# CertifHy$^{TM}$ – Implementing an EU-wide certification system for clean Hydrogen

CertifHy

An initiative funded by the Clean Hydrogen Partnership

Clean Hydrogen Partnership

Stakeholder Plenary Session
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## CertifHy$^{TM}$ methodologies for GHG footprint quantification

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# Quantification of the carbon footprint of hydrogen is addressed by Working Group 2 – $H_2$ certification & GO issuing (Producers)

Role of Working Group 2:

- Verify practicality of the developed CertifHy scheme with regards to hydrogen certification for disclosure or compliance purposes, from producers' perspective

- Develop and establish consensus-based methods, considering relevant regulation and standards, for defining the origin and carbon footprint of hydrogen from specific processes, mainly through case studies

Continuation of *CertifHy 2* activity on footprint of H2 produced by the CertifHy pilot plants


CertifHy 2 pilots plants

# Why is a CertifHy carbon footprint calculation procedure needed?

1. GHG footprint calculation methodology depends on certification purpose.
   - For Disclosure (GOs), the reference is ISO 14067 *Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification*, for calculation of a cradle-to-gate carbon footprint, using an attributional approach.
   - For demonstrating regulatory Compliance, e.g. with RED II, the methodology is defined by regulation (upcoming delegated act in the case of RFNBOs), for calculating GHG emission savings compared to a specified reference, with a cradle-to-grave perspective.
2. Applicable standards and regulation do not always fully define the calculation procedure to be applied.
   - ISO standards do not address "allocation" precisely (consensus building among LCA practitioners is still in progress).
   - Methodologies defined by regulation and intended to cover all possible fuels and situations can have "blind spots".
3. Rules for determining the origin of a product made from inputs having different origins are not yet well established.
4. Guidelines become simpler and easier to apply when only Hydrogen production and supply needs to be addressed.

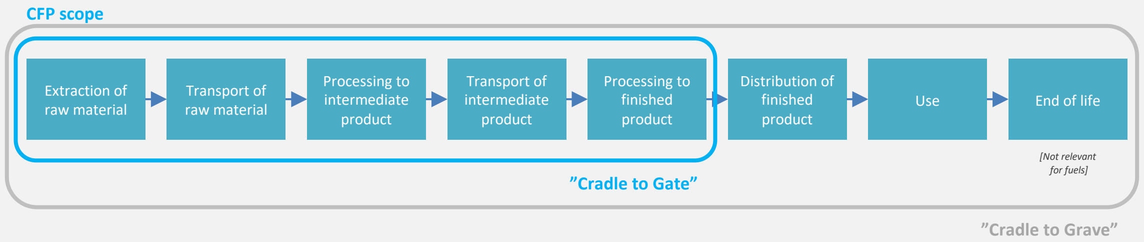
# GHG calculation methodology depends on certification purpose

## Disclosure

Focus up to now

Reference: ISO 14067:2018 *Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification*

Quantity: Cradle-to-Gate carbon footprint (CFP) of $H_2$ (gCO2e/MJ)




CertifHy: Emissions from capital goods not included in calculation today

→ This footprint is called "Well-to-Gate" in CertifHy

## Compliance

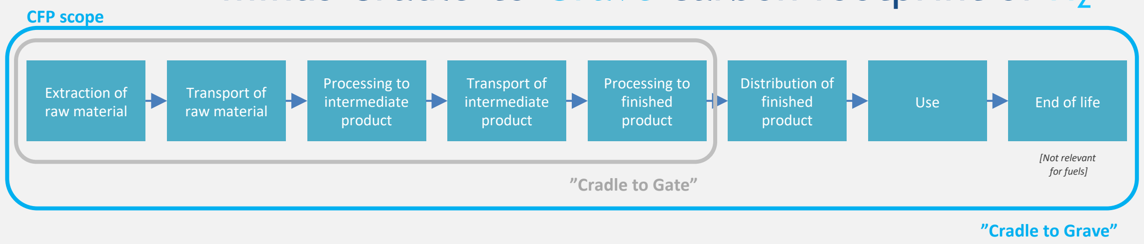
e.g. with RED II of $H_2$ as an RFNBO

Reference: Delegated act

Quantity: Emission savings per MJ of $H_2$ (gCO2e/MJ)

