

France Hydrogène's contribution on the Delegated Act defining a method for assessing GHG emission savings for renewable hydrogen

The Renewable Energy Directive (RED II) establishes rules to define renewable hydrogen as “renewable liquid and gaseous fuels of non-biological origin” (RFNBO), with a greenhouse gas emission savings requirement of -70% compared to a fossil fuel comparator¹. The [Delegated Act from Article 28 \(5\) of RED II and its Annex](#) establish a methodology to assess GHG emission savings from RFNBOs (renewable hydrogen and its derivatives, such as renewable ammonia, methanol, e-fuels, e-methane) and have a structural impact for the EU hydrogen industry:

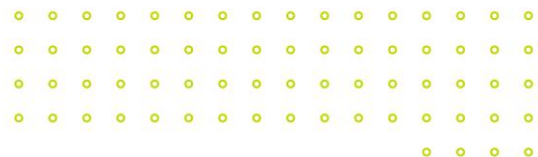
- If the methodology is currently limited to RFNBOs for the transport sector only, **it is supposed to be extended to all uses of RFNBOs in the future** with [the ongoing revision of RED II](#) introduced with the Fit-for-55 Package (RED III).
- This methodology will also **apply to the [EU Taxonomy on Sustainable Activities](#) for the “manufacture of hydrogen”**, with a threshold of 3.0 kgCO₂_{eq}/kgH₂.
- The **future methodology to assess GHG emission savings for low-carbon hydrogen and low-carbon fuels**, to be defined in a Delegated Act expected by 2024 (Article 8 from [Directive on gas and hydrogen](#)), would be very likely based on same principles and approaches.

France Hydrogène welcomes the initiative which has been long awaited to complete the legal definition of renewable hydrogen, provide a clear and certain framework to investors and industrials, and open the way to the certification of RFNBOs within the EU market. However, several technical details included in the Annex raise serious concerns and **France Hydrogène would like to draw the attention on some provisions which could be improved to provide clearer guidance for the development of the hydrogen industry.**

KEY RECOMMENDATIONS

- 1. Clarify the status of emissions from transport and storage of hydrogen.** It should be explicitly referred whether they are included or excluded from the scope of the carbon methodology for hydrogen as distribution is explicitly excluded, and to clarify the downstream gate to be considered.
- 2. Attribute correct and consistent average GHG emissions intensity to Member States' electricity mixes** in table A part C of the Annex. Alternative sources of data from European or national reliable references such as TSO/DSO should be of use instead, so that the French electricity mix could be properly assessed.
- 3. Introduce an alternative approach to assess GHG emissions content of grid electricity, based on the hourly average carbon content.** This will provide consistency with the hourly time correlation expected for PPA-contracted renewable electricity supplying electrolyzers by 2027.
- 4. Use the average value from the three previous calendar years to assess the number of full load hours an electrolyser can operate** with low-carbon electricity, based on the number of hours in which the marginal price of electricity is set by renewable or nuclear installations.
- 5. Streamline the carbon intensity of renewable electricity and nuclear electricity.** Assumptions made in the Delegated Act favor renewable electricity by neutralizing its upstream emissions, and disfavor nuclear electricity by including upstream emissions. Both renewable and low-carbon electricity generation technologies should be treated with a level-playing field.
- 6. Introduce a grandfathering clause for e-fuels production projects using industrial CO₂.** Installations producing methanol, e-fuels or e-methane, by combining renewable hydrogen with CO₂ captured from industrial plants, should not be obstructed after 2036, otherwise current e-fuels projects with a 15 to 20 years lifetime would be cancelled.

¹ Article 25 (2) of RED II: “the greenhouse gas emissions savings from the use of renewable liquid and gaseous transport fuels of non-biological origin shall be at least 70 % from 1 January 2021”



1. On the threshold for the definition of renewable hydrogen

The Annex establishes the minimum threshold for GHG emissions for renewable hydrogen, by defining the fossil fuel comparator missing in Article 25 (2) from RED II from which the GHG emissions savings of -70% shall be applied. It specifies that **the fossil fuel comparator shall be 94 gCO_{2eq}/MJ for all kinds of RFNBOs, including renewable hydrogen**. This value seems appropriate as it reflects fairly accurately the carbon footprint of the conventional fossil-based hydrogen predominantly produced and consumed in the EU, i.e. “grey hydrogen” produced with steam methane reforming, with a corresponding equivalent of 11.28 kgCO_{2eq}/kgH₂.

