BRIEFING

Towards climate neutrality

European Parliament

EU rules for renewable hydrogen

Delegated regulations on a methodology for renewable fuels of non-biological origin

SUMMARY

Renewable hydrogen has the potential to play a significant role in the energy system as a versatile energy carrier and feedstock that can help decarbonise a variety of applications in areas such as heavy industry, chemicals manufacturing, transportation, and electricity generation and storage. Hydrogen can be produced through the electrolysis of water with renewable electricity, using different setups that vary in terms of cost, impact on the electricity system and carbon emissions.

Today, renewable hydrogen makes up a small fraction of total hydrogen production. Most hydrogen is produced from fossil fuels and, although cheaper, it causes carbon emissions. Demand for renewable hydrogen is expected to grow quickly as the need for climate-friendly solutions increases. While the falling cost of renewable electricity certainly plays a role in boosting this demand, sustaining it still requires support measures aimed at growing the market and bringing down the cost of electrolysers. To avoid a situation where renewable electricity used for hydrogen production is diverted away from other uses, it is important to ensure additionality, i.e. additional renewable electricity capacity for renewable hydrogen production.

On 10 February 2023, in line with the requirements of the Renewable Energy Directive, the Commission adopted two delegated regulations: one defining rules on renewable hydrogen production and clarifying the additionality criteria for renewable electricity, and another setting out a methodology to calculate lifecycle GHG emissions. The European Parliament and the Council of the EU have four months to approve or reject the rules, but they cannot amend them. On 28 March 2023, the Committee on Industry, Research and Energy (ITRE) decided not to raise an objection to the delegated regulation on additionality. Having in place definitive criteria for renewable hydrogen is key to making investment decisions and to launching EU and Member State initiatives that can support the growth of the European hydrogen industry.

IN THIS BRIEFING

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Renewable hydrogen in a low-carbon economy

Hydrogen is expected to play a key role in a climate-neutral economy, acting as a feedstock, fuel or energy carrier. While it is currently mainly used in the chemicals industry for producing ammonia (fertiliser) and methanol, hydrogen also has the potential to replace natural gas or coal as an input in industrial processes. Steel production and further chemical processes could use hydrogen produced with renewable energy to achieve CO_2-neutral production.

Hydrogen and hydrogen-derived fuels can also be used for transportation. While batteries are a suitable technology for light-duty road vehicles and urban buses, their lower energy density compared to fossil fuels restricts their use for long-distance road transport, shipping or aviation. Renewable or low-carbon hydrogen can be an alternative fuel for this type of transport, offering higher driving ranges than batteries and quicker refuelling. However, vehicles running on hydrogen or hydrogen-derived fuels have a lower overall energy efficiency than battery-electric vehicles.

EU definition of renewable hydrogen

The Commission's hydrogen strategy defines renewable hydrogen as hydrogen produced through the electrolysis of water powered by electricity from renewable sources or through the reforming of biogas or biochemical conversion of biomass. In EU legislation, renewable hydrogen and hydrogen-derived fuels produced without the use of biomass are referred to as renewable fuels of non-biological origin (RFNBO). The hydrogen strategy defines low-carbon hydrogen by significantly reduced full life-cycle GHG emissions.

The energy used for producing hydrogen can come from a variety of sources, such as electricity, fossil fuels or biomass, resulting in different amounts of GHG emissions. Many industrial processes require a steady stream of hydrogen. This can be achieved with fossil fuels or electricity from the grid, but not with variable renewable electricity sources such as wind or solar. Fluctuations in renewable electricity generation could be overcome through electricity storage or the use of flexible electrolysers in combination with hydrogen storage, but either approach may increase the overall cost of renewable hydrogen production. Industrial processes could also be made more flexible, for example, by using different types of machinery or working with different levels of pressure; however, industry has only limited experience with adjusting to variable hydrogen supply to date.

