United Nations ECE/ENERGY/GE.3/2023/6

Economic and Social Council

Distr.: General
10 February 2023

Original: English

Economic Commission for Europe

Committee on Sustainable Energy

Expert Group on Resource Management

Fourteenth session
Geneva, 25-28 April 2023
Item 7 (j) of the provisional agenda
Development and Implementation Road Map for the United Nations Framework Classification for Resources: The next five years: Hydrogen and other potential applications

Concept Note and Proposed Actions: Application of the United Nations Framework Classification for Resources and the United Nations Resource Management System to Hydrogen Projects

Prepared by the Hydrogen Task Force of the Expert Group on Resource Management

Summary

This concept note outlines a proposal for additional guidance on the application of the United Nations Framework Classification for Resources (UNFC) and the United Nations Resource Management System (UNRMS) to hydrogen projects. This includes specifications for applying UNFC and UNRMS to hydrogen projects, a taxonomy on hydrogen based on a life cycle analysis (LCA) approach, a proposal for a Guarantee of Origin for Hydrogen (GOH) and a pilot project to test the application. The note also discusses the benefits and a recommendation to endorse a UNFC and UNRMS based framework to track the classification and sustainability of hydrogen projects.

I. Introduction

1. Hydrogen is a versatile element currently used as feedstock[1] for energy production and other industrial applications. While the application as an energy resource is emerging and has the potential to play a significant role in the transition towards a low-carbon[2] economy. Hydrogen can be used in various applications as a transportation fuel, power generation, and industrial processes. Hydrogen is the most abundant element in the universe, and natural occurrences on earth are found in water (H_2O), methane (CH_4), and other hydrocarbons. Most hydrogen is still produced from hydrocarbon resources via steam methane reforming (SMR) or autothermal reforming (ATR). One of the main advantages of hydrogen is that its use as an energy carrier does not result in carbon emissions. Hydrogen production via electrolysis can be efficient if several factors are optimized. These factors include the efficiency of the electrolysis process, the electricity source used to power the process, and the overall system design. One key challenge is to achieve energy efficiency and prevent or reduce greenhouse gas (GHG) emissions in the hydrogen production processes and the infrastructure to transport it over large distances.

2. This concept note proposes how the application of the United Nations Framework Classification for Resources (UNFC)[3] and the United Nations Resource Management System (UNRMS)[4] to hydrogen projects, including a taxonomy on hydrogen based on a life cycle analysis (LCA) approach, a Guarantee of Origin for Hydrogen (GOH) and a pilot project to test the UNFC and UNRMS based framework. This framework is essential for providing the governance structure for this emerging sector. This document expands the concepts presented in earlier United Nations Economic Commission for Europe (ECE) documents:

- Hydrogen – an innovative solution to carbon neutrality (ECE/ENERGY/2020/8)[5]
- Technology Brief – Hydrogen[6]
- Attaining carbon neutrality - The role of hydrogen: Focus on Guarantees of Origin (ECE/ENERGY/2021/20)[7]
- A comprehensive and science-based terminology, classification and taxonomy for hydrogen (ECE/ENERGY/2022/8).[8]

3. The framework for applying UNFC and UNRMS to hydrogen projects support the Committee on Sustainable Energy's goal of building resilient energy systems and reaching carbon neutrality. This note aims to address the need for criteria for sustainable hydrogen projects to facilitate the scale-up of the industry, as identified by the Committee on Sustainable Energy at its thirty-first session (Geneva, Switzerland, 21-23 September 2022).[9]

---

[1] Feedstock refers to raw material processed or converted into a desired end product.

[2] "Low-carbon" refers to the reduction of greenhouse gas (GHG) emissions, typically measured in terms of equivalent carbon dioxide (CO_2e) to express the total global warming potential (GWP) across all GHGs. This encompasses not only CO2 emissions but also other gases such as methane, nitrous oxide, and fluorinated gases, which have a GWP relative to CO_2.

