Public consultation comments and responses

Hydrogen
Production
Criteria

Documents Supporting this document

Information to support issuers and verifiers is available at Hydrogen Criteria | Climate Bonds Initiative as follows:

- Hydrogen Criteria Document: The complete criteria requirements.
- Hydrogen Background paper: Contains details on why the criteria were chosen.
- Hydrogen Frequently Asked Questions
- Climate Bonds Standard: contains the requirements of the overarching CBS
- The Climate Bonds Standard & Certification Scheme Brochure: provides an overview of the Climate Bonds Standard & Certification Scheme, of which these Criteria are a part

For more information on Climate Bonds and the Climate Bonds Standard and Certification Scheme, see www.climatebonds.net.

1. Is the cradle-to-site system boundary defined, which includes cradle-to-gate emissions plus any transportation emissions to the site where a product is used appropriate to conduct the life cycle assessment for the hydrogen production criteria?

Feedback received	Response
The scope of hydrogen production may be globally accepted 'well to gate'. LCA description on P.14 may include transportation, which is different from P.4 figure.	There are two different scopes to be considered. First, the scope of activities, which contain all the activities that can be certified. The scope of activities is on production of hydrogen. And second, the scope of emissions and system boundaries for the GHG accounting. It includes not only production, but transport emissions as well. We will make it clearer in the document. Further, including transport emissions is still under discussion. It could be eventually modified.
It is clear that the emissions intensity of the hydrogen produced is a key factor in defining whether or not it meets CO2 reduction objectives. In this respect, the LCA should cover: the CO2 intensity of the energy source used to produce the hydrogen, the CO2 emitted by the hydrogen production process itself , and the CO2 emissions related to the transportation of the hydrogen to the region/site where it is to be used . Regarding the CO2 intensity of the energy source, we are very concerned to see the criteria "Grid electricity is used for electrolysis-based production if it has at least 90% of renewable energy share". If the goal is to encourage the production of low-carbon hydrogen, then it is the carbon intensity of the grid which matters, not the technology used. Also, given that in Europe the grids are interconnected, it will be very difficult to identify the technology used to produce the electricity. Therefore, the focus should be on the average CO2 intensity of the grid. Otherwise, the criteria risks penalising some of the most decarbonised countries in the EU (e.g. France) simply because they have decarbonised their grid by using nuclear. Whilst we fully respect that there are currently no CBI criteria for nuclear (as indicated in the Background Document P25 – 26), we do not believe this justifies its automatic exclusion. Over the last two years important work has been undertaken by independent organisations which confirms that nuclear has no more of an environmental impact compared to other renewable technologies. Two notable examples are: The Joint Research Centre assessment (March 2021)	Relating to the requirement to include 90% of share of renewables for electrolytic production, it was decided to remove it. The total carbon intensity benchmark from hydrogen production covers electricity emissions as well, so it is not necessary to specify it. On nuclear, although the TWG acknowledges the important role of nuclear energy for hydrogen production, Climate Bonds cannot incorporate nuclear energy in sectors criteria until criteria for nuclear energy is not developed by Climate Bonds.

UNECE Carbon Neutrality Toolkit (2022) In the absence of CBI criteria for nuclear, decisions should be based on existing – independent – scientific assessments:	
What is the Hydrogen criteria's guidance on the GHG accounting from hydrogen transportation? Transportation is usually a separate entity from the hydrogen production entity, so it brings difficult to count GHG in practice. Currently, there are different LCA methods to count GHG emissions from transportation, so he would like if the criteria have guidance on this.	After public consultation, it was decided to incorporate the IPHE methodology s a guidance for hydrogen GHG accounting. However, so far, they only have guidance for hydrogen production and conditioning. Once IPHE methodology includes transport emissions, it will be included in the criteria as an alternative for guidance.
It appears that the emissions intensity thresholds will generally exclude blue hydrogen, even in 2022. Several successful green financings (see e.g., government of Canada green bond) have included blue hydrogen with a standard of 4.37 t CO2e / t H2, but the CBI standard is the same as the EU Taxonomy standard of 3 t CO2e / t H2. We are working with a company implementing state of the art technology in a low upstream emissions environment and below 4 t CO2e / t H2 is not feasible. In the United States, the Inflation Reduction Act set a minimum standard for purposes of tax credit eligibility at 4 t CO2e / t H2, and even that is receiving industry pushback. Compounding this issue, the perimeter of the lifecycle analysis is wider for CBI than existing methodologies. Typically, measurement is well to gate, but CBI includes transportation to the use site. The scope 2 emissions of a hydrogen production facility for purposes of the lifecycle analysis and carbon intensity calculation should be pursuant to the Greenhouse Gas Protocol as usual.	The 3 kgCO2e/kgH2 carbon intensity limit can be achieved via both natural gas reforming with CCS and electrolytic hydrogen production options. For the natural gas with CCS path, at 90% carbon capture rate, the upstream methane leakage should be below 0.45% or at 95% carbon capture rate, up to 0.75% upstream methane leakage rate will be tolerable. It was decided to include the IPHE methodology to offer guidance for GHG accounting. The criteria also incorporate the ISO standards for the GHG accounting. Transport of hydrogen can demand high amounts of energy. Including their emissions aims to promote a fair comparison of GHG emissions between local production and imports. However, it is still under discussion.