Hydrogen production technologies

Hydrogen use does not emit any GHG, but its production often does. The methods for producing hydrogen include thermochemical conversion (steam methane reforming, partial oxidation, autothermal reforming), biochemical conversion and electrolysis. Thermochemical conversion uses fossil fuels or biomass, while biochemical conversion uses algae from sunlight or biomass. Electrolysis uses electricity from various renewable or non-renewable sources, to split water into hydrogen and oxygen.

In 2020, steam methane reforming using natural gas or coal accounted for 96 % of hydrogen production in Europe. According to the International Energy Agency (IEA), only 0.7 % of global hydrogen production was considered to be low-carbon in 2020, and came mostly from installations using fossil fuels with carbon capture and storage (CCS). This technology captures and stores the carbon emitted during hydrogen production, thus reducing overall emissions. The number of projects for low-emission hydrogen production is increasing fast: in 2021, the volume of hydrogen production with the use of water electrolysis grew by 20 %. That said, it still accounted for only around 0.1 % of global hydrogen production.

The IEA expects that by 2030, 32 % of global electrolyser capacity will be located in Europe, if all the projects currently in the pipeline are realised. Installed electrolyser capacity in the EU was 0.2 gigawatts (GW) in 2021. The IEA expects the announced projects in the EU to reach an installed capacity of 39 GW by 2030, still falling short of the 80-100 GW capacity needed to reach the targets of the REPowerEU plan and the Green Deal industrial plan. The Commission estimates that around 500 terawatt-hours of renewable electricity will be needed for renewable hydrogen production in the EU by 2030 (that is, around 18 % of the EU's total electricity production in 2022), and around 46 % of today's renewable electricity production.

The different types of hydrogen production are often classified with the help of the colour scheme used in Table 1. The Commission and Parliament are moving away from this scheme to one where hydrogen production is classified on the basis of the definitions for renewable and low-carbon hydrogen. As can be seen in the yellow box on the right, electricity from the grid can fall into all categories depending on the electricity mix.

Table 1 – Colour definitions compared to new definitions

Hydrogen by new definitions	**Hydrogen by colour**	
Renewable hydrogen (sometimes referred to as clean hydrogen)	Green hydrogen (renewable electricity through electrolysis)	Electricity from grid (electrolysis)
Low-carbon hydrogen	Blue hydrogen (natural gas with CCS)	
Fossil-based hydrogen (without CCS)	Grey hydrogen (natural gas), brown hydrogen (brown coal), black (black coal)	

Data source: Author's compilation based on Hydrogen in the Energy Transition, Florence School of Regulation, July 2022.

The distinction between low-carbon hydrogen and renewable hydrogen is that the latter is defined by the energy sources it uses, such as wind, hydro and solar power, while the former is defined by the amount of GHG emissions it produces and is neutral to the method used. As a result, low-carbon hydrogen can come from a variety of energy sources such as natural gas with CCS or electrolysers running on nuclear electricity.

Hydrogen production through electrolysis

Hydrogen can be produced through electrolysis using an off-grid or an on-grid setup. The off-grid one, also referred to as the co-located (island) setup, uses only the electricity generated on-site and has no connection to the grid for sourcing electricity. In the co-located setup, the energy source is clearly identifiable, which makes it possible for hydrogen to be classified as renewable, low-carbon, or generated by fossil fuels, based on the co-located power plant. While off-grid is the simplest approach to ensuring that the electricity used to produce hydrogen is 100 % renewable, it limits operation to the periods when renewable electricity can be produced, or requires additional investment into electricity storage.

When electricity is sourced from the grid, it becomes more difficult to ensure its renewable nature, because grid electricity is usually generated by a mix of renewable, nuclear and fossil sources. This requires setting criteria according to which electricity used for electrolysis can be counted as renewable. To ensure that renewable hydrogen production does not divert renewable electricity away from other uses (such as heat pumps or electromobility), a criterion on additionality could be introduced to ensure that only new and additional renewable electricity generation capacity would be used. Criteria on temporal and geographic correlation could help to ensure that there is a physical flow of renewable electricity to the electrolyser and thus to avoid the activation of fossil power plants to meet the electricity demand for electrolysis.

