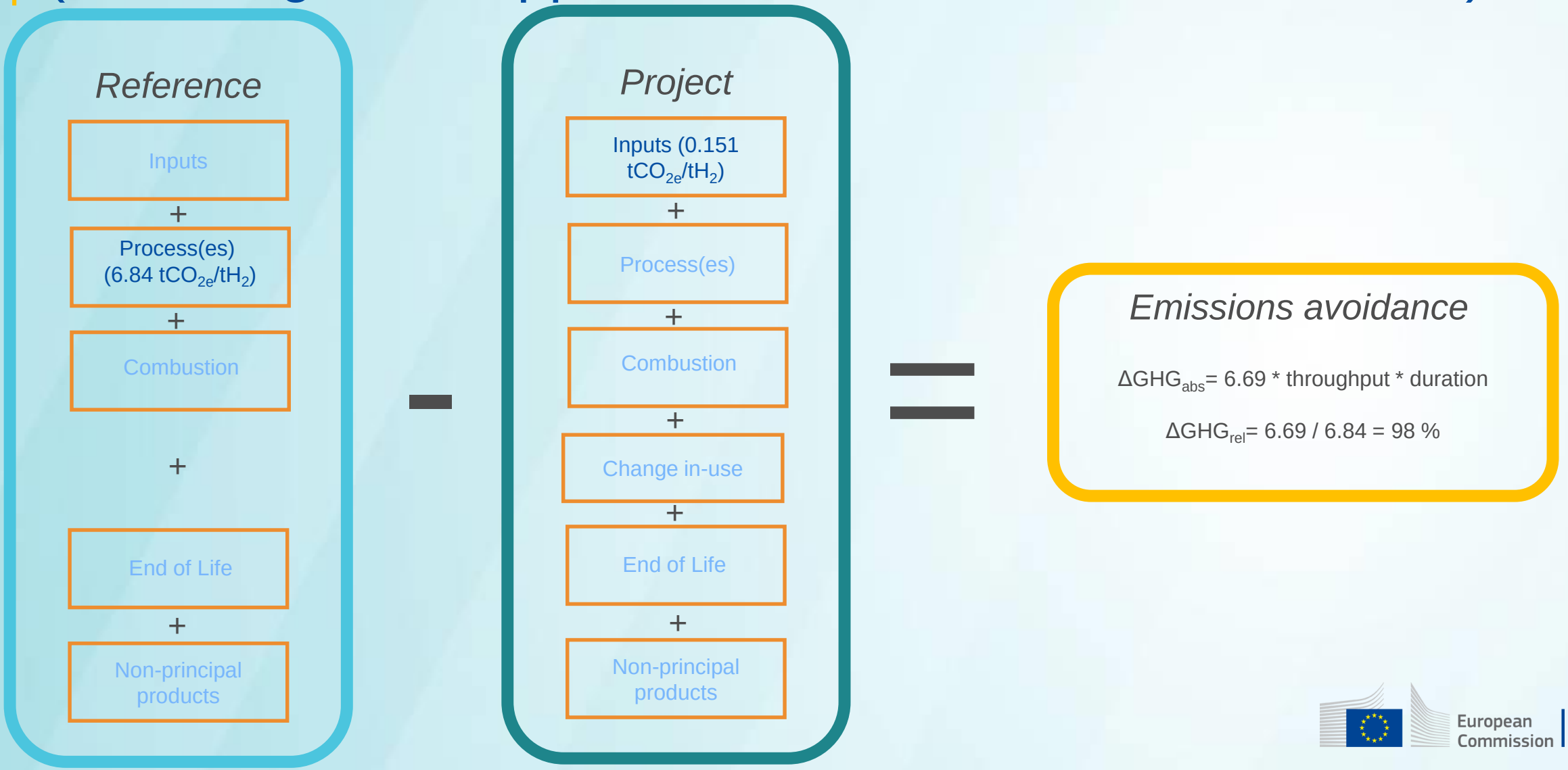
# Emissions for Processes and Inputs

- **Reference**
  - Process 1, ETS benchmark for hydrogen: 6.84 $tCO_2e/tH_2$
- **Project**
  - Input 1, power: 0 $tCO_2e/tH_2$
  - Input 2, water: “emissions for water provision may be neglected”
  - Input 3, heat: must assess GHG intensity (ETS heat benchmark is 47.3 $tCO_2e/TJ$ × 0.0032 $TJ/tH_2$ = 0.151 $tCO_2e/tH_2$)

# Overall Change in Emissions
## (assuming heat supplied at ETS benchmark GHG value)

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# Variation 1: add a fuel synthesis step