= Cradle-to-Grave carbon footprint of reference fuel

*minus* Cradle-to-Grave carbon footprint of $H_2$



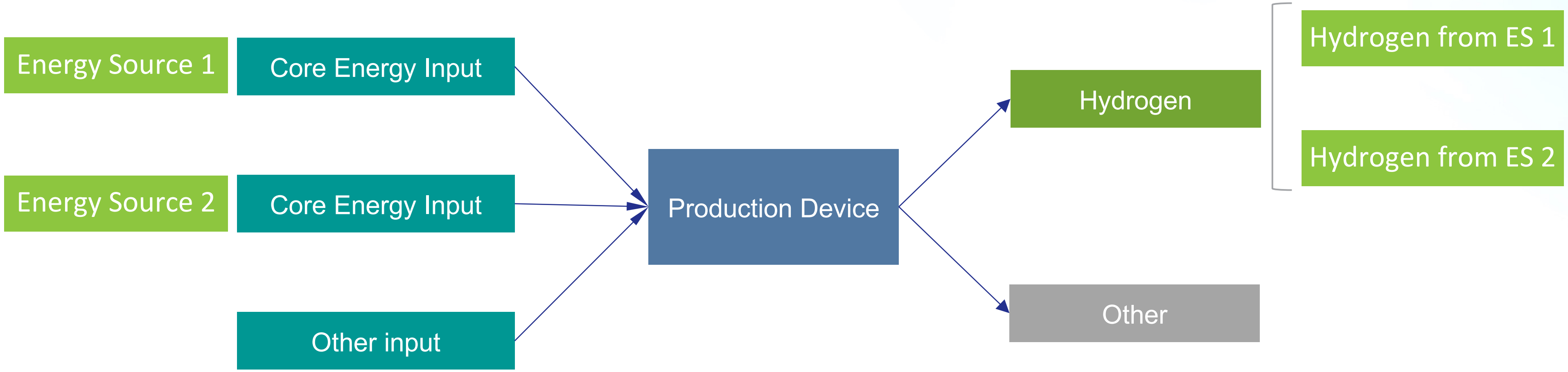

RED II: Emissions from capital goods not included

Note: EU Taxonomy refers to ISO 14067

While the GHG emissions calculation methodologies for Disclosure and Compliance are currently defined separately, convergence could be targeted, in order to have a single GHG metric, with only scope depending on purpose.

# The key questions to be addressed by a well-to-gate carbon footprint calculation methodology for GOs

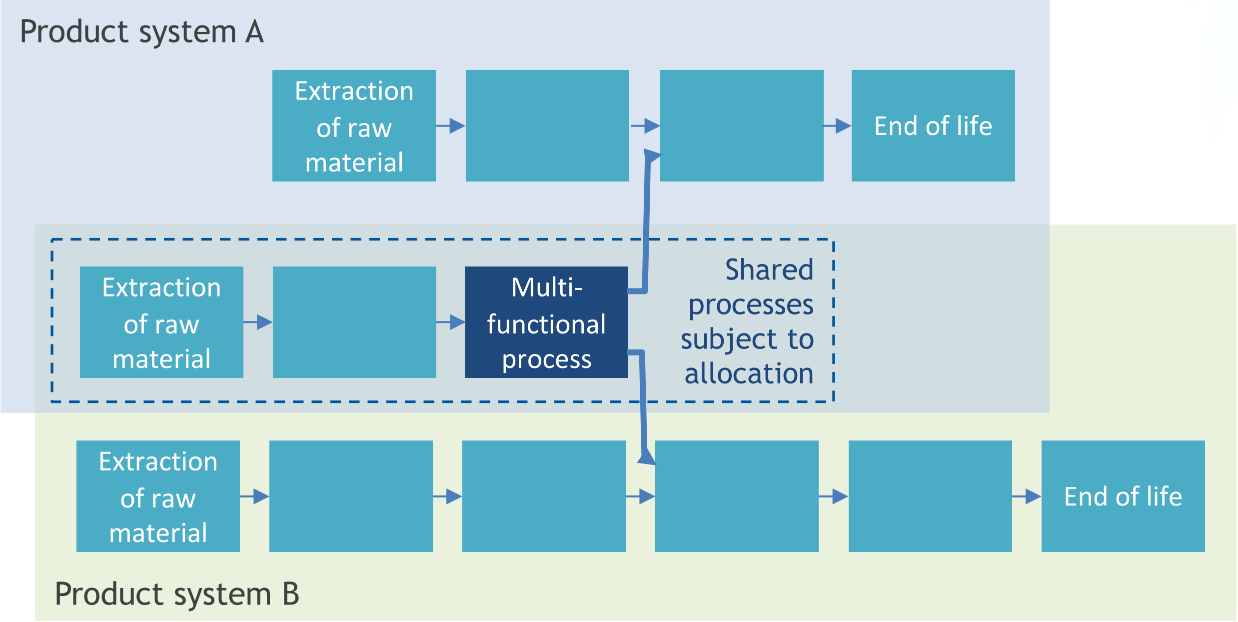
| 3. Footprint of inputs at production device input gate? | 2. Allocation of upstream and process emissions to each co-product? | 1. Quantity of hydrogen from each energy source? |
| --- | --- | --- |
| In particular when the input is itself a co-product → allocation issue | | |