Putting in place a policy where renewable energy can be sourced from the grid requires taking the following criteria into consideration:

- **origin (additionality)**: Use of the existing grid mix, or requirement to build 'additional' renewable electricity capacity;
- **temporal correlation (simultaneity)**: the time frame when the generation of renewable electricity and its use for electrolysis are balanced. This can vary from a 15-minute interval[1] to an annual level;
- **geographical correlation**: The electrolyser and the renewable power plant can either be in the same location, the same bidding zone (usually one country) or in a completely different area. Issues such as electricity grid congestion can be taken into account.

Choices regarding these criteria have an important impact on the capital expenditure and operating cost of renewable hydrogen production, because these restrict flexibility and capacity utilisation. To facilitate the ramp-up of renewable hydrogen production and incentivise investment, the criteria may be relaxed in the early stages, when hydrogen production volumes are still rather low.

Flexible electrolysers are needed to meet temporal correlation with shorter intervals, for example, hourly correlation. Flexible electrolysers are engineered to adapt their hydrogen output to align with fluctuations in electricity supply on the grid. By doing so, they can contribute to grid stability and benefit from low electricity prices by using surplus renewable energy when it is available for producing hydrogen. Flexible electrolysers are usually smaller than non-flexible ones and are more appropriate for use in distributed energy systems.

In contrast, inflexible electrolysers are typically large-scale systems that operate at a constant production rate. They are typically used in the production of hydrogen on an industrial scale and are not well suited for use in distributed energy systems. They are more capital-intensive than flexible electrolysers but have higher efficiencies.

Table 2 –Set-ups for hydrogen production from electricity

	Inflexible electrolyser (grid to hydrogen)	Flexible electrolyser (grid to hydrogen)	Co-located (island)	Co-located including grid connection (grid)
Energy source	Grid electricity mix	Grid mix but can choose operating hours depending on mix or price	Only runs on the generation source it is connected to	Electrolyser connected to grid and energy source connected to grid
Stable hydrogen output	Yes	No	Depends on source	Yes, if topped up by grid
Cost	Capital cost of grid connection	Can lower cost depending on price on grid	Depends on source	Can top up electrolyser with grid electricity
Carbon intensity	Uncertain	Uncertain but able to run when high level of renewable in grid	Depends on source	Depends on source

Data source: Author's compilation based on Shades of green (hydrogen) – part 2: in pursuit of 2 EUR/kg, Aurora Energy Research, February 2022.

The most flexible type of electrolyser is the proton exchange membrane electrolyser, which can start in 1 minute. It has a capital expenditure (CAPEX) of €900-1800/kilowatt (kW); is most suitable for combining with renewable sources; and is easily used in non-industrial environments. The alkaline electrolyser – the second most flexible one –has a start response of up to 10 minutes and is mainly suited for an industrial environment. It has a CAPEX of €750-1400/kW. Solid oxide electrolysis cells are still in a technological demonstration stage and are best suited for stable electricity supply with an average CAPEX of €800-2300/kW. Moreover, it is the only electrolyser that can be reversible and can operate as a fuel cell to generate electricity.

Efforts are under way to lower renewable hydrogen production costs, which stand at around US$5/kg today. The US Department of Energy supports research and development to bring the cost of hydrogen from electrolysis to US$2/kg by 2026 and to US$1/kg within 10 years.

In 2021, 70 % of electrolysers worldwide were alkaline, and 25 % were of the proton exchange membrane type. Other types of electrolysers are less mature and have a minimal share. Currently, inflexible electrolysers are more commonly used in Europe for large-scale hydrogen production. These electrolysers are typically used in industrial settings to produce hydrogen for a variety of uses, such as fuel for transportation and feedstock for the chemical industry.