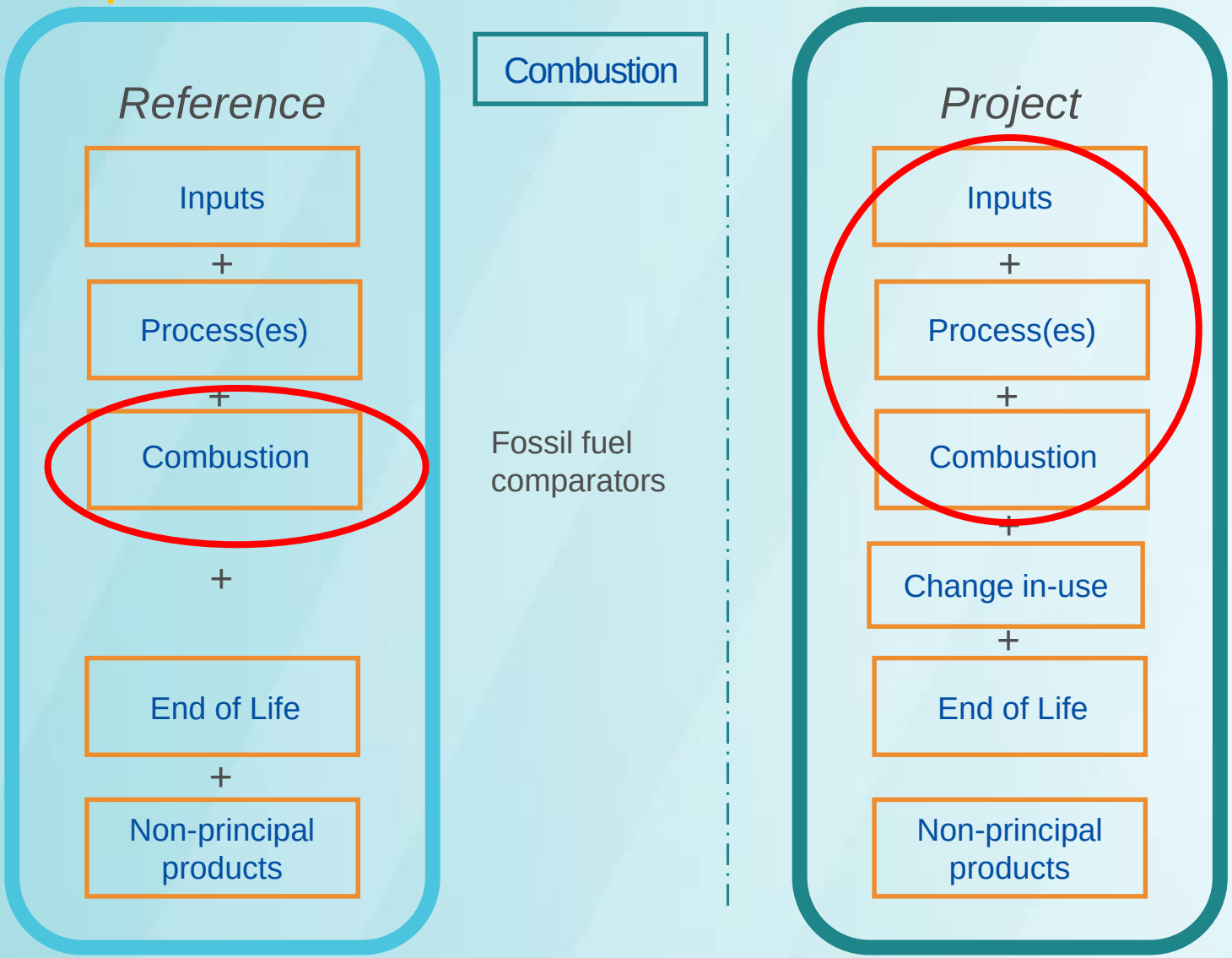
- Still an EII project
- Sector changes: hydrogen -> refineries (e-fuels)
- Product changes -> e-fuels. Output products could include*:
  - Synthetic aviation kerosene
  - Synthetic diesel
  - Synthetic gasoline
- The three products can be principal products as they all belong to the same sector (refineries)

** Output product mix will vary according to synthesis technology and upgrading choices*

# Setting the Reference

- Now the principal products are e-fuels.
- Use the appropriate fossil fuel comparators instead of an ETS benchmark:
  - Aviation kerosene: 78.3 gCO2e/MJ
  - Diesel: 80.4 gCO2e/MJ
  - Gasoline: 78.9 gCO2e/MJ
- All reference emissions fall within the combustion box of the diagram (so no ‘inputs’ emissions in the reference scenario)
- If heat is exported by the fuel synthesis facility, include equivalent heat production (ETS heat benchmark)

