The role of hydrogen for a sustainable energy transition in the EU: Between a fossil gas-based and a renewable path

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Is the H2-related regulatory framework considering fossil gas a transitional energy source?

What are the main issues that arise from this regulation to follow a climate-aligned path?

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Is there a role for H2 to achieve the decarbonization goals?

2

The expected role of H2 in the European Union

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1. Is there a role for H2 to achieve the decarbonization goals?

H2 can be **potentially used for decarbonization** in different sectors and applications: as a feedstock or a source of energy in industrial and chemical processes, in air, maritime and heavy-duty road transport, in heating applications, and as energy storage.

However, its use should be **only for sectors in which direct electrification is not technologically possible or excessively burdensome** (e.g., not for heating or short-distance transport). Not all the uses of H2 have the same technological maturity. There are still uncertainties. Also, **important energy losses** occur in hydrogen production, transport and conversion (European Parliament, 2021).

Assuming massive hydrogen use in not-so-hard-to abate sectors runs the risk of oversizing hydrogen infrastructure (Andreola et al, 2021).

IPCC (2022). Mitigation of Climate Change report

"Progressing towards net-zero GHG emissions from industry will be enabled by the adoption of new production processes using low and zero GHG electricity, hydrogen, fuels, and carbon management (high confidence).

Sustainable biofuels, low emissions hydrogen, and derivatives (including synthetic fuels) can support mitigation of CO2 emissions from shipping, aviation, and heavy-duty land transport but require production process improvements and cost reductions (medium confidence).

Using electricity directly for heating, cooling, and other building energy demand is more efficient than using hydrogen as a fuel".

IRENA (2022)

"Indiscriminate use of H2 can slow the energy transition, also diluting the decarbonisation efforts of the power generation sector.
Hydrogen is therefore best reserved for the uses that currently have no viable alternative".

2. The expected role of H2 in the European Union to achieve the decarbonization goals

EC (2018). Strategic vision for a climate-neutral EU
"H2 in the EU energy mix is projected to **grow from less than 2% to 13-14% by 2050**".

EC (2019). The European Green Deal
"Further decarbonizing the energy system is critical to reach climate objectives.
The production and use of energy across economic sectors account for more than 75% of the EU's GHE. **Energy efficiency must be prioritised.**
A power sector must be developed that is based largely on renewable sources, complemented by the **rapid phasing out of coal and decarbonising gas**".

EC (2020). EU Strategy for Energy System Integration
"While direct electrification and renewable heat present the most cost-effective and energy-efficient **decarbonisation options** in many cases, **there are a number of end-use applications where they might not be feasible or have higher costs**".

EC (2020). A hydrogen strategy for a climate-neutral EU
"**Large-scale** deployment of clean hydrogen at a **fast pace** is key for the EU to achieve a **higher climate ambition in a cost-effective way**".

REPowerEU Plan (2022)
"**Renewable hydrogen will be key** to replace natural gas, coal and oil in **hard-to decarbonise industries and transport**".

3. What type of H2? Fossil-based and/or renewable H2?

- H2 is an energy carrier: it needs to be produced using other sources of energy.
- The **carbon footprint of H2 depends on how it is produced.**
- A **color-code system** is commonly used to refer to different hydrogen production methods. Instead, it should be determined according to an independent, science-based assessment (European Parliament, 2021).
- Among other methods, hydrogen can be produced from:
  - Fossil fuels (**grey hydrogen, with high carbon emissions**). If the CO2 resulting from the process is captured and stored (CCS) the hydrogen produced is referred to as "**blue hydrogen**".
  - From renewable electricity (**renewable or green hydrogen**).

Concerns around fossil-based hydrogen with CCS

- Risks of leakages of methane (more potent GHG than CO2).
- Could have very low GHG if methane leakage emissions do not exceed 0.2%, with close to 100% carbon capture. **Such rates are still to be demonstrated at scale** (IEA, 2021; IRENA 2022)
- Adds CO2 transport and storage costs and impacts and requires monitoring of stored CO2.
- It uses fossil fuels, exposing it to price fluctuations, insecurity of supply, and dependence on producing countries.
- The GHG footprint of blue hydrogen is more than 20% greater than burning natural gas or coal for heat and some 60% greater than burning diesel oil for heat (Howarth; Jacobson, 2021).
- Risk of stranded assets (IRENA, 2022).

Concerns around green H2: additionality principle

- Electrolytic hydrogen requires large amounts of electricity to be produced. Ensuring this electricity is from additional renewables and is **not cannibalising existing renewable electricity currently used for direct electrification is crucial.** It could slow down the energy transition and possibly draw **more fossil fuels back** into the power mix and could also impede progress toward expanding **access to energy** to those who lack it today, (IRENA, 2022).
- Furthermore, electrolytic hydrogen is only as clean as the electricity it is made from (BELLONA EUROPA, 2021).

