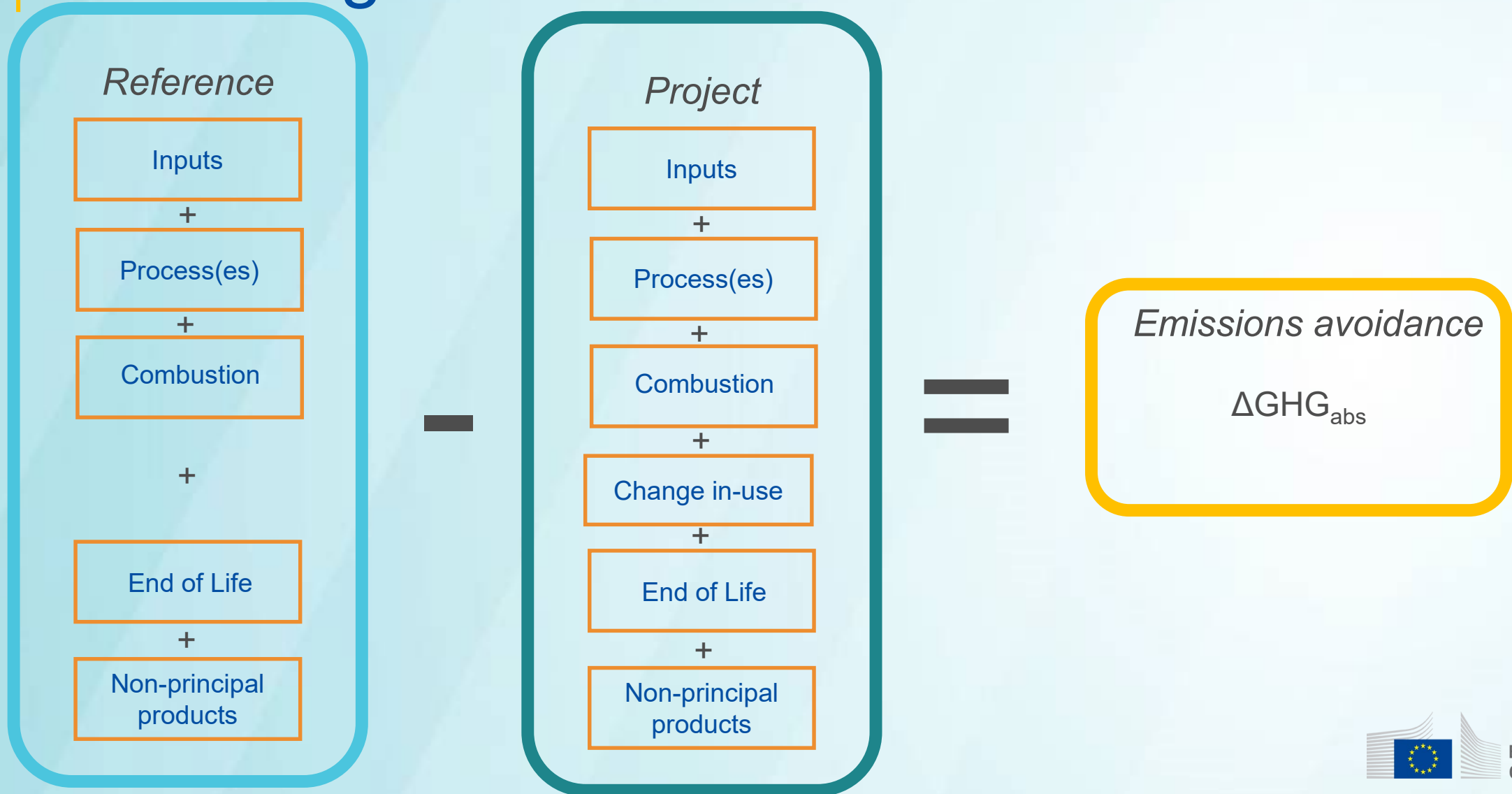# Calculation example

Example: Green Hydrogen

The following example is **intended to show important aspects of how the methodology works