Core energy input: Energy Input used to generate the hydrogen molecules composing the Hydrogen

# The reference ISO standards provide only high level guidance on allocation, to be based on physical relationships between inputs or emissions and the products delivered

Allocation as defined by ISO 14044: "*partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems*"




*"Output: product, material or energy flow that leaves a unit process"*
→ includes GHG emissions and waste

*"The sum of the allocated inputs and outputs of a unit process shall be equal to the inputs and outputs of the unit process before allocation."*

*"Where allocation cannot be avoided, the inputs and outputs of the system should be partitioned between its different products or functions in a way that reflects the underlying physical relationships between them; i.e. they should reflect the way in which the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system."*

**Allocation options need to be assessed looking at the whole picture**

# Case studies and topics addressed under CertifHy 3 to date

1. Hydrogen production by high temperature electrolysis (SOEC) — **Completed**
   - Sponsor: MULTIPLY project involving Sunfire, Engie, Neste
   - Focus: Footprint of the steam used depending on origin
2. Hydrogen and Carbon Monoxyde co-production by steam reforming of natural gas (HyCO) — **On-going**
   - Sponsor: Air Liquide
   - Focus: Co-production of $H_2$ and CO
3. By-product Hydrogen from chlor alkali process — **On hold**
   - Sponsor: Nobian
   - Focus: Share of energy input allocated to the by-product $H_2$
4. Hydrogen production from waste — **Completed**
   - Sponsor: Concord Blue
   - Focus: Footprint at gate of waste
5. Co-production of hydrogen and hydrocarbons — **On-going**
   - Focus: Restoring consistency with energy balance of energy based allocation