[3] ECE (2019) United Nations Framework Classification for Resources https://unece.org/DAM/energy/se/pdfs/UNFC/publ/UNFC_ES61_Update_2019.pdf

[4] ECE (2022) United Nations Resource Management System: Principles and Requirements https://unece.org/sites/default/files/2022-12/UNRMS%20Principles%20and%20Requirements_0.pdf

[5] Hydrogen – an innovative solution to carbon neutrality https://unece.org/fileadmin/DAM/energy/se/pdfs/CSE/comm29_Nov.20/ECE_ENERGY_2020_8_Hydorgen_final.pdf

[6] Technology Brief – Hydrogen https://unece.org/sites/default/files/2021-10/Hydrogen%20brief_EN_final_0.pdf

[7] Attaining carbon neutrality - The role of hydrogen: Focus on Guarantees of Origin" (ECE/ENERGY/2021/20) https://unece.org/sites/default/files/2021-09/ECE_ENERGY_2021_20-ACN-role-of-hydrogen.pdf

[8] A comprehensive and science-based terminology, classification and taxonomy for hydrogen (ECE/ENERGY/2022/8) https://unece.org/sites/default/files/2022-08/ECE_ENERGY_2022_8e.pdf

[9] UNECE (2022) Report of the Committee on Sustainable Energy on its thirty-first session https://unece.org/sed/documents/2022/09/Report_31_CSE_ECE_ENERGY_143.pdf

4. Hydrogen production can be sourced from renewable resources, such as hydro, wind and solar power, resulting in a low-carbon resource project. Hydrogen production from fossil fuel sources produces carbon dioxide (CO_2) as a by-product. This may require secondary CO_2 treatment by geological or tank storage or by producing green synthetic fuels to minimise emissions. A Horizon Europe project is researching ways of splitting methane into hydrogen and elemental carbon without GHG emissions.[10] Hydrogen projects will require proper due diligence and foresight in analysing technical, economic, and commercial issues that must be considered before large-scale implementation. Liquefaction of hydrogen, and transporting and storing hydrogen can be challenging, requiring specialized infrastructure and equipment. These and other technical challenges need rigorous evaluation through the whole value chain to make projects economically viable.

5. Despite these challenges, hydrogen has the potential to play a significant role in the decarbonisation of the economy, including the transportation and industrial sectors. The Hydrogen Council has projected that hydrogen could account for 18 per cent of the world's final energy consumption by 2050, with most of this hydrogen being produced from renewable energy sources.[11]

6. According to the International Energy Agency's (IEA) Global Hydrogen Review 2022,[12] hydrogen demand is growing with positive signals in crucial applications. The pipeline of projects for low-emission hydrogen production keeps expanding, and only some are nearing final investment decisions (FID). As a way to produce low-carbon hydrogen, the expanding electrolyser manufacturing capacity is critical to rolling out hydrogen supply chains. Large volumes of hydrogen could be traded by the end of the decade if barriers are addressed soon. The current global energy crisis is an important impetus for hydrogen, and there are opportunities and challenges with repurposing infrastructure for the use of hydrogen. As policy action intensifies, the focus must move to implementation to ensure that hydrogen projects are evaluated consistently, and that hydrogen is produced, stored, transported and used sustainably. According to the Hydrogen Council's Hydrogen Insights 2022[13] report, joint action by the public and private sectors is required to move from project proposals to final investment decisions to accelerate the deployment of hydrogen projects. The development and advancement of hydrogen as an energy carrier is an essential area of research and investment to support a sustainable energy future.

7. Hydrogen itself can be stored and transported in different forms, the most important ones being (i) hydrogen gas (low and high pressure), (ii) liquid hydrogen, (iii) ammonia, and (iv) as Liquid Organic Hydrogen Carriers (LOHC). An essential aspect of hydrogen as an energy carrier is its production through the ammonia synthesis process. Ammonia can then be used as a hydrogen carrier, which can be converted back to hydrogen on demand. This makes ammonia an attractive option for hydrogen storage and transportation. It has a higher energy density than gaseous hydrogen and can be stored and transported at lower pressures and temperatures. Additionally, ammonia can also be used as a fuel for internal combustion engines and gas turbines.