in practice** and where possible errors could occur. The slides are included purely for illustrative purposes
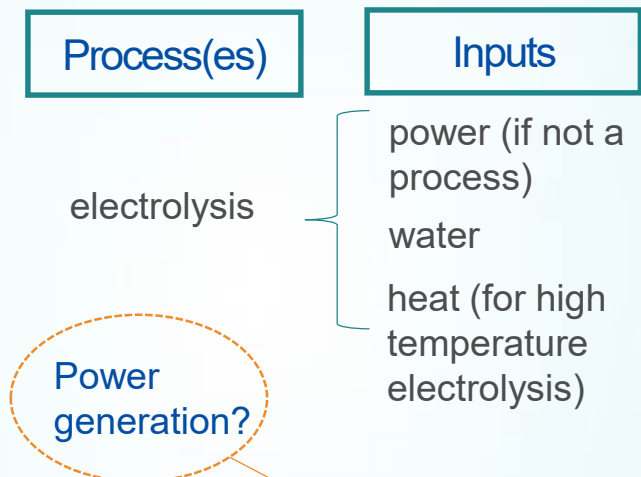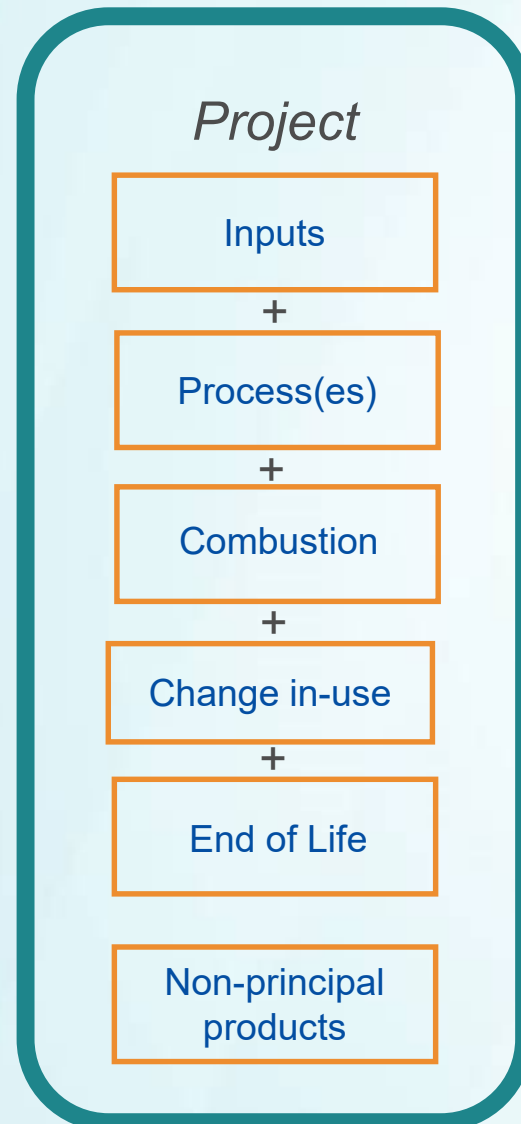