

# Is nuclear green? European Union is splitting on hydrogen from nuclear power

July 7, 2023

Hydrogen will play an important role in the decarbonization of hard-to-abate sectors, such as heavy industry, shipping, aviation and heavy transport.<sup>1</sup>

Nonetheless, the deployment of low-emission hydrogen as clean industrial feedstock and energy vector is at an early stage globally. According to the European Commission, in 2022 hydrogen has accounted for less than 2% of Europe's energy consumption and has been used primarily to produce chemical products, such as plastics and fertilizers. Moreover, almost 96% of that 2% was made from natural gas, therefore resulting in significant amounts of CO<sub>2</sub> emissions.<sup>2</sup>

France and a few other Member States are calling on the EU to include hydrogen produced from nuclear energy among its "renewable energy" targets so as to foster decarbonization through production and use of low-emission hydrogen.

This request has been opposed by other Member States, including Germany, Denmark, Austria and Luxembourg, arguing that the EU targets should only focus on renewable sources, such as wind and solar, to cut on Europe's reliance on fossil fuels. According to the opposing Member States, "*counting low-carbon energy towards renewable targets would rather reduce our climate efforts and slow down investment in the much-needed additional renewable capacity*".<sup>3</sup>

If you have any questions concerning this memorandum, please reach out to your regular firm contact or the following authors

Brussels

**François-Charles Lapr v te**  
+32 2287218  
[fclaprevote@cgsh.com](mailto:fclaprevote@cgsh.com)

Milan

**Cristina Dionisio**  
+39 02 7260 8238  
[cdionisio@cgsh.com](mailto:cdionisio@cgsh.com)

Rome

**Pollonara Consuelo**  
+39 06 6952 2616  
[cpollonara@cgsh.com](mailto:cpollonara@cgsh.com)

<sup>1</sup> Heavy industry, shipping, aviation and heavy transport are sectors where emissions are hard to abate, and clean energy alternatives cannot be implemented due to lack of up-to-date technology and/or prohibitive costs. Low-emission hydrogen and hydrogen-based fuels can be used to replace fossil-based hydrogen fuels for transport and industrial processes and to start new industrial products, such as green fertilizers and steel (see European Commission, Topics, Energy system integrations, Hydrogen, available [here](#)).

<sup>2</sup> European Commission, Topics, see footnote 1.

<sup>3</sup> Joint ministerial letter from Austria, Denmark, Germany, Ireland, Luxembourg, Portugal, Spain on the Renewable Energy Directive and Article 8a of the Gas Directive, March 16, 2023, available [here](#).



The diverging positions of Member States have created an impasse in Brussels leading to delays in the formal approval of the new revised Renewable Energy Directive proposed by the European Commission in July 2021 (“RED III”).<sup>4</sup>

## 1. The color spectrum of nuclear-produced hydrogen

Hydrogen may be produced by means of different types of energy sources (coal, oil, natural gas, biomass, renewables and nuclear) through a wide variety of technologies (reforming, gasification, electrolysis, pyrolysis, water splitting and many others).

In recent years, hydrogen (including nuclear-produced hydrogen) has been identified by a specific color code depending on the applications.<sup>5</sup> In particular, with respect to nuclear-produced hydrogen:

- *Red Hydrogen* - produced through high-temperature catalytic splitting of water using thermal nuclear power;
- *Pink Hydrogen* - produced through electrolysis of water fed by electricity from a nuclear power plant;
- *Purple Hydrogen* - produced from nuclear power and heat through combined chemo-thermal electrolysis splitting of water.

<sup>4</sup> Proposal for a Directive of the European Parliament and of the Council of July 14, 2021, amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC with respect to the promotion of energy from renewable sources and repealing Council Directive (EU) 2015/652, available [here](#).

<sup>5</sup> The best-known hydrogen categories are the following:

- *Grey Hydrogen* - fossil-based hydrogen derived from natural gas, which emits a significant amount of CO<sub>2</sub> emissions in the production process;
- *Blue Hydrogen* - also generated from natural gas, but the carbon generated from steam reforming is captured and stored underground through industrial carbon capture and storage (CSS). In this case, emissions are not released in the atmosphere;
- *Green Hydrogen* - mainly produced by splitting water (water electrolysis) using electricity generated from renewable energy sources;
- *Turquoise Hydrogen* - still at the experimental stage, produced through methane pyrolysis to produce hydrogen and solid carbon;

According to the latest report of the Nuclear Energy Agency (NEA),<sup>6</sup> nuclear power is a competitive energy source to produce low-emission hydrogen on a large scale. Almost globally, the cost of hydrogen produced from new nuclear reactors is similar to that of hydrogen produced from renewable energy sources (solar and wind). Moreover, nuclear has low grid and system level costs.<sup>7</sup>

Several Member States favor investments in hydrogen from nuclear power, provided however that such type of hydrogen will be defined as a “renewable” or at least a “low-carbon” energy source in the EU legislative framework.

