Green Hydrogen Organisation

# The “three pillars” are gaining momentum in the green hydrogen industry

In 2023 the European Union, the United States and Canada adopted or proposed regulations with relatively stringent specifications for what can count as green hydrogen for the purpose of tax incentives or to meet emissions reduction targets[1]. The regulations are complex (including some important exemptions). Below, we summarise some of the key features:

## Overview of EU, US and Canadian Regulations on Green Hydrogen

| | RFNBO | IRA: Clean Hydrogen Production Credit | Investment Tax Credit for Clean Hydrogen |
|---|---|---|---|
| **Status** | **Final** (Feb 2023) | **Proposed** (Dec 2023) | **Proposed** (Dec 2023) |
| **GHG Emissions System boundary & threshold** | **3.4 kg CO2e/kg H2** Full life cycle (excluding embodied emissions) | **4 kg CO2e/kg H2** [A] Well–to–gate | **4 kg CO2e/kg H2** [A] Well–to–gate |
| **Time matching** | Monthly matching until end 2029. Hourly matching starting in 2030. | Annual matching until 2027. Hourly matching starting in 2028. | Not specified |
| **Geographical matching (or “Deliverability”)** | Renewable electricity asset and H2 production must be in the same bidding zone (or interconnected bidding zone if day-ahead market price is equal or higher) | Renewable electricity source must be located in the same power grid region as the hydrogen project (exceptions under consideration). | Renewable electricity source must be located in the same province as the hydrogen project. |
| **Additionality (“Incrementality”)** | Renewable electricity asset < 3 years old before H2 production. Does not apply until 2038 if electrolyser comes into operation before 2028. [B C] | Renewable electricity facility cannot have started “commercial operation” more than 36 months before the hydrogen plant is placed in service. [D] | Renewable electricity facility must commence generation after 28 March 2023 and no more than one year before the “clean hydrogen project plan” is filed. |

*A. To claim subsidies at the full rate, the emissions must be <.45kg in the US and <.75kg in Canada*
*B. Exemptions where the grid is 90+% renewable (or < 18 gCO2eq/MJ) and during curtailment*
*C. Additional limitations on state aid (OPEX and CAPEX) for renewable electricity source*
*D. Treasury is considering a number of ways that electricity might be supplied from existing facilities and still qualify as incremental.*

**A key takeaway is that the “three pillars” are emerging as important benchmarks in the development of the green hydrogen industry.**

There is a growing body of research and advocacy[2] warning that the additional demand for renewable electricity from green hydrogen production will reduce renewable energy consumption in other sectors (which can use renewable energy more efficiently) driving up total emissions. In response, they propose a policy with three pillars (see box). These pillars have been adopted or proposed – with some important exceptions and exemptions – in these three key hydrogen markets.
There is also fierce criticism that the overzealous application of these pillars will curtail green hydrogen production and undermine efforts to reduce emissions in hard to abate sectors.

**The three pillars**

1. **Hourly time-matching.** Requires the electrolysers’ electric consumption to match renewable electricity production by the hour.
2. **Deliverability** (“or market matching”). Requires electrolysers to source renewable electricity from within the same market or operating region.
3. **Additionality** (or “Incrementality”). Requires that the renewable electricity is sourced from new renewable generation sources.

There are some important differences in these regulations, and in the application of the three pillars:

1. **Different system boundaries and thresholds.** The EC DAs are based on a life cycle approach covering the upstream feedstock supply (electricity and water), through to energy used in the production process and the downstream transportation to the end customer including the end customer's use of the fuel (including combustion where applicable). The overall GHG emissions intensity of the RFNBO must be no greater than 3.4kg of CO2e per kg of H2 (in volumetric terms) or 28.2g CO2e per MJ (in energy terms).
   In contrast, the US and Canadian proposals are based on a more limited system boundary. While the proposals refer to "a lifecycle basis", they only include emissions up to the point of production (so called "well-to-gate" emissions). The thresholds are nevertheless higher. Hydrogen with well-to-gate emissions of up to 4 kg of CO2e per kg of H2 qualify as "clean hydrogen", although to claim credits at the full rate, the emissions must be <.45kg in the US and .75kg in Canada. None of the three regulations address embodied or embedded emissions.

2. **Hourly time-matching.** The EU and the US have embraced hourly time matching, with some exemptions to encourage early movers. Hourly matching requires the electricity consumption by the electrolyser to match renewable production by the hour. This reduces the scope to use other energy sources (including fossil fuel-based electricity) in the hours when there is no renewable source. The EU allows for monthly matching until the end of 2029, with hourly matching starting in 2030. The US proposes annual matching until 2027, with hourly matching starting in 2028. The requirements in Canada are not specified. The cost of implementing these provisions is hotly debated, although it is clear that, in many cases, hourly matching will substantially curtail hydrogen production and/or increase productions costs. A key consideration will be the availability of Energy Attribute Certificates (EACs) and Renewable Electricity Certificates (REC) with the necessary level of granularity.