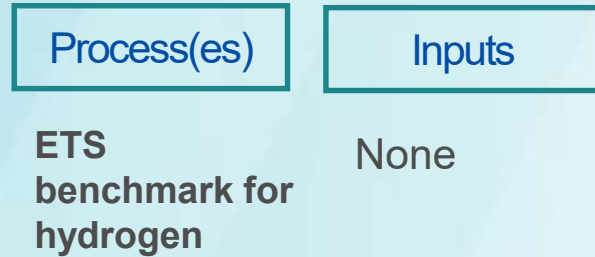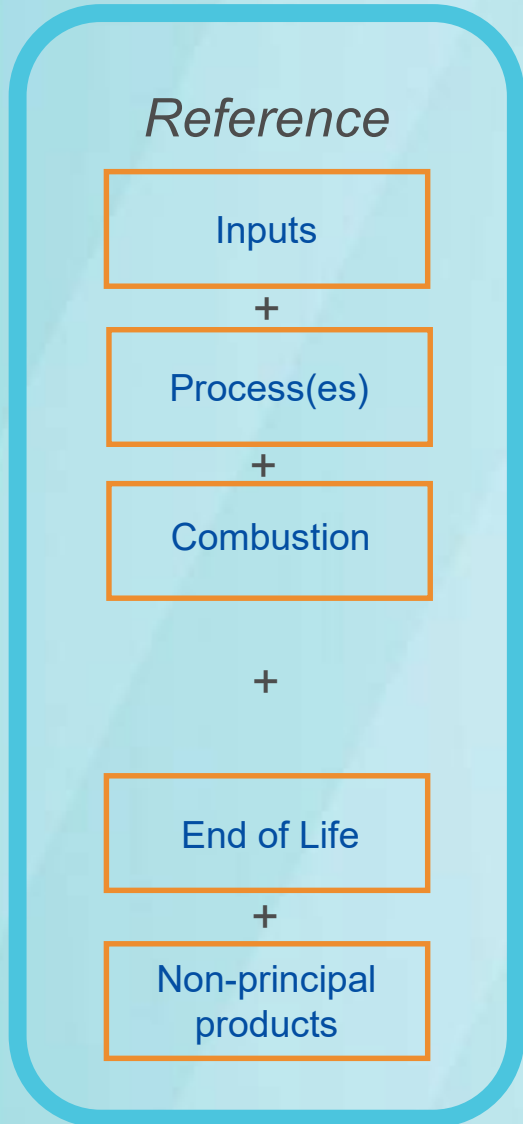
- Consider a project to produce **Green Hydrogen**. Note this example project;