## 2. Nuclear-produced hydrogen in the EU legislative framework

### 2.1 Why does being “renewable” matter?

Production of “renewable” hydrogen is a priority for the European Union.

- First, the RepowerEU Plan<sup>8</sup> sets out a binding target for the European Union of 10 million tons “renewable” hydrogen production and 10 million tons of “renewable” hydrogen import by 2030.

- *Black/Brown Hydrogen* - uses black (bituminous) or brown (lignite) coal in the hydrogen production process and is the most environmentally damaging type of hydrogen.

<sup>6</sup> NEA, “*The Role of Nuclear Power in the Hydrogen Economy: Cost and Competitiveness*”, March 1, 2023, available [here](#).

<sup>7</sup> According to the NEA Report, “*the costs of producing hydrogen from solar in the European Union and nuclear new builds are largely similar. [...] In general, technologies that benefit from cheap electricity such as amortised nuclear (e.g. nuclear-LTO) and renewables in locations with high resource endowments (e.g. solar-ME and solar-NA) provide very competitive hydrogen, around USD 2 per kgH<sub>2</sub>*” (§ 2.2.2). Regarding hydrogen storage, transport and distribution costs, the NEA Report highlights that “*systems with steady production (i.e nuclear) have hydrogen storage, transport and distribution costs that are up to four or five times lower than systems with variable production (i.e variable renewables)*.” (§2.4).

<sup>8</sup> Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, May 18, 2022, REPowerEU Plan, COM/2022/230 final, available [here](#).

- In addition, Directive (EU) 2018/2001 (“**RED II**”)<sup>9</sup> provides that the portion of “renewable” energy consumed in the transport sector shall reach at least 14% by 2030. In particular, RED II and Council Delegated Regulation of February 10, 2023 (the “**First Delegated Act**”),<sup>10</sup> required under RED II, provide that such target can be fulfilled by using renewable liquid and gaseous transport fuels of non-biological origin (“**RFNBOs**”), which generally means “renewable” hydrogen-based fuels.<sup>11</sup>
- RED III further strengthens the target for “renewable” hydrogen in the EU energy mix, establishing that 42% of hydrogen used in the industry sector must come from RFNBOs by 2030 and 60% by 2035. It also provides the portion of RFNBOs consumed in the transport sector reach at least 1% by 2030.

As a result, Member States are pushing to include nuclear-produced hydrogen in the “renewable” hydrogen category, which would allow nuclear-produced hydrogen to be part of the binding quotas of “renewable” hydrogen or RFNBOs under the RepowerEU Plan, RED II and RED III.

## 2.2 “Renewable” hydrogen or “low carbon” hydrogen?

Despite not being defined as “renewable”, nuclear-produced hydrogen has somehow made its way

through the EU legislation regulating the energy transition process.

### A. *The First Delegated Act on “Renewable” Hydrogen*

The First Delegated Act required under RED II sets out the criteria for electricity used in hydrogen production to be considered as fully “renewable”.<sup>12</sup>

Nuclear energy does not qualify as “renewable” energy under RED II and the First Delegated Act and does not fall within the group of energy sources from which RFNBOs may be produced.<sup>13</sup>

However, Article 4 of the First Delegated Act provides that electricity taken from the grid may be considered fully “renewable” if the relevant hydrogen installation is located in a bidding zone where the emission intensity is lower than a certain threshold (*i.e.* 18 gCO<sub>2</sub>eq/MJ). In this respect, media sources<sup>14</sup> have argued that Article 4 has paved the way for nuclear-produced hydrogen to be considered as “renewable” hydrogen.

This interpretation is questionable and may not be expressly inferred from the text of the first Delegated Act. In fact, the First Delegated Act does not expressly state that nuclear-produced hydrogen can be considered fully “renewable”. On the contrary, the Commission itself while questioned on the matter stated that “*the proposed delegated acts stem from the*

<sup>9</sup> Directive (EU) 2018/2001 of the European Parliament and of the Council of December 11, 2018 on the promotion of the use of energy from renewable sources, available [here](#).