As a result, **the minimum threshold for renewable hydrogen would be assessed at 3.38 kgCO_{2eq}/kgH₂ (or 28.2 gCO_{2eq}/MJ)**. This threshold is sufficiently flexible to include various production pathways of renewable hydrogen, such as electrolysis of water with solar electricity, wind electricity (onshore and offshore), or hydropower. It provides certainty to investors and industrials to build up projects of renewable hydrogen production in the EU.

However, the Annex claims that **emissions from compressing hydrogen are excluded from the fossil fuel comparator as well as the carbon footprint of renewable hydrogen**³. This provision is insufficiently clear as it does not give any data nor figures on emissions from compressing hydrogen to be deducted, preventing a precise threshold for renewable hydrogen to be calculated. The French Environmental Agency ADEME has assessed the impact of compression of hydrogen (200 bars) at 0.1 kgCO_{2eq}/kgH₂, using French grid electricity⁴.

ADEME’s assessment of carbon footprint of various hydrogen production pathways²

Production pathway	Carbon footprint (kgCO _{2eq} /kgH ₂)
Steam methane reforming (SMR)	11.1
Electrolysis from grid electricity (France)	2.77
Electrolysis from grid electricity (EU)	19.8
Electrolysis from solar electricity	2.58
Electrolysis from wind electricity	0.70
Electrolysis from hydro electricity	0.45

France Hydrogène considers that this provision should therefore be either removed as the impact of compression could be considered as insignificant, either be specified in the Annex with a clear value of emissions from compressing hydrogen (to be deducted from the fossil fuel comparator).

2. On the scopes of the carbon methodology for renewable hydrogen

The carbon methodology proposed in the Annex for assessing GHG emissions for RFNBOs is not based on a full life-cycle analysis of the carbon footprint, but on a partial LCA. Section 1 of the Annex reminds that under RED II methodology, **emissions from the manufacture of machinery and equipment are not taken into account** (i.e. upstream indirect emissions). This choice means there is no need to assess emissions from manufacturing of electrolyzers, vehicles, hydrogen refueling stations, or power plants. **Applied to renewable hydrogen produced with electrolysis**, this methodology would cover the following scopes:

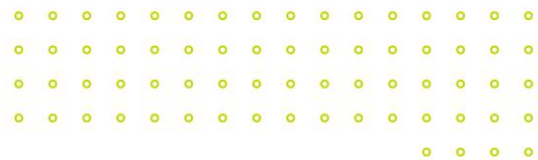
$$E = e_i + e_p + e_{td} + e_u \quad \text{where}$$

- E = total emissions for renewable hydrogen.
- e_i = emissions from supply of inputs. **For electrolyzers, the only elastic inputs would be electricity** (i.e. indirect emissions), let it be considered as fully renewable (section 5 of the Annex) or partially renewable (sections 6 and 7 of the Annex).

² All assessments on hydrogen production and compression from ADEME are available on its Carbon Database online ([link](#))

³ Section 1 of the Annex: “emissions from (...) compressing and distribution of hydrogen for its direct use in vehicles shall not be taken into account”; as well as footnote page 1: “emissions from compressing and transport of hydrogen are also excluded from the fossil fuel comparator applied to hydrogen”.