Although less common, flexible electrolysers are being increasingly used as hydrogen demand increases and the need for grid stabilisation services becomes more pressing. The more the hydrogen economy develops and the more renewable energy is integrated into the grid, the number of flexible electrolysers being deployed in the EU may grow. So far, the EU's policy on electrolysis technology is rather neutral.

EU legislation and initiatives

Strategic initiatives

Renewable hydrogen plays a crucial role in plans to advance towards EU climate neutrality and transform emissions-intensive industries, as outlined in the 'fit for 55' package and the Commission's REPowerEU communication. REPowerEU has set a target of reaching annual domestic production of 10 million tonnes of renewable hydrogen by 2030 and importing the same amount, and of doubling the number of hydrogen valleys in the EU. The key role of renewable hydrogen in reducing GHG emissions and the EU ambition to go from technological to commercial leadership are highlighted in the EU's hydrogen strategy, the Green Deal industrial plan and the Member States' hydrogen strategies. The EU supports initiatives such as the European Clean Hydrogen Alliance and the Clean Hydrogen Joint Undertaking.

To achieve these strategic objectives, the EU provides significant funding for research and development of hydrogen technologies and infrastructure, including a €200 million investment for research and innovation through REPowerEU. Additionally, the Recovery and Resilience Facility dedicates over €10 billion to hydrogen. A clear definition and certification of renewable hydrogen is needed, to ensure that all this funding is channelled to activities that effectively contribute to the decarbonisation of the energy system. The Parliament's own-initiative resolution on a European Strategy for Hydrogen of 19 May 2021 underlines the urgent need for international standards and certification of different types of hydrogen based on lifecycle GHG emissions. It also calls for a clear distinction between low-carbon hydrogen and renewable hydrogen.

The Commission published a communication on the European hydrogen bank on 16 March 2023 to accompany its legislative proposal for a net-zero industry act that seeks to boost EU manufacturing of clean technologies, including renewable hydrogen. The hydrogen bank would accelerate investment in order to develop a renewable hydrogen market, while also facilitating renewable hydrogen imports to the EU. To address the cost gap between renewable hydrogen and fossil fuels for early projects, it would set up an auction system with a fixed price payment per kilogram of renewable hydrogen produced for up to 10 years, starting with a pilot auction for €800 million from the Innovation Fund in autumn 2023.

Review of the Renewable Energy Directive

EU legislation treats renewable hydrogen as a 'renewable liquid and gaseous fuels of non-biological origin' (RFNBO), an umbrella term that includes renewable hydrogen produced from renewable energy sources (other than biomass) and other renewable fuels produced without biomass.

The current Renewable Energy Directive (EU) 2018/2001 (RED II) requires 32 % of the energy consumed within the EU to be renewable by 2030. The directive mentions RFNBOs only in their role as transport fuels and defines them as 'liquid or gaseous fuels which are used in the transport sector other than biofuels or biogas, the energy content of which is derived from renewable sources other than biomass'. In practice, this generally covers hydrogen produced by electrolysis and hydrogen-derived fuels.

RED II also provides that as of 1 January 2021, RFNBOs need to deliver greenhouse gas emissions savings of 70 % compared to fossil fuels; this is equivalent to 3.38 kg CO_2 per kg of hydrogen in lifecycle emissions. If it meets this requirement, it counts towards the Member States' renewable energy targets. Under RED II, the Commission is required to adopt a delegated act on GHG savings and calculation of lifecycle emissions by 1 January 2021, which it did with a two-year delay.

Furthermore, RED II sets a general rule that RFNBOs produced with electricity from the grid are deemed renewable in proportion to the average share of electricity from renewable sources in the country of RFNBO production, as measured 2 years before the year in question. However, electricity can be deemed to be 100 % renewable in case of a direct connection between the renewable electricity generator and the RFNBO producer, provided that no electricity from the grid is used for RFNBO production and the renewable electricity generator comes into operation at the same time or after the RFNBO producer – thus ensuring additionality. Under RED II, the Commission is required to adopt a delegated act additionality by 31 December 2021, which was again delayed by two years.