<sup>10</sup> Council Delegated Regulation of February 10, 2023 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, available [here](#). On February 10, 2023 the Council also approved a second Delegated Act (Council Delegated Regulation supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels, available [here](#)). The two Delegated Acts were formally published on June 20, 2023 and will enter into force 20 days following their publication in the Official Journal (*i.e.* on July 10, 2023).

<sup>11</sup> According to the amendments to RED II proposed within the “Fit for 55” package (*i.e.* Article 1(3) of the Proposal for a Directive of the European Parliament and of the Council amending Directive (EU) 2018/2001), “renewable liquid and gaseous transport fuels of non-biological origin” will no longer be limited to “transport” and thus become relevant also for industrial and heating sectors.

<sup>12</sup> For more information on the EU Delegated Acts on Renewable Hydrogen see Cleary Alert Memo “[European Commission Proposes Definition of Renewable Hydrogen in the EU](#)”.

<sup>13</sup> Pursuant to Article 2(1) of RED II, recalled in Article 2(3) of the first Delegated Act, renewable energy sources include “wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas”.

<sup>14</sup> See, for instance, Reuters: “[EU opens door to ‘green’ nuclear-derived hydrogen](#)” and Bloomberg: “[Nuclear power wins carve-out under EU’s green hydrogen rules](#)”.

*Renewable Energy Directive, under which nuclear is not listed among the renewable energy sources”.*<sup>15</sup>

Furthermore, Article 4 requires hydrogen producers to demonstrate that the hydrogen installation relies on electricity produced under a renewable power purchasing agreement (PPA)<sup>16</sup> and complies with “temporal” and “spatial” correlation requirements under the First Delegated Act. If these conditions and criteria are not met, electricity used for the production of RFNBOs will not be considered as fully renewable.

### **B. “Low-carbon” hydrogen: the Hydrogen and gas markets decarbonization package**

As part of the “Hydrogen and gas markets decarbonization package” (the “**Fourth Package**”) proposed by the European Commission in December 2021<sup>17</sup> and currently under discussion between the European Parliament and the Council, the European Commission has put forward a definition of “low-carbon” hydrogen as hydrogen derived from “non-renewable” sources producing at least 70% less greenhouse gas emissions than fossil natural gas across its full lifecycle.<sup>18</sup> Since nuclear power plants produce

few emissions, it may not be excluded that nuclear-produced hydrogen might fall under the definition of “low-carbon” hydrogen.<sup>19</sup> To ensure compliance with the 70% threshold, European legislators have proposed certification rules for “low-carbon” hydrogen and “low-carbon” fuels, which may apply to both imported and domestic production to ensure a level-playing field and avoid carbon leakage. By 31 December 2024, the European Commission shall adopt delegated acts to specify the methodology for assessing greenhouse gas emissions savings from “low carbon” fuels.<sup>20</sup>

Although “low-carbon” gases, including “low-carbon” hydrogen, are not “renewable”, they are equated to “renewable” gases in several provisions of the Fourth Package.<sup>21</sup> For instance, the Fourth Package aims at easing the integration of “renewable” and “low-carbon” gases into the existing gas network. As a matter of fact, the European Commission is proposing to: (i) grant discounts of 75% on entry tariffs (as already provided for “renewable” gases) and (ii) eliminate cross-border tariffs for both “renewable” and “low-carbon” gases<sup>22</sup>.

<sup>15</sup> See Commission’s press release entitled “*Questions and Answers on the EU Delegated Acts on Renewable Hydrogen*” (available [here](#))

<sup>16</sup> According to Article 4(2) of the First Delegated Act fuel producers shall prove that they “*have concluded directly, or via intermediaries, one or more renewables power purchase agreements with economic operators producing renewable electricity in one or more installations generating renewable electricity for an amount that is at least equivalent to the amount of electricity that is claimed as fully renewable, and the electricity claimed is effectively produced in this or these installations*”.

<sup>17</sup> The “Hydrogen and gas markets decarbonization package” consists of: (a) a Proposal for a Directive of the European Parliament and of the Council on common rules for the internal markets in renewable and natural gases and in hydrogen, COM(2021) 803 final, available [here](#) (the “**Proposed Directive**”); and (b) a Proposal for a Regulation of the European Parliament and of the Council on the internal markets for renewable and natural gases and for hydrogen, COM(2021) 804 final, available [here](#) (the “**Proposed Regulation**”).