# Identify components with emissions in the diagrams




Combustion

Fossil fuel comparators




Process(es)

Inputs

electrolysis

*power (if not a process)*

*water*

heat

fuel synthesis and upgrading

*power (if not a process)*

*water*

hydrogen for upgrading?

catalysts

$CO_2$

* *Upgrading to transport fuels must be included in order to use FFCs on comparable productS*

Combustion

Combustion emissions of: aviation kerosene, diesel and gasoline

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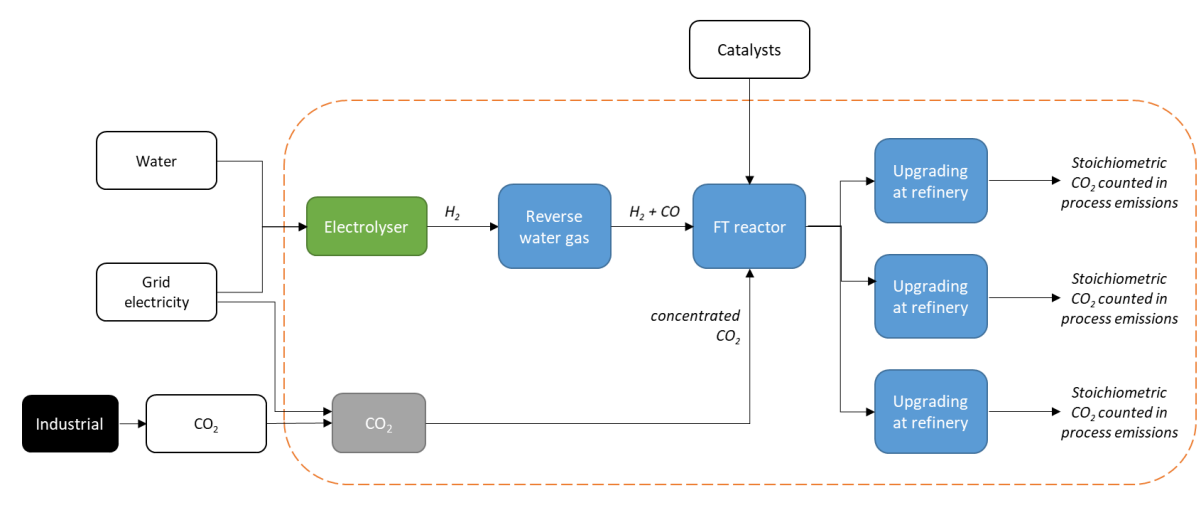
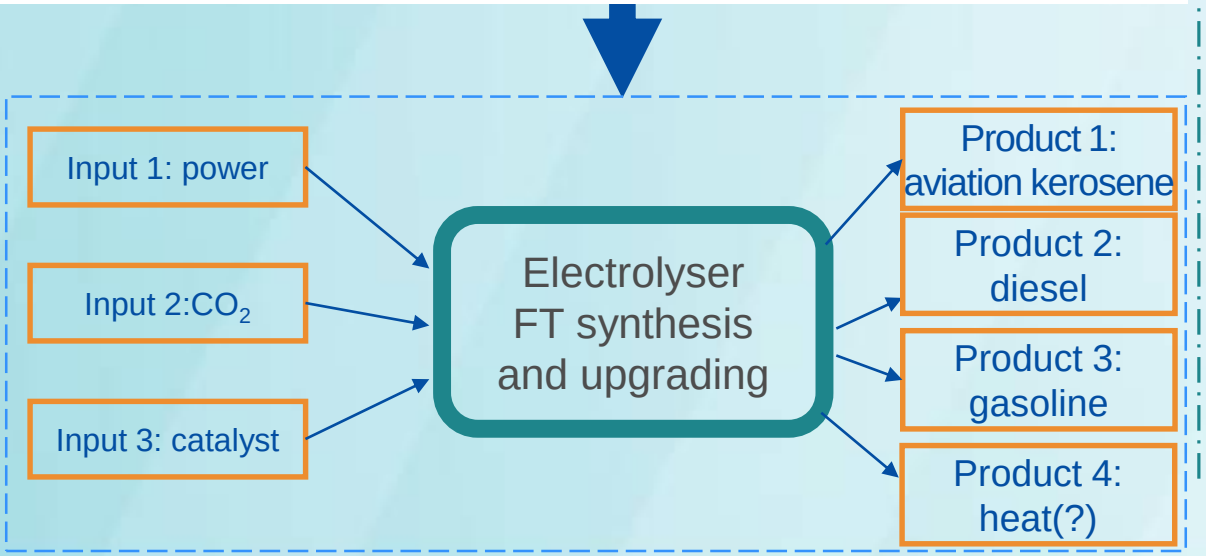
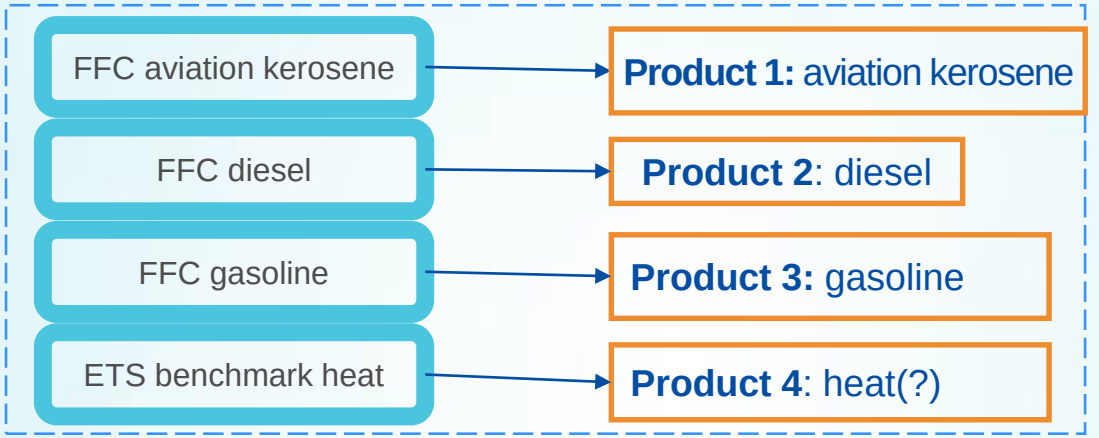
# Calculate the emissions avoidance