8. The proposed UNFC and UNRMS based framework will provide comprehensive and scientifically based background for evaluating, managing and tracking the sustainability of hydrogen projects. Further, by providing precise and consistent information on the origin and sustainability of the hydrogen life cycle, the tool can help to build investor confidence in hydrogen projects and increase the likelihood that they will reach final investment decisions. Additionally, the framework will provide a way to evaluate the economic viability and social and environmental impacts of hydrogen projects, including storage, transport and use.

---

[10] Coldspark Project https://coldspark.eu/

[11] Hydrogen Council (2017) Hydrogen, Scaling Up https://www.h2knowledgecentre.com/content/policypaper1201?crawler=redirect&mimetype=application/pdf

[12] IEA (2022) Global Hydrogen Review 2022 https://iea.blob.core.windows.net/assets/c5bc75b1-9e4d-460d-9056-6e8e626a11c4/GlobalHydrogenReview2022.pdf

[13] Hydrogen Council (2022) Hydrogen Insights 2022 https://hydrogencouncil.com/wp-content/uploads/2022/09/Hydrogen-Insights-2022-2.pdf

II. Developing specifications for the application of the United Nations Framework Classification for Resources and the United Nations Resource Management System to hydrogen projects

9. UNFC and the emerging UNRMS are rapidly gaining acceptance as tools for consistently evaluating and managing natural resources. Using these frameworks will enable sustainable and efficient management of hydrogen resources, and hydrogen projects' social, environmental and economic impacts are considered in a manner that is compatible with other comparable resource projects. Developing a UNFC and UNRMS based framework for hydrogen projects will provide the tools to ensure that hydrogen resources are managed sustainably.

A. The United Nations Framework Classification for Resources and the United Nations Resource Management System

10. The Expert Group on Resource Management develops UNFC and UNRMS to classify and manage natural resources comprehensively and consistently. UNFC offers a consistent and transparent method for reporting and comparing resources, including classifying resources based on their environmental-social-economic viability, degree of confidence in estimates and technological feasibility.

11. UNRMS is designed to be a comprehensive resource management system that includes concepts to assist with analysis and decision-making for the optimized management of resources and aims to support the development of policies and regulations in the framework of the Sustainable Development Goals (SDGs). UNRMS is based on principles and requirements that help governments, industry, capital allocators, and civil society address impacts by promoting resource efficiency and a more circular economy through rigorous sustainable resource management practices.

12. A number of countries and organizations have adopted UNFC and UNRMS. In Europe, UNFC is used by the European Union (EU) and some of its Member States, as it is promoted as a standard for reporting and comparing raw materials data. The European Commission promotes use of UNFC and UNRMS as resource management tools for classifying and monitoring the development of primary and secondary raw materials projects. UNFC assesses the environmental, social, and economic acceptability of a project and reflects its stage of technical feasibility from exploration to decommissioning. It also includes metrics such as in situ and recoverable quantities, cash flows, supply and product chain items, and energy and labour requirements, with quality control and assurance principles in place. In Africa, UNFC and UNRMS are recognized by the African Union (AU) and its Member States as valuable tools for the sustainable management of natural resources. They have adopted them as a framework for the classification and management of natural resources in the context of the African Mining Vision. In addition, a number of other countries and organizations globally have adopted UNFC as a framework for classifying and managing natural resources.

13. UNFC and UNRMS may be used by stakeholders such as the UN and other intergovernmental bodies, government policymakers, industry decision-makers, the investment community and civil society as a standard for reporting and comparing natural resource data and assessing the social, environmental, and economic viability and technical feasibility. These systems can be applied to hydrogen projects and include them with interacting projects to evaluate the potential for sustainable development. A UNFC and UNRMS based framework provides a common basis for comparing hydrogen in conjunction with other types of resources.