<sup>18</sup> See Article 2(10) of the Proposed Directive.

<sup>19</sup> According to the International Atomic Energy Agency (IAEA) “*During operation, nuclear power plants produce almost no greenhouse gas emissions*”. IAEA Bulletin, “*What is the Clean Energy Transition and How Does Nuclear Power Fit In?*”, September, 2020, Vol. 61-3, available [here](#). See also the Commission’s press release “*Questions and Answers on the EU Delegated Acts on Renewable Hydrogen*” (link in footnote 15) in which the Commission appears to agree that nuclear-produced hydrogen might be considered “low-carbon” within the meaning of

the Package. Indeed, in relation to nuclear-produced hydrogen, the Commission stated that: “*As part of the Hydrogen and gas markets decarbonization package proposed in December 2021 and currently being negotiated by the co-legislators, the Commission put forward a definition of low-carbon hydrogen*”.

<sup>20</sup> See Article 8(5) of the Proposed Directive.

<sup>21</sup> The Proposed Directive explains that “*the priority for the EU is to develop renewable hydrogen produced using mainly wind and solar energy. [...] However, low-carbon fuels (LCFs) such as low-carbon hydrogen (LCH) may play a role in the energy transition, particularly in the short and medium term to rapidly reduce emissions of existing fuels and support the uptake of renewable fuels such as renewable hydrogen*”. However, “*LCF and LCH are not renewable fuels and therefore their terminology and certification could not be included in the proposal for the revision of Directive (EU) 2018/2001 of the European Parliament and of the Council. Their inclusion in the “Hydrogen and gas markets decarbonization package” is aimed to fill in the gap*”.

<sup>22</sup> In the Commission Staff Working Document accompanying the Proposed Directive and the Proposed Regulation (available [here](#)) the Commission explains that the costs of transporting gases are borne by the transmission system operators (TSOs), and recovered via grid tariffs taking into account the allowed revenues to remunerate the TSO’s assets. However, the methodology to define how allowed revenues are determined - established by the National Regulatory Authorities (NRAs) - is not homogeneous among the Member States and it is not harmonised at EU level. Therefore, “*although being transparent and cost reflective, tariffs effectively render cross-*

Finally, the Fourth Package proposes harmonized gas quality standards, allowing the blending of up to 5% hydrogen into the existing grid. It also guarantees access to LNG terminals and gas storage for both “low-carbon” and “renewable” gases.

### C. *The RED III Directive*

The definition of nuclear-produced hydrogen has also become a key sticking point in reaching a political agreement on RED III.

On March 30, 2023 the Council and the European Parliament reached a provisional agreement recognizing “*the specific role of nuclear power, which is neither green nor fossil*”.<sup>23</sup> This has been seen as a victory for France, which has been lobbying for nuclear-powered hydrogen to be considered “low-carbon” given nuclear energy production in the country.

In addition, the provisional agreement has helped pro-nuclear energy Member States scoring another small victory. It requires the industry sector to increase use of “renewable” energy by 1.6% per year, while 42% of hydrogen used in the industry sector should come from RFNBOs by 2030 and 60% by 2035. At the same time, it introduces the possibility for Member States to benefit from a 20% rebate on the contribution of RFNBOs in industrial use under the following two conditions:

- if such Member States’ national contribution to the binding overall EU target meets their expected contribution;
- the share of hydrogen from fossil fuels consumed in such Member State is below 23% in 2030 and 20% in 2035.

---

*border flows uneconomic in case the tariff of the needed capacity is higher than the price difference between markets, to the detriment of overall efficiency. The more borders are crossed, the higher the effect of adding tariff layer on tariff layer, which is called the ‘pancaking’ effect” (§ 2.2.1.3).*

<sup>23</sup> As stated by French MEP Pascal Canfin’s (see the article at this [link](#)).

<sup>24</sup> Recital 3c states as follows: “*The targets for renewable energy sources should go hand in hand with the complementary decarbonisation efforts based on other non-fossil sources towards reaching climate neutrality in 2050. Member States should be able*

*This would allow Member States producing large quantities of atomic energy to use nuclear-produced hydrogen to benefit from the rebate.*

The formal approval of RED III, which should have been discussed at the Coreper meeting on May 17, 2023, has nonetheless been postponed following an objection by France and pro-nuclear Member States, seeking for additional assurances with respect to low-carbon hydrogen derived from nuclear power.