## Project




## Reference




## Emissions avoidance

$$\Delta GHG_{abs} = (FFC_{kerosene} + FFC_{diesel} + FFC_{gasoline} + ETS_{heat}) - (GHG_{proj\_inputs} + GHG_{proj\_processes} + GHG_{proj\_combustion})$$

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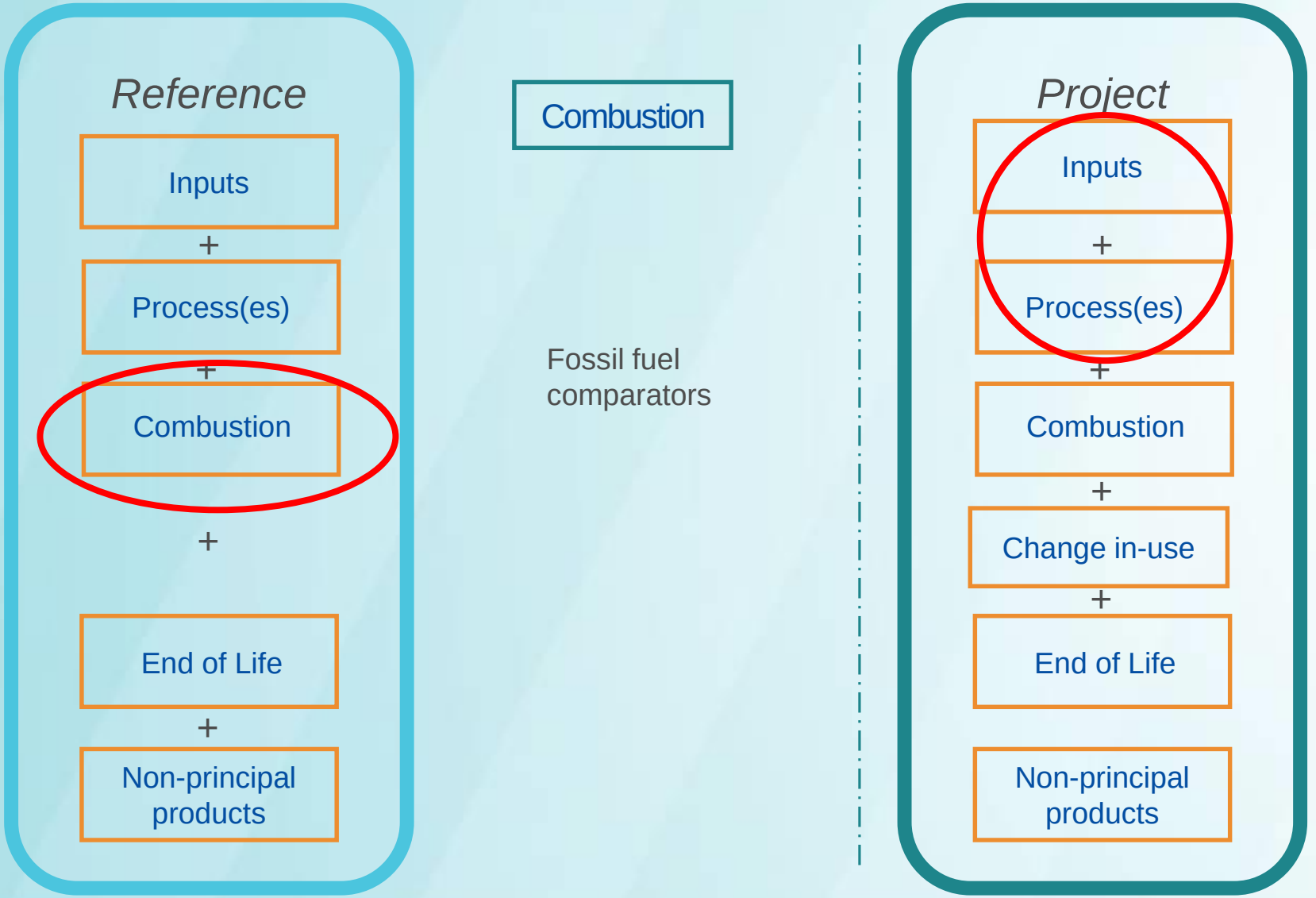
# **Variation 2**: hydrogen supplied for refuelling fuel cell vehicles