B. Importance of applying a UNFC and UNRMS based framework to hydrogen projects

14. A hydrogen project can encompass all stages of production, transportation, storage, and use. It could be horizontally integrated with each step designated as a sub-project, or each stage could be a standalone project. Hydrogen production can occur naturally or be artificially generated using various methods such as water electrolysis, steam methane reforming, and biological sources. The hydrogen produced is transported through pipelines or as a liquid or compressed gas in specialized vehicles. Hydrogen can be stored in gaseous or liquid form in tanks, caverns or underground geological reservoirs. Hydrogen is an energy source in various applications such as power generation, transportation, industrial processes and heating. The components and technologies used for each project stage will depend on the desired output, location, and available resources.

15. In some cases, natural hydrogen may be treated similarly to hydrocarbons. In some other cases, it is considered a secondary resource. Hydrogen production is strongly interconnected and dependent on other primary resources such as hydrocarbons, nuclear, hydropower, solar and wind. The Specifications for the Application of UNFC to Injection Projects for the Purpose of Geological Storage already include hydrogen.[14]

16. UNFC and UNRMS can assist stakeholders with standards for assessing hydrogen projects. Examples of project activities may include:

- Evaluate the degree of confidence in the source product
- Identify the most optimal locations for hydrogen projects
- Compare the technical feasibility and economic, social and environmental viability of different hydrogen technologies and sustainability of hydrogen projects to all stakeholders
- Set goals and targets for deploying hydrogen technologies
- Assess the risk profile of hydrogen projects. Capital allocators can use UNFC and UNRMS to evaluate the economic, social and environmental risks associated with different hydrogen technologies and to identify factors that might impact their viability
- Develop policies and incentives to support the deployment of hydrogen technologies. Policymakers might use UNFC and UNRMS to design financial incentives to encourage the deployment of hydrogen fuel cell vehicles or to design regulations and other critical framework conditions under their control[15] to encourage sustainable hydrogen production and use.

C. Proposed specifications for hydrogen projects

17. UNFC and UNRMS Specifications and guidance for hydrogen would also include the development of a resource supply system, which would provide a way to monitor, track and report on the resource potential and the economic, environmental and social impacts of hydrogen production, storage and utilization.

18. UNFC and UNRMS Specifications and guidance may assist in the following ways:

- Setting goals and targets for the production and use of hydrogen and its provenance
- Developing policies and incentives to support the production, storage, transport and use of hydrogen
- Regulating the production, storage, transportation and use of hydrogen

[14] https://unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/UNFC_specs/UNFC.IP_e.pdf

[15] Including, inter alia, fiscal structures, public and private R&D, infrastructure, contractual standards, and tariffing.

- Coordination of production, storage, distribution, and use of hydrogen
- Development of infrastructure
- Facilitating the transition to a hydrogen economy
- Promoting the adoption of hydrogen technologies
- Increasing the efficiency of hydrogen use
- Creating new products and services
- Responding to changing market conditions to optimize production
- Supporting the development of a hydrogen supply chain
- Promoting good governance in the hydrogen economy
- Monitoring and enforcing compliance with regulations and standards
- Monitoring and mitigating the social and environmental impacts
- LCA and minimizing of carbon footprint and emissions in the hydrogen value chain
- Adequate and fair comparison of societal costs and benefits
- Building public support for the use of hydrogen
- Addressing the needs and concerns of stakeholders
- Building trust and confidence in the hydrogen industry.

19. UNFC and UNRMS Specifications and guidance for hydrogen production technologies are key as an accountable way to measure and ensure that the technical feasibility and environmental, social and economic impacts of hydrogen projects are taken into account and that hydrogen production, storage and transport are carried out sustainably and efficiently. They can also assist in understanding the resource potential and maturity of the technology and providing a comprehensive assessment of the resource, including opportunities, risks and challenges. This will help to promote technical rigour, transparency, traceability and accountability in the management of hydrogen resources while supporting informed decision-making in the hydrogen and interconnected sectors.

III. Establishing a taxonomy on hydrogen based on a life cycle analysis approach

20. Life Cycle Analysis (LCA) is a widely used methodology[16] for evaluating product and process economic, social and environmental impacts. The application of LCA to hydrogen projects is essential as it allows for a comprehensive assessment of the economic, social, environmental and governance performance aspects.

