Defining sustainable hydrogen: beyond colours

At its 8th Session held on 25- 26 March 2021, the Group of Experts on Gas stressed the need to develop a scientifically based terminology for renewable, decarbonized, and low-carbon hydrogen. A clear taxonomy would provide legal certainty, foster collaboration, and investment flows. Member States are invited to adapt national legal definitions to reflect the definitions established by this new standard.

Developing internationally recognized terminology requires agreement on fundamentals reached within the ECE community. An issue to address beforehand are the sustainability credentials of hydrogen.

Now the general trend is on qualifying hydrogen environmental properties based on the specifics of its manufacturing. A conventional classification assigns colours to each production method. Typically, there are several arbitrary colours of hydrogen: green (for renewables-based production); blue (for production with carbon capture and storage (CCUS)); turquoise (for methane pyrolysis); yellow (for nuclear-based production); grey or brown (for SMR production), and black (for production based on coal gasification). The last two methods are considered carbon-intensive; the others are usually associated with low/zero carbon dioxide emissions.

The common criticism of this classification points to the absence of a quantitative reference standard. This has a reason: a coloured taxonomy draws from common-sense associations, not numbers. Qualitative classifications are prone to subjectivity, arbitrariness, and inconsistencies. The issue is the most pronounced in the case of “green” hydrogen. For one thing, following a recently adopted Delegated Act to the EU Taxonomy of Sustainable activities, hydrogen production could be qualified as sustainable, or “green” (subject to meeting predefined emissions savings thresholds). The rules equally apply to renewable and non-renewable hydrogen. At the same time, the conventional “colour” classification reserves “green” for renewable sources only. If to establish an official colour-based taxonomy for hydrogen, all such discrepancies should be considered and brought to a consensus. The work is lengthy and resource-consuming.

No less challenging is to keep the “colours” taxonomy relevant. Lacking clear reference benchmarks, the colour categories could not be assigned automatically. Each time a new production method emerges, the list should be updated. Such a procedure raises strong efficiency concerns. Already today there is a large disproportion between the existing technologies/ways of H2 manufacturing and the number of classes comprising the color taxonomy.

UNECE is looking into more practical ways to classify hydrogen production; the priority is given to quantitative-based categorizing. Aiming for international convergence, it seeks to learn from the experience of the ECE member States and beyond, where such approaches have already been established.

UNECE commends the efforts of the European Union's made in this domain. It is the first sub-region within the ECE borders that proposed a clear, technologically-neutral, and scientifically-derived standard for sustainable hydrogen production. The solution, suggested by the mentioned Delegated Act, refers to measuring the carbon intensity of hydrogen extraction. The method is based on calculating the respected CO2 emission savings with a fossil fuels comparator taken as a benchmark. It is then compared against the predefined quantitative threshold. The production approach with savings equal to or higher the threshold is qualified as sustainable, low-carbon. Everything above goes as residual, or carbon-intensive. That is, to qualify as sustainable by the EU Taxonomy, a hydrogen manufacturing activity should comply "with the life-cycle GHG emissions savings requirement of 73.4% for hydrogen [resulting in 3tCO2eq/tH2] and 70% for hydrogen-based synthetic fuels relative to a fossil fuel comparator of 94g CO2e/MJ".

The proposed classification has its limits: it does not distinguish between low-carbon and zero-carbon hydrogen. UNECE is discussing the opportunity to solve the issue by adding a "clean" or "decarbonized" hydrogen category. To accommodate for the specifics of hydrogen extracted from non-renewables, a maximum CO_2 leakage level should be integrated into the respected threshold definition.

For more information on the sustainable hydrogen classification, please consult the extended report that will be available soon.