For case study proposals please contact frederic.barth@hinicio.com

# Hydrogen production by high temperature electrolysis (SOEC)

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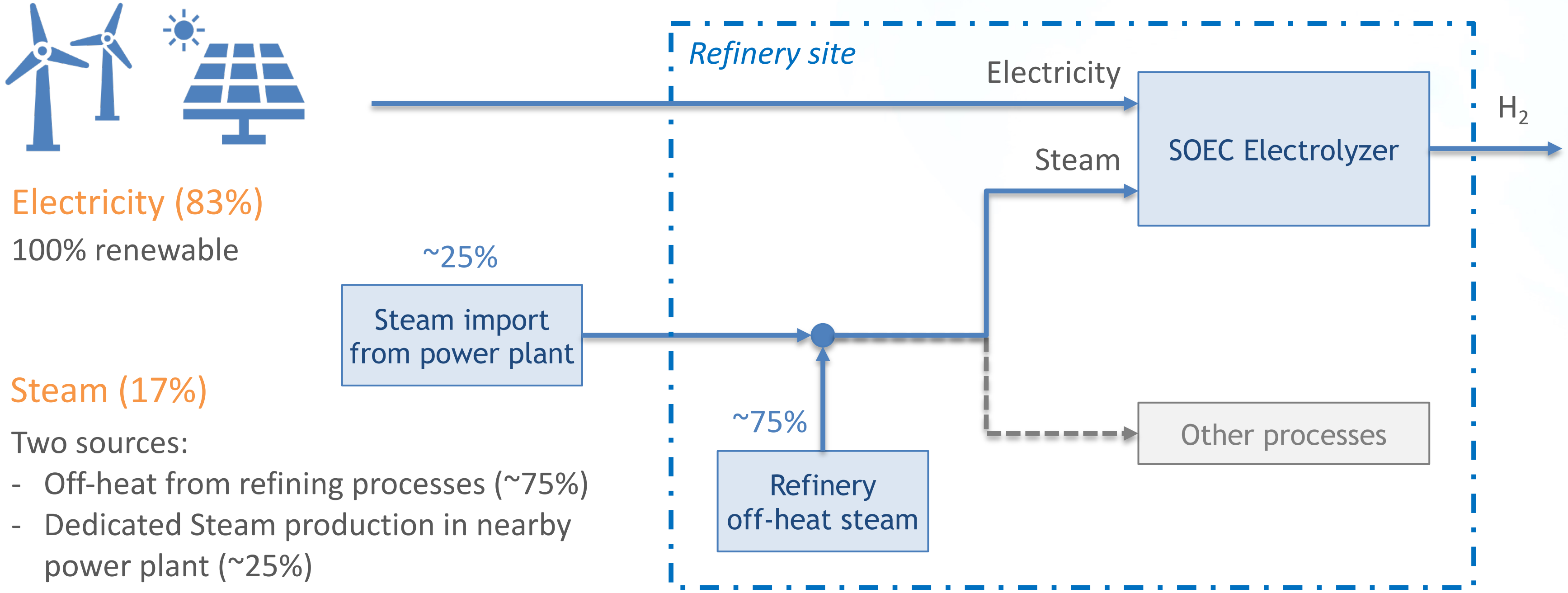


Electricity (83%)

100% renewable

Steam (17%)

Two sources:

- Off-heat from refining processes (~75%)
- Dedicated Steam production in nearby power plant (~25%)

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# Steam supply configurations to be addressed

| | | | | | |
|---|---|---|---|---|---|
| Steam energy source | Non-renewable | Renewable - Biological origin | Renewable - Non-biological origin | | Determines whether or not steam is "renewable steam" |
| Steam generation process | 1. Fired boiler | 2. Cogeneration | 3a. Off-heat from HT source | 3b. Off-heat from LT source | Determines the way GHG emissions are allocated for steam footprint quantification |
| Supply system complexity | Single source | Steam supply system with multiple sources | | | Approach proposed for assigning a heat source to steam supply from a steam network |

1

# Steam footprint - Steam produced from process off-heat

| | 3.a. Steam from off-heat - Heat source temperature ≥ 650°C* | 3.b. Steam from off-heat - Heat source temperature < 650°C |
|---|---|---|
| Emissions allocation method | Allocation of heat used | Allocation of heat used w/ correction for exergy |
| Footprint calculation | Steam footprint<br>= Emission factor of input generating heat ($g_{CO2e}/MJ_{LHV}$) / 90% | Steam footprint<br>= Emission factor of input generating heat ($g_{CO2e}/MJ_{LHV}$)<br>/ 90%<br>x $[(T_h-T_0)/T_h]$ / 0,703<br>Th =Temperature in kelvin of the steam at point of delivery<br>T0 =Temperature of surroundings, set at 273,15 kelvin (equal to 0 °C)<br>(0,703 is the Carnot efficiency for heat with a temperature of 650 °C) |
| Rationale | • Division by 90% to account for heat transfer losses<br>• Steam footprint does not carry other heat losses in the heat originating process because it is a by-product | • Same as for steam from high temperature heat source, with **consideration of exergy through Carnot Factor**, as low temperature heat should have a smaller allocation per MJ than high temp heat, since it is more difficult to make use of. |

* Temperature beyond which heat is qualified as high grade heat in an Interreg publication accessible through this link