3. What type of H2? Fossil-based and/or renewable H2?

EC Hydrogen strategy (2020)

- The **priority** for the EU is to develop **renewable hydrogen**.
- In the **short and medium term, other forms of low-carbon hydrogen are needed**: to rapidly reduce emissions from existing hydrogen production and support the parallel and future uptake of renewable hydrogen.
- An **incentivising policy framework needs to enable renewable** and, **in a transitional period, low-carbon hydrogen** to contribute to decarbonisation at the lowest possible cost.

Considers **low-carbon hydrogen: fossil-based hydrogen with carbon capture** and electricity-based hydrogen, with significantly reduced full life-cycle greenhouse gas emissions compared to existing hydrogen production.

This definition includes fossil-based hydrogen (also known as blue hydrogen) within the action of the EU to promote the use of H2.

Since then, fossil-based hydrogen, with CCS, is considered a transitional gas in the European Union.

4. Fossil gas in the approved and proposed regulatory framework of H2

The concept of **low-carbon hydrogen**, linked to the consideration of methane as a transition gas, is **present in the regulatory developments or proposals of regulations** that affect hydrogen since 2020:

1. **Proposal for an Energy Taxation Directive (2021)**
2. **Taxonomy regulation: climate delegated act (2021) and proposal for a complementary act (2021)**
3. **Guidelines on State aid for climate, environmental protection, and energy (2022)**
4. **Proposals for a recast regulation and directive on EU gas and hydrogen markets (2021)**
5. **Revision of the TEN-E Regulation EU guidelines for new energy infrastructure (2022)**

4.1 Proposal of revision of Energy Taxation Directive

The Energy Taxation Directive 2003/96/EC lays down structural rules and sets out minimum excise duty rates for the taxation of energy products used as motor fuel and heating fuel, and for electricity.

- The lowest minimum rate of €0.15/GJ applies to electricity, advanced sustainable biofuels and biogas, and renewable fuels of non-biological origin such as renewable hydrogen.
- **Low-carbon hydrogen** will also benefit from that same rate for a transitional period of 10 years.

Definition of low-carbon H2

- Low-carbon hydrogen and synthetic gaseous and liquid fuels the **energy content of which is derived from low-carbon hydrogen**, as well as any fossil-based fuels, which meet the **technical screening criteria** for determining the conditions under which a specific economic activity qualifies as contributing substantially to climate change mitigation according to Article 10 of **Regulation (EU) 2020/852** of the European Parliament and of the Council and Annex I to **Delegated Regulation** (EU) […]/[…]37 .

Definition of low-carbon H2: technical screening criteria of taxonomy regulation and climate delegated act.

4.2 Taxonomy delegated acts

Climate taxonomy delegated act (2021)	Complementary delegated act (transitional activities)
• **Transmission and distribution networks for renewable and low-carbon gases** (a) construction or operation of new transmission and distribution networks dedicated to hydrogen or other low-carbon gases. (b) conversion/repurposing of existing natural gas networks to 100 % hydrogen. (c) retrofit of gas transmission and distribution networks that enables the integration of hydrogen and other low-carbon gases in the network (includes blending). The activity includes leak detection and repair of existing gas pipelines and other network elements to reduce methane leakage.	• **Production of heat/cool from fossil gaseous fuels in an efficient district heating and cooling system** • **High-efficiency co-generation of heat/cool and power from fossil gaseous fuels** The facilities are designed and constructed to use renewable and/or low-carbon gaseous fuels and the switch to full use of renewable and/or low-carbon gaseous fuels takes place by 31 December 2035, with a commitment and verifiable plan approved by the management body of the undertaking.
• **Manufacture of equipment for the production and use of hydrogen**	
• **Manufacture of hydrogen** Life-cycle GHG emissions savings requirement of 73,4 % for hydrogen [resulting in life-cycle GHG emissions lower than 3tCO2e/tH2] and 70 % for hydrogen-based synthetic fuels relative to a fossil fuel comparator of 94 g CO2e/MJ. Where the CO2 that would otherwise be emitted from the manufacturing process is object of CCS.	
• **Storage of hydrogen**	

Considers a substantial contribution to mitigation of climate change: methane-based hydrogen if there is a % of savings of GHG (including CCS), as well as the retrofit of networks for blending H2.

H2 also would serve to define methane-gas as a transitional activity: plan to incorporate low carbon gas by 2035.

4.3 EC Guidelines on State aid for climate, environmental protection and energy

Methane investments

- Member States **must explain how** they will ensure that such investment contributes to achieving the EU 2030 and 2050 climate target. In particular, the Member States must explain **how a lock-in of this gas-fired energy generation will be avoided**.

Construction, upgrade or operation of district heating generation installations

- Member States also must **explain how it does not displace investments into cleaner alternatives** that are already available on the market, thereby impeding the development of cleaner technologies and their use.

Fossil-refuelling infrastructure

- Refueling infrastructure supplying fossil-based fuels, including fossil-based hydrogen, is not compatible when GHG emitted as part of the hydrogen production are not **effectively captured**, and are unlikely to be offset, in the absence of a **credible pathway toward the supply and use of renewable or low-carbon fuels in the medium term**.