    - Falls within Energy Intensive Industry

    - Hydrogen as the only (and therefore principal) product

    - The sector is hydrogen

    - Hydrogen is supplied for industrial use

From: http://www.hydrogen.energy.gov/h2a_production.html

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GHG diagrams

Reference

Inputs

+

Process(es)

+

Combustion

+

End of Life

+

Non-principal products

−

Project

Inputs

+

Process(es)

+

Combustion

+

Change in-use

+

End of Life

+

Non-principal products

=

Emissions avoidance

ΔGHG_{abs}

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)
water
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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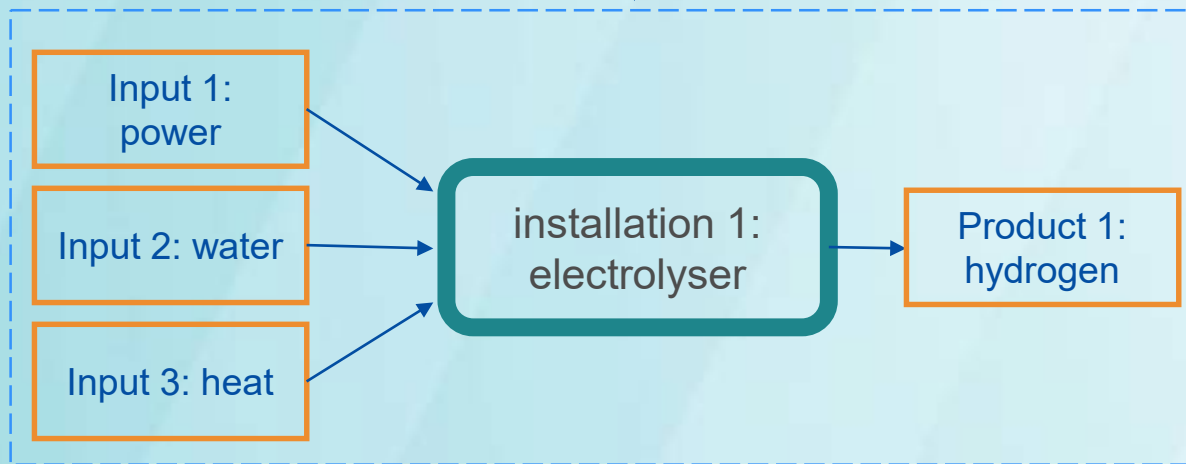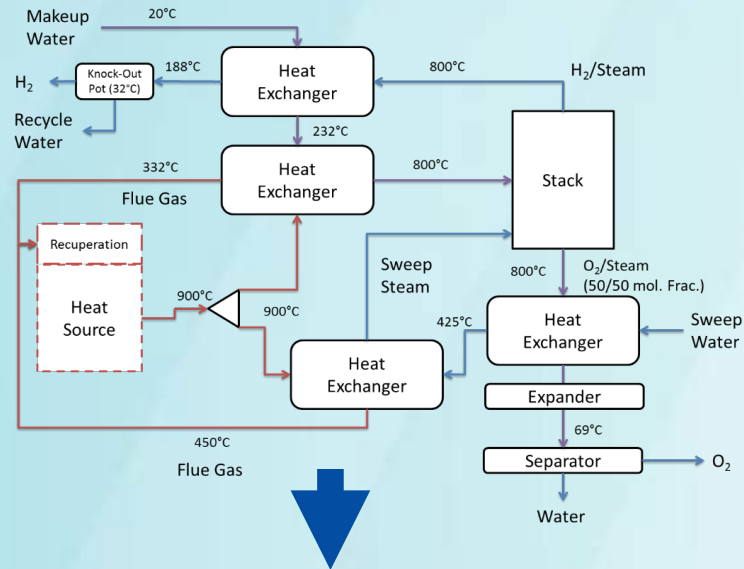
Focus on Heat

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

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Process(es) Boxes

Project

Reference

installation 1:
ETS benchmark
for hydrogen

→ Product 1:
hydrogen
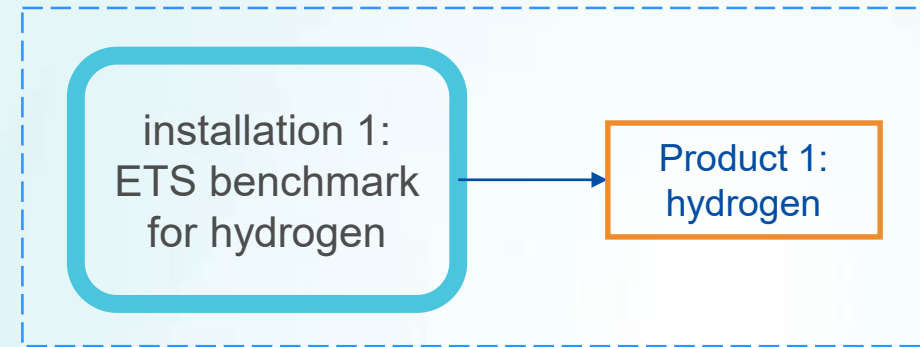
Emissions avoidance