The delegated acts on GHG savings and additionality, supplementing the RED II, were finally adopted on 10 February 2023, after pressure from the Parliament's RED III rapporteur. The following section provides a detailed account of these acts.

The Commission's July 2021 proposal to revise the Renewable Energy Directive (RED III) widens the definition of RFNBOs by removing the transport sector aspect used in RED II. The proposal also clarifies that as a result of the modified definition, RFNBOs would count as renewable energy regardless of the end-use sector. The rules to determine RFNBOs' renewable nature when produced from electricity, which so far only apply to transport, would cover all RFNBOs. If the proposed amendments are adopted, the delegated acts would apply to renewable hydrogen in all sectors. The trilogue agreement reached in March 2023 sets a target for an increase in renewable energy use in industry by 1.6 %/year and requires that 42 % of hydrogen used in industry be renewable by 2030, and 60 % by 2035. For the transport sector, it sets a target for a 1 % share of RFNBOs by 2030, as part of a combined target of 5.5 % for advanced biofuels and RFNBOs. The Parliament's position on RED III proposed a more ambitious target of 5.7 % for the 2030 RFNBO share in transport.

The definition of RFNBO in the proposal does not preclude the production or use of other types of hydrogen. Although under the proposal RFNBOs would serve as a critical component of mandatory quotas in the transport and industry sectors, other low-carbon molecules derived from non-RFNBO sources would still satisfy demand for hydrogen and its derivative products outside these quotas.

Other relevant EU legislation

Other existing and proposed EU legislation has an impact on hydrogen production and use as well. The EU emissions trading system (EU ETS) requires hydrogen producers to surrender emissions allowances for GHG emissions related to hydrogen production. However, since hydrogen production is part of a sector (industrial gases manufacturing) considered at risk of carbon leakage, installations can benefit from free allocation of ETS allowances. This system of free allowances will gradually be replaced by a carbon price for imported goods applied in the context of the new

Carbon Border Adjustment Mechanism (CBAM), on which a trilogue agreement was reached in December 2022. Hydrogen will be included in the CBAM from the start, as requested by the Parliament. The proposed ReFuelEU aviation regulation sets mandatory minimum shares for sustainable aviation fuels, with a specific sub-quota for RFNBOs from 2030. The amendments introduced to the proposed FuelEU maritime regulation as a result of the trilogue agreement provide incentives for RFNBOs in maritime transport and envisage the introduction of a RFNBO target from 2034 if the RFNBO share in 2030 is less than 1 %. The proposed alternative fuels infrastructure regulation aims to expand hydrogen refuelling infrastructure, and the proposed review of the Energy Taxation Directive would benefit renewable hydrogen by raising taxes for fossil fuels.

The proposed gas and hydrogen regulation and directive aim to facilitate network access and boost the market penetration of renewable and low-carbon gases, including low-carbon hydrogen, defined as hydrogen derived from non-renewable sources that meet a criterion of 70 % less lifecycle GHG emissions than fossil fuels.[2] The methodology for calculating the GHG savings from low-carbon fuels would be specified in another delegated act by 31 December 2024.

Delegated acts on renewable hydrogen

As mentioned above, on 10 February 2023 the Commission adopted two delegated acts related to the production and certification of renewable hydrogen. The Delegated Regulation on Additionality establishes the rules for the production of RFNBOs. The Delegated Regulation on GHG Savings establishes rules for calculating life-cycle GHG emissions for RFNBOs. The rules apply to domestically produced and to imported hydrogen.

Before adopting the delegated acts, the Commission consulted the expert group on renewable fuels, held two stakeholder workshops and published the draft acts for public feedback on the Better Regulation Portal. As they are technical acts, they did not require an impact assessment or a public consultation.

Delegated Regulation on Additionality

As already specified in the RED II, electricity counts as renewable if the renewable power plant and the electrolyser[3] are co-located in the same installation or there is a direct connection between them, and electricity from the grid is not used for electrolysis. Moreover, the renewable electricity generator must not have come into operation more than 36 months before the electrolyser.