Fossil gas aids are initially allowed if MEs proved to prevent lock-in effects. Methane gas is considered a transitional gas.

4.4 Hydrogen and decarbonised gas market package proposals

Definitions of renewable and low-carbon H2

- Renewable hydrogen **derives its energy content from renewable sources** other than biomass; and **achieves a 70% GHG emission reduction compared to fossil fuels**.
- Low-carbon hydrogen is hydrogen with an energy content derived from non-renewable sources, and that **meets a GHG emission reduction threshold of 70% compared to fossil-based hydrogen**.

Certification system for low-carbon

- Renewable gases shall be certified.

Blending

- Introduces a 5% allowed cap (without setting a blending obligation) for hydrogen blends at cross-border points, which TSOs must accept.

"Blending"' means the admixture of hydrogen with methane to use the methane infrastructure. Blending faces multiple challenges: leads to limited CO2 benefits and a large increase in energy costs (IRENA, 2022).

The exact methodology to assess emissions for low-carbon hydrogen will be developed through a Delegated Act adopted by the end of 2024.

4.5 Revision of the TEN-E Regulation
EU guidelines for new energy infrastructure

Adopted by the Council on 16th May 2022 (pending publication).
The regulatory framework for energy infrastructure, including the TEN-E Regulation was **reviewed to ensure consistency with the climate neutrality objective**.

Methane infrastructure

- Methane infrastructure projects would no longer be eligible as projects of common interest and therefore unable to secure Connecting European Facility funding.

- Some funding for natural gas projects would still be possible where the main purpose is to **convert existing gas infrastructure to transport and store renewable and low-carbon gases** (also in the modality of **temporary blending solutions**).

*"To ensure the transition to hydrogen, the project promoter should **demonstrate**, including through commercial contracts, **how, by the end of the transitional period, the natural gas assets will become dedicated hydrogen assets and how the use of hydrogen will be enhanced during the transitional period**".*

Possibility of continued funding for fossil fuel projects, including modifications to methane gas infrastructure to allow for blending with renewable gases.

5. REPowerEU: towards a renewable path?

- Target **10 million tonnes of renewable hydrogen** production in the EU and the same quantity of imports by 2030.
- **Rapidly conclude the revision of the Hydrogen and Gas Market package.**
- **Proposal of two delegated acts on the definition of hydrogen according to different production methods.**
- **Mapping hydrogen infrastructure needs** by March 2023. ENTSOG assessment of additional gas infrastructure needs.
- 3 hydrogen import corridors via the Mediterranean, the North Sea area, and, as soon as conditions allow, with Ukraine.
- Scale-up of electrolyser manufacturing (Electrolyser Declaration).

H2 objectives for 2030	
H2 Strategy	H2 needs to become an intrinsic part of our integrated energy system At least 40GW of renewable electrolysers **Production** of up to **10 million tonnes of renewable hydrogen in the EU**
REPowerEU	Renewable hydrogen **use** reaches 20 Mt by 2030 (of which about 4 Mt as ammonia) **10 million tonnes of domestic renewable hydrogen** production and **10 million tonnes of renewable hydrogen imports**

Commission staff working document accompanying Communication REPowerEU Plan
Table 8: Hydrogen use by sector in 2030 (kt hydrogen)

Sector	REPowerEU	Fit-for-55
Blending	1335	0

6. Final reflections

Planning and regulation for H2 must consider the declining role of methane gas to comply with the climate objectives.

The legal framework that affects H2 development has considered low-carbon H2 as necessary to achieve the decarbonization goals (techno-optimistic assumptions: CCSU and blending), and **without a clear definition** of what is a low-carbon gas. Also, risk of stranded assets (IRENA,

Although a **certification system** is proposed in the Gas Packaged, the corresponding **delegated act about its methodology is expected to be approved by 2024**.

REPowerEU and the current situation of the gas market pose a major threat to this initial conception of fossil gas as a transitional source of energy. However, the proposed **legal basis for the development of H2 remains unaltered**.

REPowerEU depends on huge quantities of **imported H2**. Implies **massive investments** and **amounts of renewable energy (additionality principle) water, and other natural scarce resources**. Consequently, deserves careful consideration of its consequences.

H2 development is being **designed from a centralized perspective (large dedicated infrastructure)**. **Lock-in effects and stranded assets must be avoided**: not overestimating H2 or methane future demand.

All relevant non-infrastructure related solutions should be considered with priority (principle of energy efficiency first). However, there is also a **lack of methodologies for the related cost-based analysis**.

Uncertain path toward a renewable future, with a **regulatory framework designed to allow the continuity of fossil energy** and related investments, and with a **lack of clear definitions and methodologies** to counterbalance the fluctuation of the renewable impulse. Also, highly dependent on imported amounts of H2.

Thank you for your attention

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