- Still an EII project
- Sector changes: hydrogen -> refineries (fuels)
- Product is still hydrogen, but it will be supplied to replace a transport function, and so the reference product changes:
  - gasoline*
  - diesel*

** Upgrading to transport fuels must be included in order to use FFCs on comparable products*

# Identify Processes and Inputs

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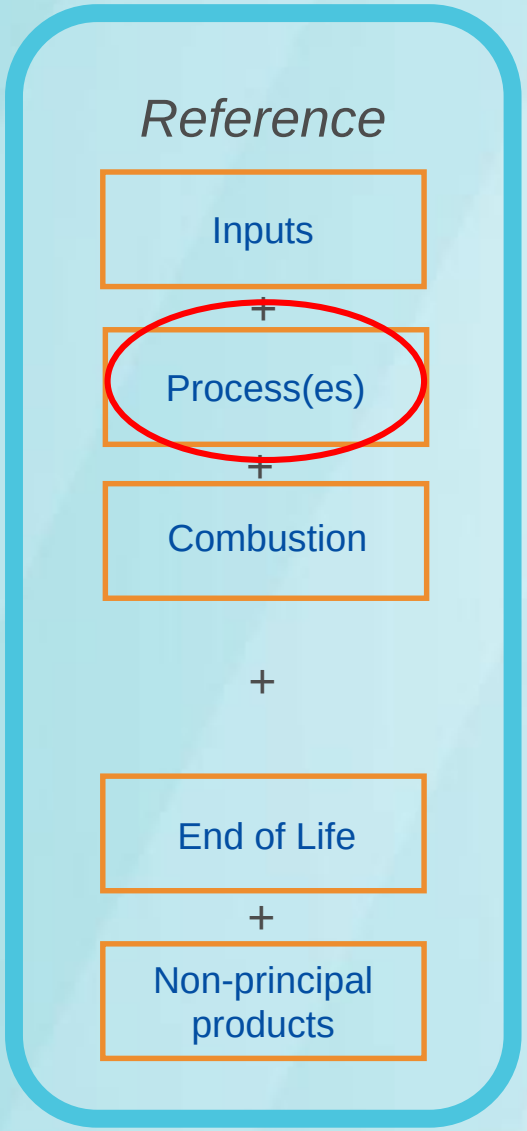
# Including Vehicle Efficiency

- Hydrogen fuel cell vehicles have greater energy efficiency than conventional vehicles:
  - E.g. JEC WTW v5 has an energy efficiency ratio ~ 2.5:1 fuel cell to spark ignition (NEDC cycle)
- Multiply fossil fuel production in reference scenario by correct energy efficiency ratio to give like-for-like comparison