2. Hydrogen production must meet specific carbon intensity thresholds over the term of the bond. These thresholds are listed in Table 3 of the criteria document. Do you agree with these decreasing thresholds?

Feedback received	Response
The definition is clear and it makes sense to use this broader approach for a fair comparison between locally produced & imported H2. It's not entirely clear to me what the intention of the second bullet point is: 99.9% vol purity (also a minimum?) & at least 3MPa pressure for H2. Is there a specific reason for selecting the GWP100 factor for methane instead of the higher GWP20 factor? Selecting the latter would increase the penalty associated with upstream CH4 emissions.	Using corrections factors for purity and pressure was for comparison purposes. However, because the system boundary includes conditioning of hydrogen related emissions, instead of using correction factors, the criteria will clarify that these emissions should be accounted in the GHG accounting. GWP100 is used to compare between different GHGs. We want to avoid focusing only on short lived gasses. Instead, we want to consider both, long- and short-lived gasses.

1.5kg/kg-H2 at year 2030 looks too stringent compared to existing standards by various jurisdictions. The threshold may be in line with 3.4kg by EU RED or 4.0kg by US IRA.	The TWG decided to align the benchmark with the one in the EU taxonomy (3kgCO2eq/kg-H2) as a starting point for projects today. The emissions reduction trajectory was set based on technologies evaluation; thus, it is technically feasible to reach 1.5 kgCO2 eq/kg-H2 by 2030 (some examples are provided in the background document). Further, the criteria aim to promote alignment with the net zero trajectory by 2050.
We support the proposal for Hydrogen carbon intensity threshold and believe this should be the only criteria applied (thus replacing the criteria "Grid electricity is used for electrolysis-based production if it has at least 90% of renewable energy share" based on the reasons outlined above)	This modification was accepted, and the share of emissions requirement was removed. It was concluded that setting that share of renewables for electrolytic production was redundant. Electricity related emissions should be covered by the total carbon intensity benchmark of hydrogen production.
We agree that the thresholds for 2022 and 2050 are appropriate for cradle to gate because they are equivalent to other standards (EU Taxonomy), and we agree that the thresholds for 2030 and 2040 were intentionally set by the CBI. If we consider the Cradle to Site, is it appropriate for the CBI to use a stricter standard than the EU Taxonomy (which is generally considered to be stricter)?	The EU taxonomy does not include an emissions reduction trajectory. Climate Bonds criteria promote the transition concept to reduce emissions over time.
I definitely agree with the decreasing thresholds in principle and the values seem reasonable to me, considering the starting point (good to have climate financing in place to support realistic 70-85% reduction measures up to 2030-2035). Setting a target of zero for 2050 seems to contradict the assessment summarized in figure 7 in the background document? For green H2 production, there's a clear correlation between the carbon intensity of the product and the carbon intensity of the power source. I wonder if it's still required to stipulate the need for at least 90% power generation from low-carbon sources? Note: the background document lists solar, wind, hydro & nuclear as zero carbon, but that's not the case – there are still some emissions associated with these power generation assets	Including transport emissions in the systems boundary is still under discussion. It will be addressed as part of the criteria development for hydrogen infrastructure, transportation, and storage.

We would like to offer the following aspects for consideration: a) Carbon intensity of hydrogen in relation to EU will be guided by Delegated Acts that are due early next year to fully understand the calculation b) does the carbon intensity refer to portfolio of hydrogen production financed by the bonds or a single asset? If single asset how this would work with a single facility in time? c) Do the thresholds proposed alter if the hydrogen is produced from bio based CO2? Some colleagues have commented that 1.5kg/kg of H2 as of 2030 looks a little too demanding even compared to various country's clean hydrogen standards. It needs to be in line with 3.4kg at 2030 of EU Renewable Energy Directive, for example. US has additional proposal for defining low carbon H2 standards via CHPS that breaks down H2 intensity between well to gate and H2 production only. Production only threshold proposed is 2kg CO2 per kg of H2 with the remainder being intensity covering upstream and downstream. Note this is only proposal at this stage.	Carbon intensity applies to both, portfolio of hydrogen production, and single assets. Where a number of production facilities are being assessed, this should be done facility by facility, i.e., not averaged across a portfolio of assets. Applicants issuing a UoP bond Applicants may either: • Calculate the average facility-level emissions intensity threshold over the term of certification, and demonstrate that the facility meets that average threshold at the time of certification; OR • Meet the threshold at the time of certification and commit to 3 yearly assessments by an approved verifier throughout the period of certification to verify that at each 3 yearly evaluation, the facility meets the new, lower emissions intensity threshold in place at that time. If on any 3 yearly verification the facility is not demonstrated to meet the emissions intensity threshold then in place, certification will be removed; OR • Meet the threshold at the time of certification, then at half of the bond duration, and at one year before the end of the bond certification. If on any verification the facility is not demonstrated to meet the emissions intensity threshold then in place, certification will be removed A linear trajectory should be assumed for time periods between the dates and thresholds provided in Table 4 of the hydrogen criteria document.