21. A taxonomy for hydrogen based on LCA is vital for providing a consistent, transparent and comprehensive evaluation of the social and environmental performance of hydrogen production pathways that can inform decision-making and policymaking in the hydrogen sector and support the development of sustainable hydrogen markets. This is particularly important as hydrogen is increasingly seen as a potential solution to decarbonize sectors of the economy, including transportation and industry. UNFC provides the basis for such a taxonomy through its project classification system and common glossary.

22. The taxonomy for hydrogen based on an LCA approach will consider the stages of the hydrogen life cycle, from the production of hydrogen to its end-use. It will provide a clear and transparent method for evaluating the environmental performance of different hydrogen production pathways. By establishing a taxonomy based on LCA, it will be possible to

[16] UNEP Glossary – Life Cycle Assessment https://www.unep.org/explore-topics/resource-efficiency/why-does-resource-efficiency-matter/glossary

identify sustainable hydrogen production pathways and to support decision-making and policymaking in the hydrogen sector.

A. Life Cycle Analysis methodology

23. LCA is a methodology used to evaluate the environmental impacts of products and processes over their entire life cycle. It involves collecting and analysing data on the inputs and outputs of a product or process, including production, storage, transportation, use, and disposal. LCA aims to identify and quantify each life cycle stage's social and environmental impacts, such as energy consumption, GHG emissions, and waste generation.

24. LCA methodology can be used for hydrogen to:

- Evaluate the environmental impact of different hydrogen production technologies and pathways, such as water electrolysis, steam methane reforming, and biological production
- Assess the energy balances and economic potentials in a hydrogen-driven economy
- Estimate the environmental impact of the entire hydrogen supply chain, from production to the end-use of hydrogen, including transportation and storage
- Identify the most sustainable hydrogen pathways and set targets for emissions reductions
- Support the development of new technologies, regulations, and policies that promote sustainable hydrogen production and use.

B. Importance of Life Cycle Analysis in evaluating the sustainability of hydrogen projects

25. A taxonomy for hydrogen based on an LCA approach is vital for several reasons:

(a) Comparability – LCA provides a consistent and transparent method for evaluating the economic, social and environmental performance of different hydrogen production pathways, allowing a fair comparison between other technologies and pathways;

(b) Comprehensive assessment – LCA considers the entire life cycle of hydrogen, from production, storage and transport to end-use, which enables a more thorough evaluation of the social and environmental impacts of the hydrogen value chain;

(c) Identification of social and environmental hotspots – LCA allows for identifying the stages of the hydrogen life cycle that have the highest environmental impact, referred to as "hotspots," which can inform where to target efforts to improve the sustainability of hydrogen production;

(d) Decision-making and policymaking – Establishing a taxonomy based on LCA can support decision-making and policymaking in the hydrogen sector, such as identifying the most sustainable hydrogen pathways and setting targets for emissions reductions;

(e) Social and environmental performance – the LCA approach can help identify the social and environmental performance of hydrogen pathways, which can inform the development of new technologies, set targets and regulations, and support the creation of sustainable hydrogen markets.

C. Proposed taxonomy for hydrogen based on Life Cycle Analysis

26. A taxonomy for hydrogen based on LCA could be developed in several ways, depending on the specific goals and needs of the project or organization. One possible approach could be to classify hydrogen pathways based on the following criteria:

- Production technology – This could include categories such as water electrolysis, steam methane reforming, and biological production

- Feedstock – This could include naturally occurring, renewable energy sources and petroleum
- Carbon intensity – Carbon intensity in hydrogen production can be quantitatively measured using metrics such as carbon footprint, carbon intensity per unit of hydrogen produced, carbon capture and utilization/storage rate, Renewable Energy Share and Net Carbon Emissions, providing a more accurate and consistent assessment of the environmental performance of different hydrogen production pathways
- Life cycle stage – This could include categories such as raw materials sourcing, production, transportation, storage, and end-use
- Social and Environmental Impact – This could include energy consumption, GHG emissions, and waste generation
- Further specifications on how to link interrelated projects for full LCA analyses - This could, for instance, be the linkage between a primary production project, such as electricity generation and a secondary one, such as hydrogen production and carbon capture and storage to ensure their linked development and production in time, quality and quantity.