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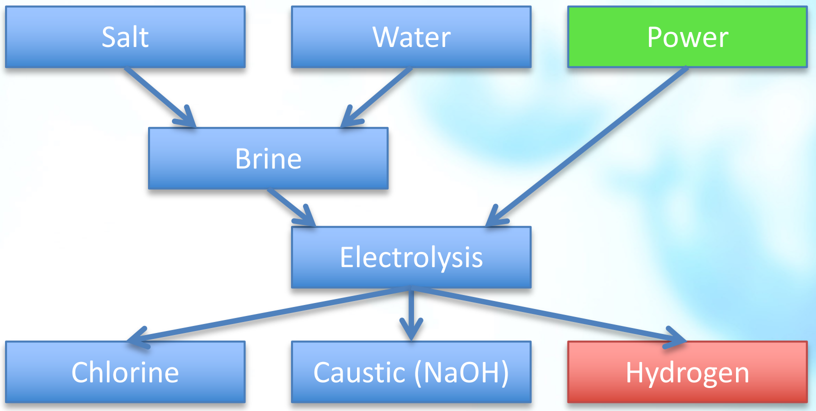
# Hydrogen from a Chlor Alkali plant – Continuation of work performed under CertifHy 2

CertifHy 2 results

- Allocation based on energy content of the co-products is not applicable
- Mass-based allocation was not deemed suitable
- Two methods were considered in more detail:
    - Value based allocation (using Eurostat statistics) (11% of energy input allocated to $H_2$)
    - Energy based allocation, based on energy consumption of new ODC process which does not generate H2 (21% of energy input allocated to $H_2$)
- In general, Energy based allocation is preferred over Value based allocation (85% vs 15% of 13 voting participants)
- However, no operational data is yet available for the ODC process
- Adopted way forward:
  Apply value based allocation in the short term, with perspective of switching to energy based allocation with ODC process as benchmark once more data is available




Work resumed under CertifHy 3 to further investigate approaches considering energy balance, yielding a robust result.
Case study currently on hold, pending further consensus within chlor-alkali Industry.
In line with CertifHy 2 results, the CertifHy carbon footprint calculation procedure will prescribe value based allocation until an energy based approach is adopted.

# $H_2$ production from waste - Principle

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Application:

*Mobility*
*Steel Industry*
*Chemical Ind.*

## Feedstock used for hydrogen production

- **Refuse Derived Fuels (RDF)**
- Mixture of municipal and industrial waste
- High content of mixed plastic waste
- 30 wt.% biogenic

→ Not suitable for material recycling
→ Currently used for electricity production in waste incineration plants or co-fired in cement plants

# Footprint of waste constituted of mixed non mechanically recyclable material in accordance with ISO 14067

- The CFP of the upstream product includes the GHG emissions from the end-of-life stage in accordance with an end-of-life scenario that *reflects the current market and is representative of one of the most likely alternatives* (ISO 14067 cl. 6.3.8).
- Emissions from extraction and processing of raw material need to be shared between the upstream and downstream product systems. However, for recycled material given free of charge the allocation factor may be considered to be zero (ISO 14067 Annex D section D.4).