3. New facilities commencing operation in 2023 or after are eligible only if they implement CCS or CCU when using fossil gas, which is eligible up to 2035. Please comment on this restriction. For CCS, is the capture rate of 90% acceptable?

Feedback received	Response
It is appropriate to exclude new facilities that start operation after 2035 if they use natural gas, because it is consistent with the EU Taxonomy. It is important whether the 90% CCS recovery rate is consistent with the thresholds in the previous section.	For production facilities certification, it was decided to remove the capture rate requirement (90%). It can be redundant. If the carbon intensity benchmark is met, capture rate must be higher enough to allow compliance with the benchmark. However, for CCS or CCU infrastructure projects certifications, which does not necessarily need to meet the carbon intensity benchmark, the capture rate will be a requirement.

The restriction of Fossil Gas feedstock requiring CCS/CCU may be an issue as some of the Blue Hydrogen projects being developed are new discoveries which will be developed together with CCUS. We believe there should be a 10 year window for new gas-based H2 facilities to be developed with CCUS. Is it possible to detail the rationale for the date limit of 2035? (2nd bullet of 4.2.1). EU in general prohibits usage of CO2 for EOR linked to hydrogen production	The time limit for fossil gas-based production projects was set aiming to avoid potential carbon lock-in risks. Fossil based production should be promoted at early stages to speed up hydrogen production. After that, based on some energy scenarios, 2035 was considered a time sufficient to transitioning to renewable based production.

4. Do you consider that MRV measures and a 0.2% of emissions target appropriate and necessary to address methane leakages? Refer to section 3, table 2 in the criteria document and 4.2.1, and 4.2.3 in the background document.

Feedback received	Response
Since the threshold in section 2 covers all GHGs (CO2e), regulation of methane leakage alone may not be necessary. MRV of methane leak is necessary to calculate GHG footprint.	Agreed. The methane leakage benchmark will be removed from the criteria. Methane emissions should be part of the total GHG accounting, thus meeting the total carbon intensity benchmark implies low carbon methane leakages.
One colleague commented that it may be impractical to require upstream MRV for hydrogen production – hydrogen operators do not operate the upstream natural gas extraction, they likely buy through a pipeline will multiple entry points. However, others feel that this can be a simple addition to the required parameters of the purchased gas so that the purchaser knows the methane intensity of the gas.	The methane intensity of the gas is important. Although the benchmark will be removed, methane emissions should be included in the GHG accounting, otherwise the total carbon intensity of fossil-gas-based hydrogen production can be underestimated.

5. Do you consider the additionality; temporal and geographic correlation requirements appropriate for renewable-based hydrogen production? Refer to Box 1 section 3 in the Criteria document, and section 4.2.2 in the Background document.

Feedback received	Response
Carbon-free electricity may be the power source, rather than renewable.	For electricity production, the carbon intensity of the grid will be removed. The total carbon intensity of hydrogen production should cover the electricity related emissions. The other low-carbon electricity source is nuclear energy; however, we will include it only when Climate Bonds has criteria for nuclear energy production.

After EU removed the additionality criteria it would be challenging promote the CBI criteria that still consider it	Climate Bonds criteria are normally more ambitious than similar initiatives. Hydrogen low-carbon projects should not be certified if it will impact negatively the decarbonization of other sectors.
The additionality component should be removed – whether green hydrogen production caused new renewable power to come online is not the issue, the issue is the emissions profile of the hydrogen production facility and the importance of hydrogen as a low emissions fuel source and input into industrial processes.	The additionality principle will be part of the criteria, to avoid cannibalizing the existing production of renewable energy for other purposes and foster the increase of fossil-based electricity.

6. Relating to electrolytic hydrogen production. If the carbon content of the electricity supply allows electrolytic production to meet the total carbon intensity benchmark, should it be eligible? Or should we include an electricity system requirement for powering the electrolyser?

Feedback received	Response
Carbon-free electricity may be the power source, rather than renewable.	For electricity production, the carbon intensity of the grid will be removed. The total carbon intensity of hydrogen production should cover the electricity related emissions. The other low-carbon electricity source is nuclear energy; however, we will include it only when Climate Bonds has criteria for nuclear energy production.
Yes. If the goal is to encourage the production of low-carbon hydrogen, then it is the carbon intensity of the grid which matters, not the technology used. As such, the criteria should remain technology neutral and thus focus only on CO2 intensity. Whilst we fully respect that there are currently no CBI criteria for nuclear (as indicated in the Background Document P25 – 26), we do not believe this justifies its automatic exclusion. Over the last two years important work has been undertaken by independent organisations which confirms that nuclear has no more of an environmental impact compared to other renewable technologies. Two notable examples are: The Joint Research Centre assessment (March 2021) UNECE Carbon Neutrality Toolkit (2022) In the absence of CBI criteria for nuclear, decisions should be based on existing – independent – scientific assessments.	Climate Bonds cannot certify projects using nuclear energy until its own criteria is developed for nuclear energy. There are some things that need to be resolved, around safety and waste. That is why developing criteria is critical for Climate Bonds.