⁴ All data on hydrogen production and compression from ADEME are available on its Carbon Database available online ([link](#))



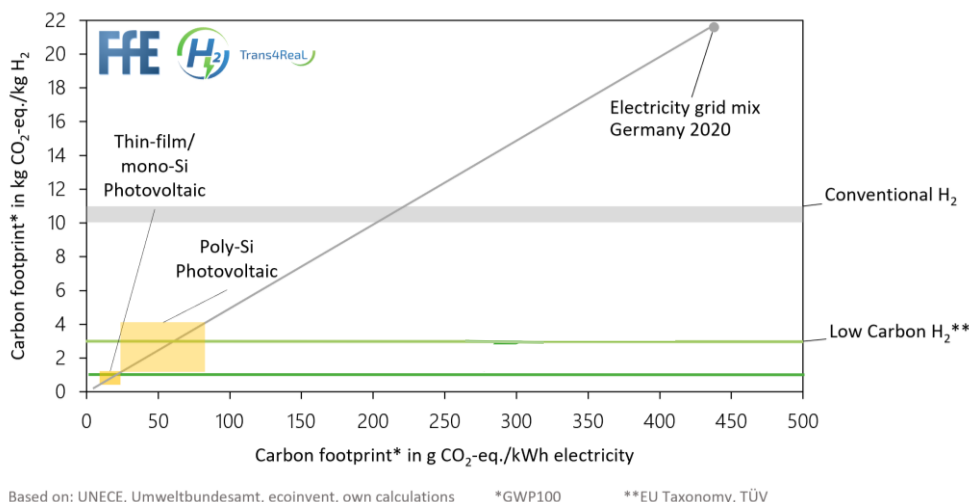
- e_p = emissions from processing (direct emissions), which are **equal to zero for electrolysis of water** producing only hydrogen and oxygen⁵.
- e_{td} = emissions from transport, storage and distribution (i.e. downstream indirect emissions). However, section 1 of the Annex states that “*emissions from compressing and distribution of hydrogen for its direct use in vehicles shall not be taken into account*”. **France Hydrogène welcomes this choice as the emissions from compression and distribution should be considered as marginal⁶**. Nevertheless, **the status of emissions from transport and storage of hydrogen, from its production site to a hydrogen refueling station (HRS), is not clear enough in the Annex**, as emissions from transport are excluded from the fossil fuel comparator. **France Hydrogène asks for a clarification of this point**. Depending on whether renewable hydrogen is produced on-site at HRS, delivered by trucks, or delivered by pipelines, emissions from transports would count differently and would vary according to the geographical distances between production and distribution sites. The downstream gate needs to be clearly defined.
- e_u = emissions from combusting the fuel in its end-use (i.e. downstream indirect emissions). These emissions are **equal to zero when renewable hydrogen is used as a fuel in a fuel cells electric vehicle (FCEV) emitting only water, or in an internal combustion engine (ICE) vehicle emitting only NOx**.

3. On the carbon intensity of electricity supplying electrolyzers

To determine the carbon intensity of electricity supplying electrolyzers (e_i), **the European Commission has chosen to establish some conventions which are not fully in line with the physical reality** of the carbon content embedded in electricity generation depending on the technologies. Besides, it is unclear at this stage whether these rules for electricity apply for supplies to electrolyzers only or its auxiliaries as well.

a) Conventions made for renewable electricity are highly favorable

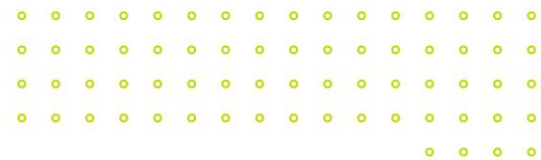
Firstly, as emissions from the manufacture of machinery and equipment are excluded, **the carbon equivalent emissions associated with renewable electricity production (wind, solar, hydro and geothermal) are conventionally considered to be equal to zero**. This choice does not actually reflect their carbon content embedded in the form of the energy necessary to extract, process and supply (critical) materials needed by renewable electricity installations, such as silicon for instance. As a result, the emission factor of renewable electricity such as solar might be potentially minimized⁷.



⁵ Section 12 of the Annex mentions that “*emissions from processing shall include direct atmospheric emissions from the processing itself, from waste treatment and leakages*”, meaning leakages of greenhouse gases (CO₂, CH₄ and N₂O) should be considered at this stage.