***Footprint of waste = "Upstream product system" emissions allocated to "Recycled chemical product system"***

**Emissions from extraction and processing of raw material**

Allocation factor determines share allocated to downstream system

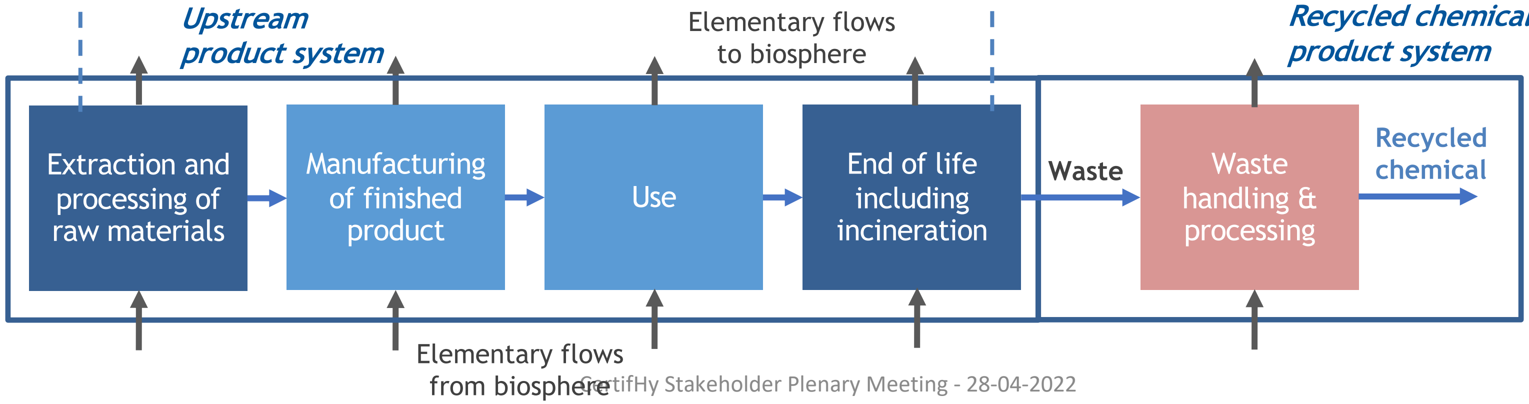
The waste is supplied free of charge → **Allocation 1 = 0**

+

**… keeping emissions of reference EoL scenario assigned to upstream product system**

→ the reduction of emissions from avoidance of incineration must be assigned to the downstream system

→ **Allocation 2 = - waste combustion emissions**




**Non incinerated waste is allocated a negative footprint that will be offset by emissions of the contained carbon when used to produce hydrogen**

# Restoring consistency with energy balance of energy based allocation in processes co-producing hydrogen and hydrocarbons

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There is a fundamental physical relationship between energy inputs and energy outputs in terms of energy balance. The ISO standards require allocation to be consistent with such a relationship. (see slide 6)

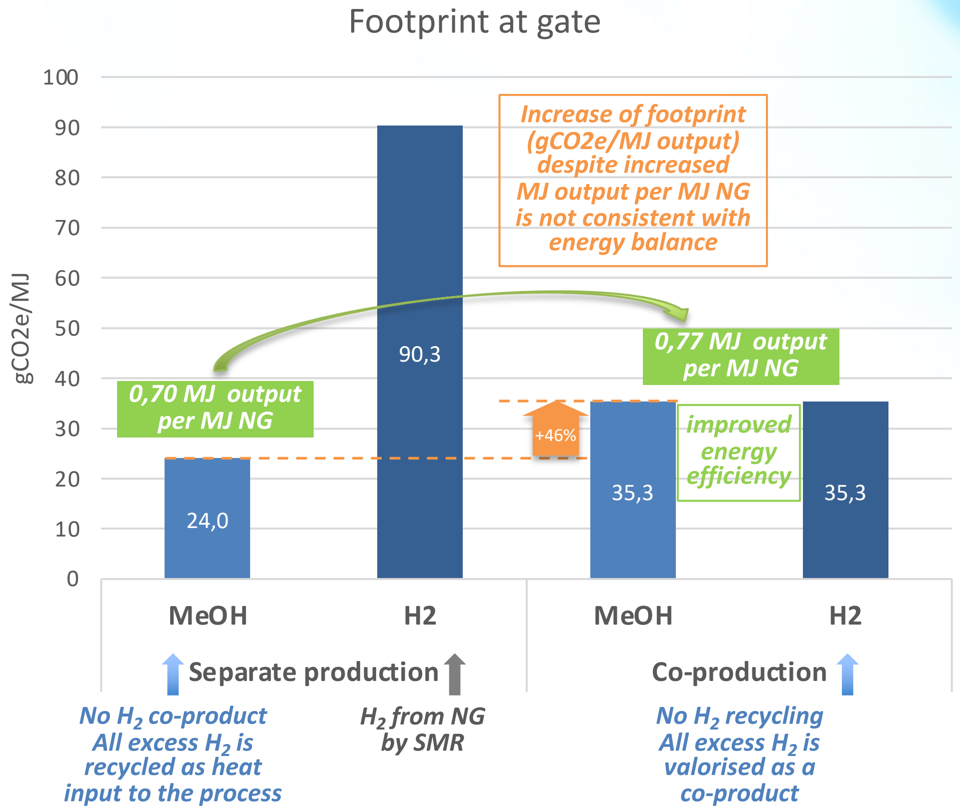
There are various ways to check consistency of an allocation method with energy balance:

1. A change in ratio of co-products improving the overall energy efficiency of the production process should not result in the well-to-gate footprint of any co-product being increased.