3. **Deliverability ("or market matching").** All three regulations require electrolysers to source renewable electricity from within their same operating region. Adding electricity load necessitates increasing electricity supply simultaneously because the power grid must be in continuous balance. As noted above, the availability of Energy Attribute Certificates (EACs) and Renewable Electricity Certificates (REC) with the necessary level of granularity will be challenging in some cases.

4. **Additionality ("Incrementality").** Crucially, all three regulations require that the renewable electricity sourced for hydrogen production comes from new renewable generation sources, again with some exemptions to encourage early movers. As noted above, the concern is that if renewable energy supply powers an electrolyser, directly or indirectly through the grid, then that renewable energy supply is diverted away from other uses. Fossil fuel derived electricity may increase to fill some of that gap, and therefore increase the carbon intensity of the entire grid.
   In the EU, a grid connected renewable PPA is only permissible if the renewable asset is built within 36 months before electrolyser unit. This requirement does not come into force until 2038 if the electrolyser comes into operation before 2028. The US is proposing a similar rule, whereby the renewable electricity facility cannot have started commercial operation more than 36 months before the hydrogen plant is placed in service. The proposed rule in Canada states that the renewable electricity facility must commence generation after 28 March 2023 and no more than one year before a "clean hydrogen project plan" is filed.

5. **State Aid and Stacking.** An underappreciated aspect of these regulations is that they take a very different approach to subsidies ("state aid") and stacking of subsidies. The EU rules limit the extent to which green hydrogen producers can utilise renewable energy assets that have received state aid (OPEX and CAPEX). The goal is to focus state aid on direct electrification, which is more efficient. The US takes the opposite approach. The IRA allows for "stacking" of subsidies along the value chain with a view to activating new markets and applications. There is an excellent explanation of the US Stacking Rules here.

6. **An emissions only approach.** In all three cases, the regulations focus almost exclusively on the greenhouse gas emissions associated with (renewable) electricity use and green hydrogen production. The wider environmental, social and governance aspects of green hydrogen production and the development impact on host communities are not addressed (although these are addressed in other regulations). While the US IRA includes some provisions addressing wages, domestic content and energy community bonuses, a more holistic approach is needed. The sustainable utilisation of water, for example, deserves more attention.

7. **Implications for global trade.** A final reflection is that the regulations have been designed with a focus on domestic consumption and production, noting the impact on the domestic electricity market. However, there are important implications for the global trade of hydrogen and hydrogen derivatives. The EU rules, for example, also apply to imports of green hydrogen and green hydrogen derivatives, which means that producers in other countries have to align their projects with the RFNBO requirements to access EU markets. In the US, is in noteworthy that US producers can still access production tax credits, even if the product is exported.

Policy makers face a delicate balancing act. It makes good sense to prioritise interventions that deliver the largest reductions in total greenhouse gas emissions as quickly as possible. However, we also need to balance the quick wins against the longer-term challenge of decarbonising hard to abate sectors. Small scale demonstration projects are useful. But scale is crucial in driving down costs and developing new industries and green hydrogen applications. The hard to abate sectors cannot be left in the too hard basket. For this reason, all three regulations include grace periods, grandfathering and other exemptions to encourage early movers.

There are also other competing objectives. Governments are jockeying to take a leading role in the development of new industries to promote economic development and job creation, all while safeguarding grid stability and energy security more generally. In developing and emerging markets, there is also an opportunity to leverage green hydrogen development to improve access to modern energy.

The three pillars are important benchmarks. But there is no "one size fits all" solution. It may well be reasonable with longer transition periods in some emerging economies and developing countries, not least because the systems for hourly matching and market matching are still being developed.

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You are welcome to contact GH2 with questions and comments on this briefing, via **Sam Bartlett** (sam.bartlett@gh2.org) and **Joe Williams** (joe.williams@gh2.org).

[1] In February 2023, after years of debate, the European Commission adopted two Delegated Acts on so-called renewable fuels of nonbiological origin (RFNBOs) which define what can be considered renewable (green) hydrogen in meeting the EU's emission reduction targets. On 22 December 2023, the U.S. Department of the Treasury and IRS on Dec. 22, 2023, released proposed regulations regarding the production tax credit (PTC) for hydrogen under Section 45V of the Internal Revenue Code, as enacted by the Inflation Reduction Act. The 45V tax credits enable eligible producers to access subsidies of up to $3 per kilogram of hydrogen. The U.S. Department of Energy also released a whitepaper on the considerations related to the credit. Also in December, Canada published a legislative proposal addressing eligibility for investment tax credits for clean hydrogen.

[2] See for example Princeton, Bloomberg NEF and the Energy Futures Initiative.