⁶ The French Environment Agency ADEME has assessed emissions from compressing and distribution of hydrogen in HRS from a range between 0.11-0.39 kgCO₂eq/kgH₂ in France

⁷ With emissions from the manufacture of solar panels included, the carbon intensity of solar electricity ranges from 23 to 83 gCO₂eq/kWh for currently common poly-Si technologies and from 7 to 23 gCO₂eq/kWh with growing cell technologies thin-film and mono-Si. As the result, the



Consequently, **the European Commission choses to attribute to electricity qualifying as fully renewable a zero GHG emissions value**⁸. In connection with the other Delegated Act from Article 27 (3) of RED II⁹, this provision means that fully renewable electricity either produced from RES sources with a direct connection, either from RES producers contracted with Power Purchase Agreements (PPA), either from grid electricity taken from electricity mixes with a share of renewables equal or superior to 90%, or either during imbalance settlement periods redispatching renewable electricity, would be carbon neutral (0 gCO_{2eq}/MJ) when supplying electrolyzers. **This convention would mean that the overall carbon footprint of renewable hydrogen produced through one of the aforementioned methods would also be close to zero**, depending on whether emissions from transport and storage of renewable hydrogen from production sites to distribution sites are included or not (see previous part).

b) Emissions from low-carbon electricity should be reassessed appropriately

Secondly, according to RED II, another method to produce RFNBOs is **to supply electrolyzers with grid electricity and use the average share of renewable electricity from the mix of production** (as measured two years before) to determine a share of renewable energy¹⁰.

On such a case, however, **grid electricity does not qualify as fully renewable nor as a result as equal to zero emissions, but as partially renewable and should be attributed a GHG emissions value**¹¹. This value shall be taken into account in the carbon methodology to assess renewable hydrogen as emissions from the supply of inputs (see previous part), and shall be sufficiently low so that the overall carbon footprint of renewable hydrogen is below the threshold of 3.38 kgCO_{2eq}/kgH₂. In other words, **grid electricity supplying electrolyzers should be low carbon**. This requirement is set to prevent electricity demand generated by electrolyzers from pulling on fossil-fuel-based power generation facilities.

To do so, one of the following **three approaches shall be used to attribute GHG emissions values to grid electricity**:

- 1) The first one consists in **attributing a default GHG emissions value defined in table A from part C of the Annex**, corresponding to **the average emission intensity of generated electricity in Member States in 2018**. The table attributes arbitrary values to Member States' electricity mixes without any sources for the calculation of the country-level factors, which seem to include upstream emissions. **France Hydrogène expresses doubts about the values chosen for some countries, such as France with a value of 20 gCO_{2eq}/MJ (72 gCO_{2eq}/kWh) in average**. Official data from the European Environment Agency tend to give alternative credible sources, with values of 58 gCO_{2eq}/kWh in 2018 or 51 gCO_{2eq}/kWh in 2020 in average in France¹². **France Hydrogène expects reliable European or national sources to be used by hydrogen producers** instead in alternative to the values from the table, notably data from TSO/DSO.
- 2) The second one consists in **attributing to grid electricity a GHG emissions value of zero (0 gCO_{2eq}/MJ) on the only condition that electrolyzers are running and producing renewable hydrogen no more than a number of full load hours equal or lower than the number of hours in**

French Environment Agency ADEME assesses the carbon footprint of renewable hydrogen from electrolysis with solar electricity to be about 2.58 kgCO_{2eq}/kgH₂ in average in France

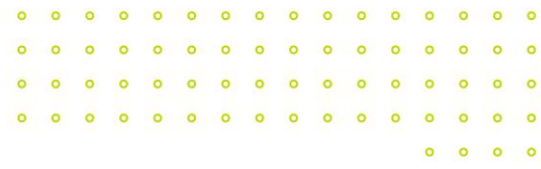
⁸ Section 5 of the Annex: "electricity qualifying as fully renewable according to the methodology set out in Directive 2018/2001, shall be attributed zero greenhouse gas emissions"