2. For the co-products that are used as a fuel, total footprint (i.e. well-to-grave) of that fuel should not be lower than the footprint of the energy input physically required to generate the fuel.

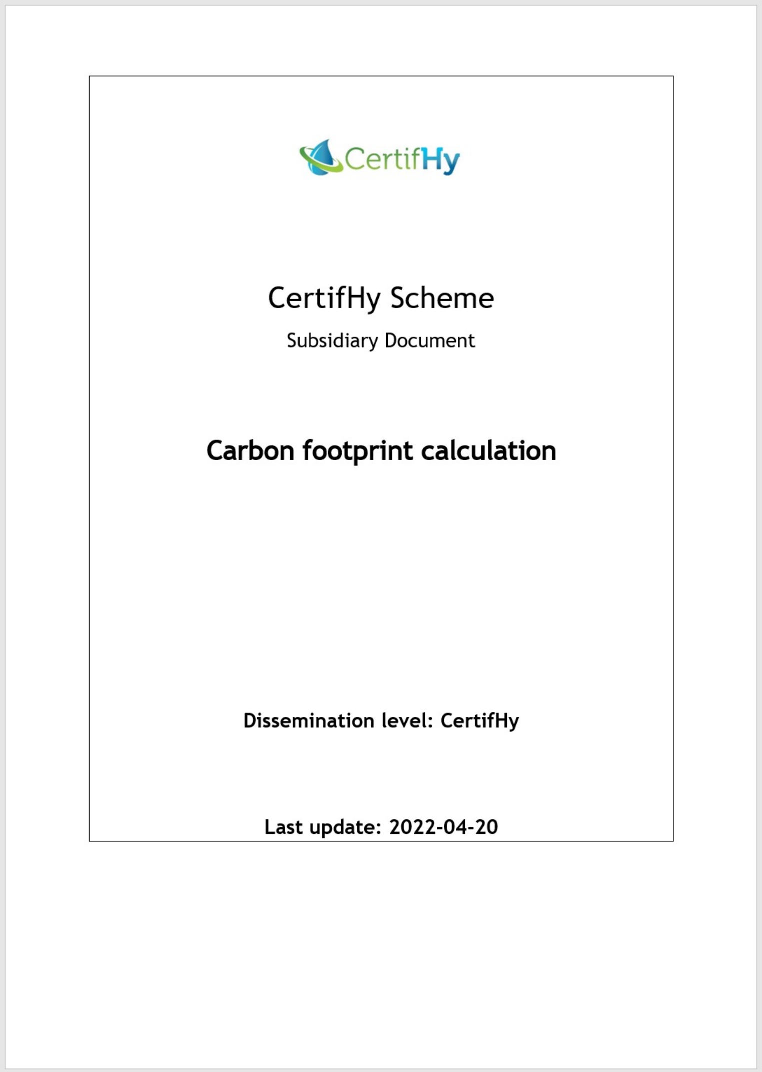
In the case of co-production of hydrogen and hydrocarbons, straightforward energy based allocation results in inconsistencies with energy balance.

Example – Straightforward energy based allocation for co-production of methanol and $H_2$ from natural gas:



# The adopted carbon footprint methodologies are formalised in a CertifHy scheme document

- A living document providing directly applicable and simple footprint calculation methods
- Provides calculation instructions for straightforward generic cases, as well as for the specific situations covered by case studies for which consensus has been achieved within CertifHy. Therefore, it is not yet fully comprehensive.
- Current version has been approved by WG2, and checked for consistency with the revised Scheme Documentation (proposed for endorsement) by WG1 and WG2 coordinators, together with WG1 chair.
- Will have the status of CertifHy public deliverable - which can be referred to - until endorsement by the Stakeholder Platform on the next occasion.


CertifHy Scheme

Subsidiary Document

**Carbon footprint calculation**

**Dissemination level: CertifHy**

**Last update: 2022-04-20**