# Innovation Fund GHG calculation example: ethylene

- Consider a project to produce ethylene from biomass
  - Falls within energy intensive industry
  - The sector is chemicals
  - Bio-ethylene as principal product (example of “organic basic chemicals”)
  - Wheat ethanol as feedstock for ethylene production
  - For the example, assume ethanol production is within the project boundary but wheat farming is not

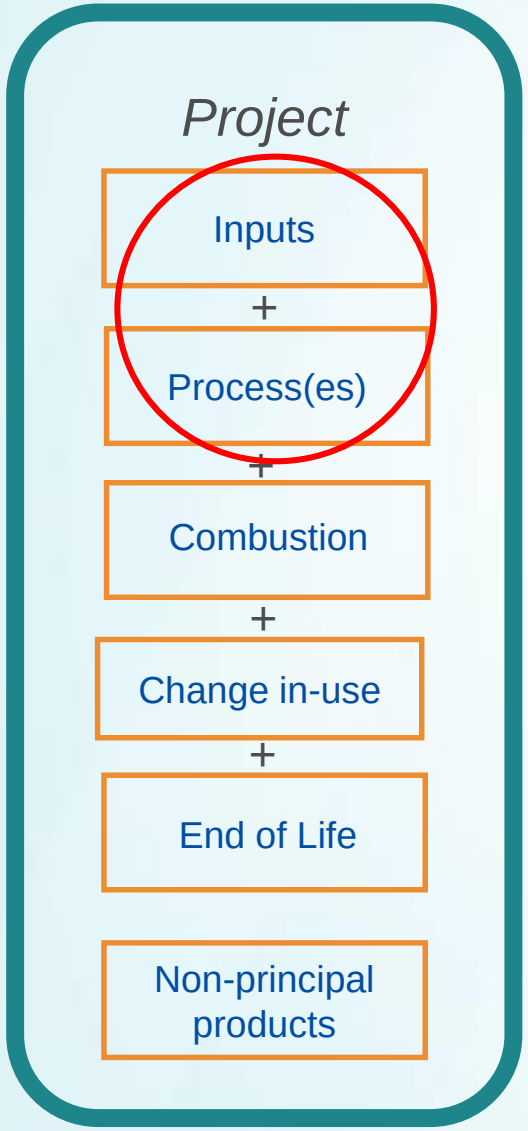
# Identify Processes and Inputs




Process(es)

ETS benchmark for high value chemicals

*Applicable for >30% ethylene in product yield*




| Process(es) | Inputs |
|---|---|
| ethanol distilling | *power*<br>*water*<br>*yeast*<br>*wheat* |
| on-site heat generation | |
| catalytic dehydration | *power*<br>*catalyst*<br>*dehydration* |

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# Status of Inputs

- Wheat – “the emissions factor for biomass, biogas, biomethane, bioliquid or biofuels from an indeterminate supplier, are the default emissions tabulated in Annex V and VI of REDII, generally diminished by 15%”
  - Cultivation: 14.1 $gCO_{2e}/MJ_{ethanol}$
- Inputs to wheat production do not need to be individually assessed
- Yeast and catalysts – likely to be de minimis inputs (no need to assess)
- Water and power – as before, treat as zero
- Assume heat is generated on-site – assessed as part of process(es) box

# Non-principal products + Change to in-use + EoL

- If wheat ethanol production is brought within the system boundary, then some emissions should be attributed to the distillers' grains co-product, giving a credit within (non-principal box)
- Bio-ethylene is chemically identical to fossil ethylene so there is no change to in-use emissions
- At end of life, in the reference scenario it can be assumed that the carbon in ethylene would be released as carbon dioxide (landfilled waste is treated in IF GHG assessment as if incinerated). Biogenic CO2 emissions are rated as zero, so there is an emission credit for avoided end of life CO2 release

# Other points of note

# Expanded Fossil Fuel comparator (Table 2.2)

Expanded range of FFCs, calculated on the same basis as the diesel, gasoline and LPG values

| Substituted fossil transport fuel | IF Fossil Fuel Comparator ($gCO_{2eq}$ / MJ) | LHV (NVC (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 (incl. gas oil and fuel oil) | 78.0 | 42.8 |
| Synthetic crude oil | 75.5 | 42.0 |

# Changes compared to the 1st LSC

- Different ‘boxes’ for lifecycle stages: ‘Combustion (principal products)’, ‘changes to in-use emissions’, ‘non-principal products’.
- 7 explicit cases for the reference scenario
- Credit for long-term (>50 years) carbon storage in a non-geological storage context
- Requirement that emissions from major inputs shall be assessed by system expansion where possible has been removed
- Additional type of EII project: innovation focuses on saving of electricity with specific conditions and greenhouses gases (GHG) calculations
- Clarification: Applications including a credit for timed operation must detail a plan to manage grid electricity consumption to coincide with times when the emissions of the electricity supply are below average.
- Clarification: EoL emissions must be included in cases where one or more principal products contain carbon
- Clarifications on non-principal products emissions: an innovative non-principal product that can be combusted can use EF based on natural gas, credit for products that provide storage on a long-term basis.
- Clarification on the treatment of transport emissions. Transport of raw materials must only be considered for waste feedstock and for biomass (see section 1.1.5).