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

Input 1:
power

Input 2: water

Input 3: heat

installation 1:
electrolyser

→ Product 1:
hydrogen

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Emissions for Processes and Inputs
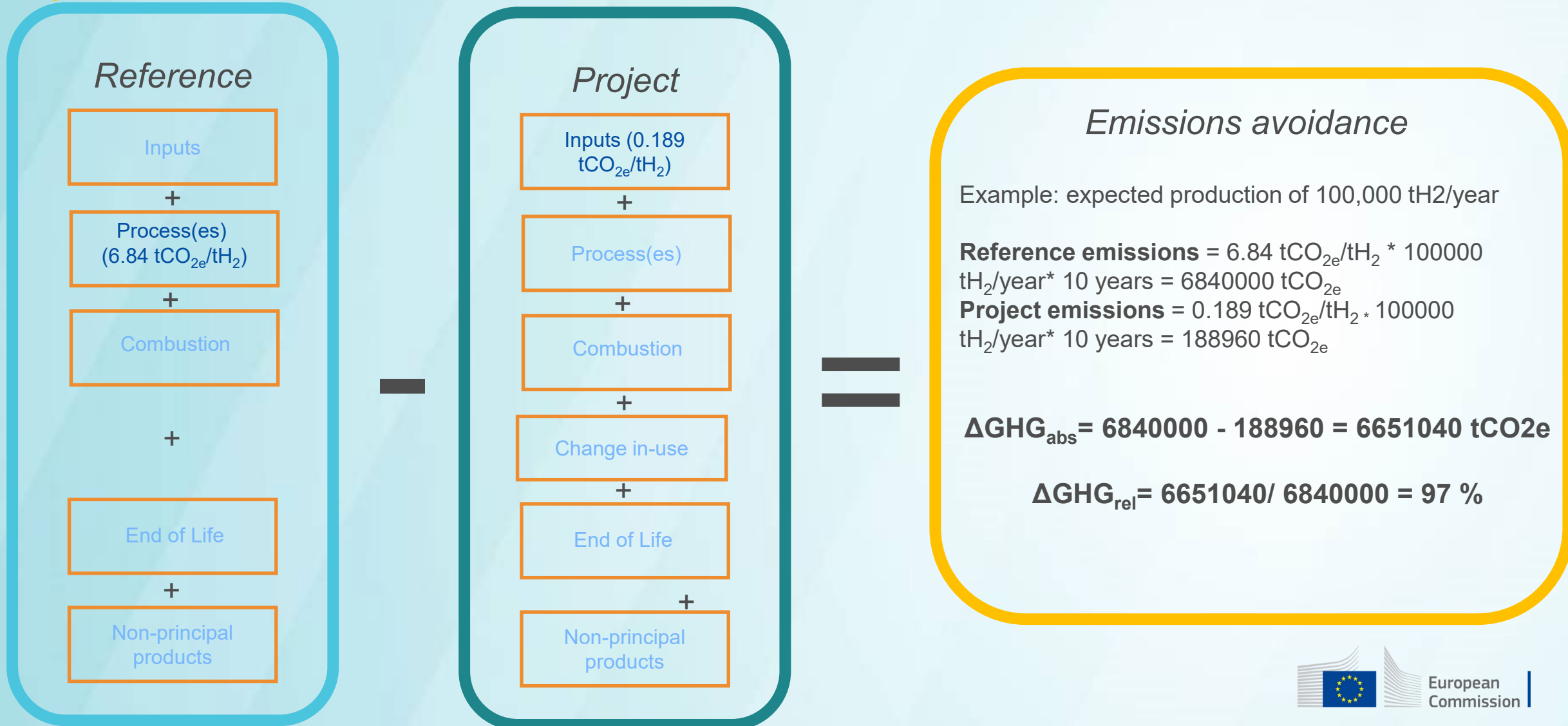
- **Reference**

  - 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: 59.1 tCO2e/TJ × 0.0032 TJ/tH_2 = 0.189 tCO_2e/tH_2

Possible SIW (e.g.: considering the emission factor of the local grid)

Overall Change in Emissions

Reference

Inputs

+

Process(es)
(6.84 tCO_{2e}/tH_2)

+

Combustion

+

End of Life

+

Non-principal products

$-$

Project

Inputs (0.189 tCO_{2e}/tH_2)

+

Process(es)

+

Combustion

+

Change in-use

+

End of Life

+

Non-principal products

$=$

Emissions avoidance

Example: expected production of 100,000 tH2/year

Reference emissions = 6.84 tCO_{2e}/tH_2 * 100000 tH_2/year* 10 years = 6840000 tCO_{2e}
Project emissions = 0.189 tCO_{2e}/tH_2 * 100000 tH_2/year* 10 years = 188960 tCO_{2e}

ΔGHG_{abs} = 6840000 - 188960 = 6651040 tCO2e

ΔGHG_{rel} = 6651040/ 6840000 = 97 %

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