⁹ Delegated Act supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a Union methodology setting out detailed rules for the production of renewable liquid and gaseous transport fuels of non-biological origin, currently under consultation

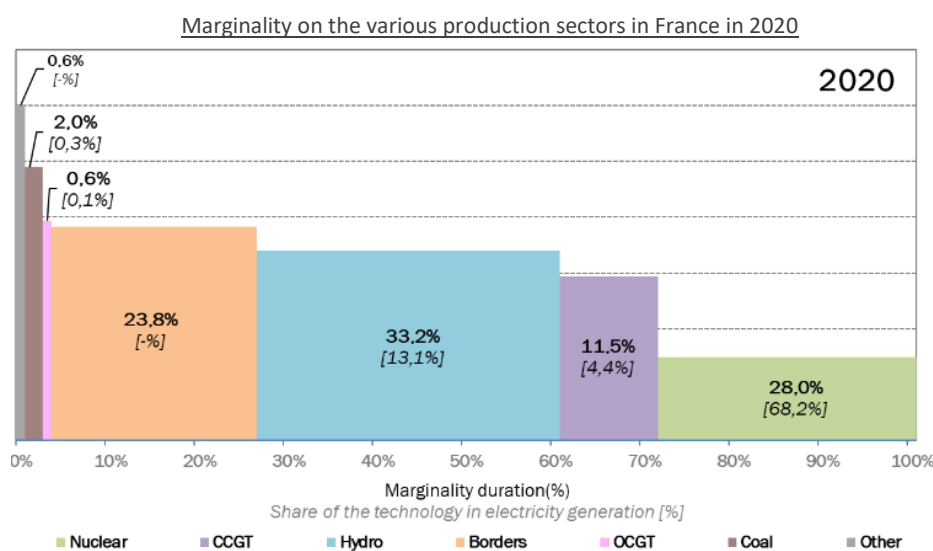
¹⁰ Article 27 (3) of RED II: "where electricity is used for the production of renewable liquid and gaseous transport fuels of non-biological origin, either directly or for the production of intermediate products, the average share of electricity from renewable sources in the country of production, as measured two years before the year in question, shall be used to determine the share of renewable energy"

¹¹ Section 6 of the Annex: "grid electricity used in the production process of renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels that does not qualify as fully renewable according to Article 27(3) of Directive 2018/2001, shall be attributed the greenhouse gas emissions values (...)"

¹² EEA website on Greenhouse gas emission intensity of electricity generation in Europe ([link](#))



which the marginal price of electricity was set by installations producing renewable electricity or nuclear power plants (in the preceding calendar year). **In France, this number was about 4900 hours in 2019, 5300 hours in 2020 and 3900 hours in 2021¹³.** With this approach, the Commission considers that electrolyzers are supplied with excesses of renewable and low-carbon electricity. **France Hydrogène asks that the number of full load hours to be assessed based on the average value from the three previous calendar years** and not only on the preceding calendar year, to provide more certainty to hydrogen producers. Above this limit, a carbon intensity of 183 gCO_{2eq}/MJ should be attributed on hours exceeding the precedent limit.



Sources: EPEX SPOT, RTE, Producers – Analysis: CRE

- 3) The third one consists in **attributing the GHG emissions value of the marginal unit generating electricity** at the time of the production of renewable hydrogen in the same geographical zone, if this information is publicly available from a reliable source¹⁴. For nuclear plants, the emission factor shall include an upstream emissions factor set in table 3 part C of the Annex¹⁵.

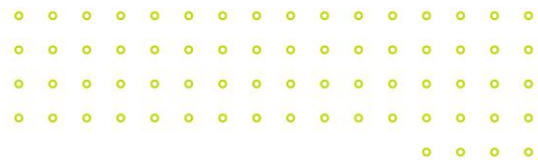
The assumptions made in the Delegated Act show a **clear preference given to renewable electricity for which upstream emissions are excluded and unfavourable assumptions made for nuclear electricity for which they are. France Hydrogène asks for the streamlining of these assumptions**, either with a proper robust LCA of the carbon intensity of renewable electricity depending on the RES power generation technologies, either with a level-playing field given to all renewable and low-carbon technologies (such as a zero direct emission factor applied to nuclear power and to renewables).