Electricity taken from the grid may be recognised as fully renewable if it meets the criteria of additionality, geographical correlation and temporal correlation.

Additionality: Hydrogen producers have to make sure that the electricity used for the production of hydrogen is matched by the production of renewable electricity:

- in the same installation, showing that the producers generate renewable electricity corresponding to the amount of hydrogen they claim as renewable; or
- through a renewables power purchase agreement (PPA) with operators producing renewable electricity.

The installation producing renewable electricity must not have been in operation for more than 36 months before the electrolyser, and it must not have received support in the form of operating aid or investment aid.

To facilitate the early ramp-up of hydrogen infrastructure, the delegated regulation introduces a transitional phase with relaxed rules. The rules on additionality would not apply until 1 January 2038 for installations that came into operation before 1 January 2028.

Geographical correlation: Hydrogen producers have to make sure the additional renewables are located in the area where hydrogen is produced. At least one of the criteria listed below must be met regarding the location of the renewable electricity generator with regard to the electrolyser. The renewable electricity generator must be:

- in the same bidding zone[4] as the electrolyser, or
- in an interconnected bidding zone with electricity prices in the day-ahead market equal or higher than the bidding zone where the hydrogen is produced, or
- in an offshore zone interconnected with the electrolyser's bidding zone.

Member States may introduce additional criteria to ensure compatibility with national hydrogen- and electricity-grid planning.

Temporal correlation: Hydrogen producers must make sure that renewable electricity generation and hydrogen production coincide temporally.

- Until 31 December 2029, hydrogen has to be produced in the same **calendar month** as the renewable electricity produced under the PPA, or from renewable electricity from a new storage asset directly connected to either the renewable electricity generator or the electrolyser, charged in the same calendar month.
- From 1 January 2030, hydrogen has to be produced during the same **one-hour period** as the renewable electricity, or from renewable electricity from a co-located new storage asset that has been charged during the same one-hour period in which the electricity under the PPA was produced. Member States may start applying this rule from as early as 1 July 2027, after notifying the Commission.
- Temporal correlation requirements are always met if the clearing price of electricity is below a certain threshold (below €20/megawatt-hour or 0.36 times of the price of emitting one tonne of CO_2).

Below is a list of the different cases under the delegated act, where the criteria of additionality, temporal and geographical correlation need not be met.

- If hydrogen production located in a bidding zone with an **average renewable electricity share** exceeding 90 % in the previous calendar year, it may be counted as renewable if it does not exceed the proportion of renewable electricity in the bidding zone. If the 90 % share is reached in 1 calendar year, it is considered to be reached in the following 5 calendar years.
- If hydrogen production is located in a bidding zone where the **emission intensity of electricity** is lower than 18 gCO2e/MJ,[5] it may count as renewable if hydrogen producers conclude one or more renewables PPAs fulfilling temporal and geographical correlation. If the emission intensity threshold is reached in 1 calendar year, it is considered to be reached in the following 5 calendar years.
- If the electricity is consumed during an **imbalance settlement period** and the hydrogen producer can show that it reduced the need for downward redispatching[6] of renewable electricity generation.

Hydrogen producers must provide reliable information about their electricity use and hydrogen production, showing that the above criteria are met at hourly intervals. They may make use of national or voluntary international certification schemes recognised by the Commission.

By 1 July 2028, half a year before the end of the transition period, the Commission must assess the impact of the regulation, and especially the rules on temporal correlation, production costs, GHG emission savings and the energy system.

Delegated Regulation on GHG Savings

The Delegated Regulation on GHG Savings establishes a method for calculating the lifecycle GHG emissions savings achieved. The method is used to asses if a batch of RFNBO meets the 70 % reduction criterion compared to fossil fuels from RED II, which allows it to count toward Member State targets.

The methodology defines the total lifecycle emissions from the use of the fuel as the sum of emissions from the supply of inputs including electricity, processing, transport and distribution, and combusting the fuel in its end use minus any emissions savings from CCS. Emissions from the manufacture of machinery and equipment are not taken into account.