A compromise, which seems to satisfy France’s interests in nuclear power without reopening negotiations, was finally reached at the Coreper meeting on June 16, 2023, thanks to an additional recital in the preamble of the RED III recognizing the role of non-fossil fuel sources in achieving climate neutrality targets by 2050.<sup>24</sup>

In this respect, media sources<sup>25</sup> have argued that the Commission has acknowledged the role of nuclear power in achieving Europe’s decarbonization objectives, although not expressly mentioning it.

Although this amendment marks another victory for France and pro-nuclear Member States, the new recital does not change the qualification of nuclear-produced hydrogen provided under the provisional agreement of March 30, 2023 and nuclear-produced hydrogen is still not defined as “renewable hydrogen” under RED III.

The new text of the RED III will be submitted to Parliament’s ITRE committee for its opinion on June 28, 2023 and then to Parliament for final approval in September 2023.

*to combine different non fossil energy sources in order to achieve the objective of the Union to become climate neutral by 2050 in the context of their specific national circumstances and the structure of their energy supply. In order to achieve such objective, the deployment of renewable energy in the framework of the increased binding overall Union target should be integrated into complementary decarbonisation efforts involving the development of other non-fossil fuel sources that Member States may decide to pursue”.*

<sup>25</sup> See Euractive, *France finally satisfied with EU deal on renewables directive*, available [here](#).

### 3. Nuclear-produced hydrogen in the European economy

While Member States are still debating on the role of nuclear-produced hydrogen in the energy transition process, few European companies have already started investing.

As highlighted by the International Atomic Energy Agency,<sup>26</sup> in recent years small scale projects for hydrogen production from existing nuclear power plants have been initiated around the world so as to demonstrate technical feasibility and economic competitiveness.

Other nuclear hydrogen projects are also underway in North America (one in Canada and four in the USA) and Europe (one in Russia, two in Sweden and one in the UK). With respect to Europe:

- Sweden is one of the most active countries in the development of nuclear-produced hydrogen. In 2022, the world’s first commercial agreement for nuclear-produced (pink) hydrogen was executed in Sweden. Swedish electricity company OKG signed a contract to supply the industrial gas company Linde Gas with hydrogen produced at the Oskarshamn nuclear power plant in Simpevarp. Since 1992, OKG has been producing hydrogen through an alkaline electrolyser fed by electricity from its nuclear power plants. Originally, such hydrogen was used to cool the Oskarshamn reactors n. 1, 2, and 3. However, in 2016 and 2017 Oskarshamn reactors n. 1 and n. 2 were permanently closed and since then OKG has been producing hydrogen in excess compared to the site’s needs. As a result, OKG is selling the hydrogen in excess to Linde Gas.
- The French energy group EDF (Électricité de France)’s subsidiary EDF Energy in the UK has conducted a feasibility study for the production of hydrogen from nuclear power at the Heysham Power Station (with two contemplated 1 MW electrolysers) and is preparing a pilot project at the

Sizewell Power Station (with one contemplated 2 MW electrolyser at Sizewell B, and one electrolyser of undisclosed size at Sizewell C).

### 4. Conclusions

At this stage, EU legislation does not classify nuclear-produced hydrogen as “fully renewable” and in light of the opposition of a number of EU Member States it is unlikely that this position will be entirely reverted.

However, recent debates have shown that Member States and EU institutions are open to discuss other definitions for nuclear-produced hydrogen, in particular a “low-carbon” hydrogen category. As a result, nuclear-produced hydrogen may be able to make its way through EU legislation regulating the energy transition process and benefit, for instance, from tariff discounts, elimination of cross-border tariffs and access to LNG terminals and gas storage.

Moreover, decarbonization in industry and transport is not yet sufficiently advanced for renewable energies alone to displace fossil energy in these sectors. Therefore, “low-carbon” hydrogen could play a role in decarbonization, especially in the short- and medium-term energy transition. A few European companies have already started investing in nuclear-produced hydrogen and might become potentially significant supporters for this energy source.

...

CLEARY GOTTLIB

<sup>26</sup> IAEA Report of January 2023, *Hydrogen Production with Operating Nuclear Power Plants – Business Case*, available [here](#).