Alternatively, **France Hydrogène suggests an additional approach based on the average hourly carbon content of grid electricity** to be used to determine the GHG emissions content of the electricity supplied to electrolyzers. Some TSO and DSO already make this information available, as close to real time as possible in time intervals of one hour. And the RED III will constrain them to provide these data to consumers. This approach would incentivize electrolyzers to be turned off during hours of highest carbon intensity. It is also in line with the time correlation of one hour required by 2027 to produce RFNBOs with renewable electricity supplied by PPAs (second Delegated Act from Article 27 (3)).

¹³ CRE, *Surveillance report 2020. The functioning of the wholesale electricity and natural gas markets*, page 46

¹⁴ Section 7 of the Annex

¹⁵ For nuclear, the upstream emission factor is set at 1.4 gCO_{2eq}/MJ (5,04 gCO_{2eq}/kWh) according to a JEC WTW v5 study. With a conversion efficiency from nuclear heat at 33% according to the Annex, this leads to an emission factor for nuclear electricity of 15.3 gCO_{2eq}/kWh. But JEC WTW v5 data for enrichment of uranium are sourced from an outdated 2002 GENIS study whose assumptions are based on obsolete technologies for the enrichment of uranium (gaseous diffusion process) and with EU average grid electricity of 105.4 gCO_{2eq}/MJ (378 gCO_{2eq}/kWh), while enrichment in France is made with new energy efficient processes (modern gas centrifuge plants) and low-carbon nuclear electricity, leading to carbon intensity below 10 gCO_{2eq}/kWh according to most recent LCA studies on nuclear electricity.



4. On the production of renewable e-fuels with CCU technologies

The carbon methodology defined in the Delegated Act not only applies to renewable hydrogen, but also to all other types of RFNBOs such as **renewable methanol, e-fuels and e-methane all derived from renewable hydrogen combined with captured CO₂ (CCU)**.

For these synthetic fuels, the scope shall include and deduct the CO₂ equivalent of the carbon captured and incorporated in the chemical composition of the fuel that was or would have otherwise been emitted as CO₂ into the atmosphere.

However, the Annex specifies that **carbon from non-sustainable sources, captured from industrial emissions with CCU technologies, could only be used to produce e-fuels before 2036¹⁶**. This choice means that from 2036, it will not be possible to use emissions from industrial plants to produce RFNBO and that only atmospheric carbon captured with Direct Air Capture (DAC) technologies and biogenic carbon captured from the combustion of bioenergy could be of use to produce e-fuels from 2036 onwards.

Volumes of biogenic CO₂ will be limited and technologies for DAC will not be available shortly at affordable costs and will require massive quantities of energy to be deployed. In the meantime, industrial plants, especially in hard-to-abate sectors such as cement factories for which CO₂ is a by-product of the chemical production process, will still emit carbon in the atmosphere. Therefore, there is no reason to favour biogenic CO₂ and DAC over CO₂ captured on industrial plants, which is also less energy intensive.

In parallel, there is a growing consensus regarding the need to develop at an industrial scale massive amounts of synthetic fuels to be able to reach decarbonation goals, especially in the maritime and the aviation sectors (with Fuel EU Maritime Regulation and ReFuel EU Aviation Regulation).

Therefore, **France Hydrogène asks that this specific point to be removed from the Delegated Act and discussed in the legislative proposal package on sustainable carbon cycles expected by the end of 2022**. Alternatively, if this provision were to remain, **France Hydrogène asks for the introduction of a grandfathering clause to safeguard projects of e-fuels production with non-avoidable CO₂ captured on industrial plants**, that will be commissioned in the coming years with an average lifetime of 15 to 20 years.

¹⁶ Section 11 of the Annex, point (a): “the CO₂ has been captured from an activity listed under Annex I of Directive 2003/87/EC and has been taken into account upstream in an effective carbon pricing and is incorporated in the chemical composition of the fuel before 2036”