Stakeholder views

Hydrogen Europe welcome the Delegated Act on Additionality as a positive step towards the development of the renewable hydrogen market. However, they warn that the strict rules of hourly and geographical correlation will make green hydrogen projects more expensive; for that reason, governments have an important role in supporting the industry and closing the price gap between renewable and conventional hydrogen. Hydrogen Europe consider the transitional period necessary to kick-start the sector, as first movers will be exempt from additionality until 2038.

Solar Power Europe welcome the monthly temporal correlation until 2030 as a positive element to encourage first movers, but would prefer treating national borders as limits for geographical correlation. They also believe the exemptions for low-emission and high-renewables electricity grids will incentivise decarbonisation through more renewables as the most cost-effective technology.

Bellona, a European environmental organisation, expressed mixed feelings about the Delegated Act on Additionality. They raise concerns about the possibility of greenwashing and increased emissions in the short term. They also criticise the long transitional periods and the possibility of producing renewable hydrogen with non-renewable electricity, which they believe could undermine the credibility of the EU's renewable energy market and contribute to increased GHG emissions.

Transport & Environment welcome the clarity but criticise the wait for temporal correlation until 2028 and warn that hydrogen should only be used in those sectors without good alternatives.

Outlook

The delegated acts have been submitted to the European Parliament and the Council, which have two months to scrutinise and either accept or reject but not amend them. At the Parliament's request, the scrutiny period has been extended by two more months. Both delegated acts have been referred to the Committee on Industry, Research and Energy (ITRE). On 9 March 2023, A Commission representative presented the delegated acts to the ITRE committee; a number of MEPs addressed critical questions and remarks to them during the meeting. Despite these reservations, on 28 March 2023 the committee voted to reject a draft motion for a resolution to object to the delegated regulation on additionality.

Definitive criteria for renewable hydrogen production and lifecycle emissions are a critical precondition for progressing on national support schemes and EU initiatives such as the establishment of the European hydrogen bank and the inclusion of hydrogen in the new Carbon Border Adjustment Mechanism. Clarity about the criteria is a precondition for investment decisions that are critical for the development of the EU hydrogen industry and the decarbonisation of EU industry and transport.

Time is of critical importance because the EU is in a competition with other regions of the world for investment in the development of green industries. In the United States, the Inflation Reduction Act supports green hydrogen with a production tax credit of US$3 per kilogram, or an investment tax credit of 30 % of the cost of the electrolyser. The rules for additionality in the US are currently under consultation, while the EU has already defined them.

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ENDNOTES

[1] This corresponds to imbalance settlement periods in electricity markets, where the imbalances between contracted and actual generation and consumption are priced and settled.

[2] This definition excludes renewable hydrogen and differs from the definition in the EU hydrogen strategy in this respect.

[3] To facilitate readability, this document uses 'hydrogen' instead of 'renewable liquid and gaseous transport fuel of non-biological origin', 'electrolyser' instead of 'installation producing renewable liquid and gaseous transport fuel of non-biological origin' and 'renewable power plant' instead of 'installation generating renewable electricity'.

[4] A bidding zone is a region in which the same electricity price is applied. In the EU, bidding zones are usually entire Member States, except for Sweden, Italy and Denmark which are divided into several bidding zones.

[5] Grams of CO_2 equivalent per megajoule of fuel. Currently, the average renewables share is under 90 % in all Member States, which means that no whole country falls under case 1. Sweden is the only country under case 2 with an emissions intensity of 4.1 gCO_2e/MJ. France (19.6), Finland (22.9) and Denmark (27.1) are closest to reaching this emissions intensity. There could be bidding zones inside these countries that do reach the criteria.

[6] A measure, including curtailment, which is activated by one or more transmission system operators or distribution system operators by altering the generation, load pattern, or both, in order to change physical flows in the electricity system and relieve a physical congestion or otherwise ensure system security.

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