# Carbon Capture and Storage (CCS)

# Carbon Capture and Storage (CCS)

- Capturing and compressing $CO_2$ from point sources or the air for injection in a storage site.
- Applications can be submitted by any players in the CCS supply chain (demonstrating the provision of the remaining services).
- EII and RES projects with CCS component: CCS part is calculated according to this section and introduced in EII/RES GHG calculations.
- No difference between $CO_2$ captured from fossil and biogenic sources. Biogenic $CO_2$ credit given to the emitting facility.

$$\Delta GHG_{abs,CCS} = \sum_{y=1}^{10} \left( Ref_{release,y} - (Proj_{capture,y} + Proj_{pipeline,y} + Proj_{transport,y} + Proj_{injection,y}) \right)$$

$Proj_y$

- $Ref_{release,y}$: $CO_2$ that would be released or available in the atmosphere in the absence of the project activity
- $Proj_{capture,y}$: emissions from the $CO_2$ capture activities
- $Proj_{pipeline,y}$: emissions from transport of $CO_2$ by pipelines
- $Proj_{transport,y}$: $= Proj_{transport,road,y} + Proj_{transport,rail,y} + Proj_{transport,maritime,y}$
- $Proj_{injection,y}$: emissions from injection at the geological storage site

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# $Proj_{transport,y}$ calculation

| Parameter | = | Equation |
|---|---|---|
| $Proj_{transport,y}$ | = | $Proj_{transport,road,y} + Proj_{transport,rail,y} + Proj_{transport,maritime,y}$ |
| $Proj_{transport,road,y}$ | = | $\sum_{L=1}^{T} (Kroad_{,L} * CO_{2road,L} * EFroad * 10-3)$ |
| $Proj_{transport,rail,y}$ | = | $\sum_{L=1}^{T} (Krail_{,L} * CO_{2rail,L} * EFrail * 10-3)$ |
| $Proj_{transport,maritime,y}$ | = | $\sum_{L=1}^{T} (Kmaritime_{,L} * CO_{2maritime,L} * EFmaritime * 10-3)$ |

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# Carbon Capture and Storage (CCS)
## Example: transport and storage

1. Description: Project intends to build a special transport system to transport large volumes of $CO_2$ by pipeline to the storage site
2. Sector classification: choose an EII sector
3. GHG calculation: CCS, Section 3 of Annex C
4. Reference: $CO_2$ released to the atmosphere

$$\Delta GHG_{abs} = \sum_{y=1}^{10} \left( CO_{2transf,y} - Proj_{capt,y} - Proj_{pipe,y} - Proj_{inject,y} - Proj_{tranport,y} \right)$$

- $Proj_{capt,y}$: Fuel and material use + fugitives+venting pre-injection
- $Proj_{pipe,y}$: Emissions at support installations + fugitives + venting + leakage
- $Proj_{inject,y}$: Emissions from fuel use at booster station + venting + leakage
- $Proj_{tranport,y}$: Emissions at each transportation modal

5. Data: $CO_2$ transferred to capture facility; quantity of fossil fuel consumed; for fugitives (unintentional), leakage events and venting (planned) it will depend on the monitoring plan to be proposed by the applicant, and method of quantification selected.

**Note that…**

- The applicant shall secure a buyer of their technology and cover the whole cycle from capture to storage in their submission, which shall be part of the boundaries of GHG emission avoidance calculation. Companies will be required to monitor and report on emissions across all stages.
- Applications can be submitted with or without a Consortium. It is up to the applicants and players to organise themselves and split the revenues and liabilities.

# Carbon Capture and Storage (CCS)
## Example: cement plant with CO2 capture and storage

1. Description: Project intends to produce cement in an innovative way and capture and store some of the $CO_2$ released
2. Sector classification / product: EII / cement & lime / cement
3. GHG calculation: EII, Section 2 of Annex C with CCS (Section 3) integrated.
4. Reference: cement EU ETS benchmark

$$\Delta GHG_{abs} = \sum_{y=1}^{10} (Ref_y - Proj_y)$$

**EII**

$$= \sum_{y=1}^{10} \left( Ref_y - ( Proj_{inputs,y} + Proj_{processes,y} + Proj_{eol,y} + Proj_{combustion,y} + Proj_{changeuse,y} + Proj_{non\text{-}principal,y} \right)$$

Aside from all the EII processes involved in the production of cement, introduce also:

- The full amount of $CO_2$ generated by the project as a **positive term** (even though some of this $CO_2$ is to be captured)
- The CCS credit calculated according to section 3 of Annex C (CCS) as a **negative** term (i.e.: $Ref_{release,y}$ - $Proj_y$ , where $Ref_{release,y}$ is the $CO_2$ transferred to the capture installation and $Proj_y$ the emissions due to the $CO_2$ capture, transport and storage)

# Carbon Capture and Storage (CCS)
## Example: waste to energy plant with CO2 capture and storage

1. Description: Project intends to produce bio-electricity from a waste to energy plant and capture and store some of the $CO_2$ released
2. Sector classification / product: EII / other / electricity
3. GHG calculation: RES, Section 4 of Annex C with CCS (Section 3) integrated.
4. Reference: expected 2030 electricity mix

$$\Delta GHG_{abs} = \underbrace{\sum_{y=1}^{10} (Ref_y - Proj_y)}_{\text{RES}} = \sum_{y=1}^{10} \left( Ref_{electricity} - Proj_y \right)$$

Possibility to claim net carbon removals credit if the project emissions are negative

Aside from the RES project emissions involved in the production of bio-electricity, introduce also:

- The amount of **biogenic $CO_2$** generated by the project **with an emission factor of zero** and the **fossil $CO_2$** generated as **a positive term** (even though some of this $CO_2$ is to be captured).
- The CCS credit calculated according to section 3 of Annex C (CCS) as a **negative** term (i.e.: $Ref_{release,y}$ - $Proj_y$ , where $Ref_{release,y}$ is the $CO_2$ transferred to the capture installation (fossil and biogenic) and $Proj_y$ the emissions due to the $CO_2$ capture transport and storage)

# Carbon Capture and Storage (CCS)

## Example: Direct air capture and storage (DACCS)

1. Description: Project intends to remove $CO_2$ from ambient air and store it
2. Sector classification / product: EII / Other / storage of $CO_2$
3. GHG calculation: CCS, Section 3 of Annex C
4. Reference: $CO_2$ removed from the atmosphere

Possibility to claim net carbon removals credit if the overall project emissions are negative

$$\Delta GHG_{abs} = \sum_{y=1}^{10} \left( Ref_{release,y} - Proj_{capt,y} - Proj_{pipe,y} - Proj_{inject,y} - Proj_{tranport,y} \right)$$

Amount of $CO_2$ removed from atmosphere

Fuel and material use + fugitives + venting + leakage

Relative GHG emission avoidance will be set at 100% to grant DACCS with an advantage over conventional CCS

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# Net carbon removals

**GENERAL RULES**

- Total project emissions should be **negative**.
- Negative emissions can only be claimed excluding any credit for **timed operation**.
- **Non-principal products** are not allowed to be the only source of negative emissions in the project.

Without permanent geological storage: relative GHG emission avoidance (e.g.: CCU)

With permanent geological storage:

- Total project emissions (should be negative)
  - DACCS: $-\Delta GHG_{abs,CCS}$
  - BECCS: total project emissions with the CCS term integrated
- Relative net carbon removals: $\boldsymbol{\Delta GHG_{abs,CCS} / \sum Ref_{release}}$ (**NOT necessarily** the same value as the "relative GHG emission avoidance" explained in 1.1.2. of Annex C) where:
  - DACCS: for the purpose of crediting carbon removals, the exact value should be calculated following the formula (note that for the main GHG calculation, this value was set as 100%)
  - BECCS:
    - $\Delta GHG_{abs,CCS}$ : calculated based **ONLY** on the **BIOGENIC** fraction of the $CO_2$ emitted by the plant (i.e.: $\sum Ref_{release}$ in equation 3.1 of Annex C considering only the biogenic fraction of $CO_2$) and that will be captured by the CCS facility (credit cannot be claimed for the fossil fraction of the $CO_2$ emitted (e.g.: WtE plant using waste from fossil and biogenic sources)).
    - $\sum Ref_{release}$ : calculated as the sum of the **TOTAL $CO_2$** emissions by the plant (i.e.: biomass and fossil, if applicable) and that will be captured by the CCS facility

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