27. Carbon intensity can be quantitatively measured based on metrics such as:

- Carbon footprint – This metric represents the total amount of GHG emissions (typically measured in CO_2 equivalents) associated with hydrogen production, storage, transportation and use (including that of hydrogen as a GHG)
- Carbon intensity per unit of hydrogen produced – This metric represents the CO_2 emissions per unit of hydrogen produced (kg CO_2e/kg H_2)
- Carbon capture and utilization/storage rate – This metric represents the percentage of CO_2 captured from the hydrogen production process and either used or stored
- Renewable Energy Share – This metric represents the percentage of the total energy input used in the hydrogen production process that comes from renewable energy sources
- Net Carbon Emissions – This metric represents the net CO_2 emissions of the entire hydrogen production, transportation, and use process after accounting for any carbon capture and storage or utilization.

28. Hydrogen production pathways can be quantitatively evaluated and compared using these metrics based on their carbon intensity. This can provide a more accurate and consistent assessment of the environmental performance of different hydrogen production pathways and supports informed decision-making and policymaking in the hydrogen sector.

IV. Developing a Guarantee of Origin for Hydrogen

A. The concept of a Guarantee of Origin for Hydrogen

29. Climate change caused by GHG emissions has placed a value on emission-free consumption, which can be addressed through a guarantee of origin for hydrogen to recognize emission-free consumption. A Guarantee of Origin for Hydrogen (GOH) is a document, label or digital passport certifying hydrogen's origin and production pathway. It is intended to provide transparency and traceability for hydrogen to ensure that hydrogen is produced ethically and sustainably. It can provide consumers and investors with information about the social, environmental, and governance performance of hydrogen production and distribution. A GOH typically includes information about the source of the hydrogen, governance practices of the producer, the production technology used, energy usage and the emissions associated with its production, transportation and storage.

30. GOH is essential for ensuring that hydrogen production is developed sustainably and ethically. It can be used as a tool for governments to verify that the hydrogen they are importing or producing meets specific sustainability and ethical criteria. It can also support

the development of regulations and policies that promote sustainable hydrogen production and use.

B. Proposed specifications for a Guarantee of Origin for Hydrogen

31. A system for the Guarantee of Origin for Hydrogen can be developed through the following steps:

- Define the scope of GOH – The first step in creating a GOH is to define the scope of the system. This might include establishing the types of hydrogen technologies covered by the system and the geographical area in which the system will apply
- Establish the rules and requirements for participation – This might include establishing the types of organizations that can participate in the system and the governance conditions that participants must meet to obtain a GOH
- Set up a tracking and verification system – A vital element of the GOH system is a tracking and verification system that allows participants to track the production, use, and trade of hydrogen and to demonstrate compliance with the system's rules and requirements. Comingled streams must be addressed
- Develop a system for issuing and trading GOH – The system should include a mechanism for issuing labels or certificates to participants who meet the system's requirements and a mechanism for trading labels or certificates between participants
- Monitor and enforce compliance – The GOH system should include mechanisms for monitoring and enforcing compliance with the system's rules and requirements to ensure the integrity and reliability of the system.

32. Developing the GOH system will involve many stakeholders, including the UN, intergovernmental organizations, governments, industry associations, capital allocators and other organizations.

V. Developing a pilot project

A. Importance of a pilot project

33. A pilot project is essential in testing the application of the proposed tools for managing hydrogen resources. It provides an opportunity to evaluate the effectiveness of the tools in a real-world setting and to identify any challenges or limitations that may arise. Piloting the application of UNFC and UNRMS to hydrogen projects would allow for the evaluation of the effectiveness of the classification and assessment process in identifying the resource potential, the level of technical knowledge and understanding of the resource, its economic viability, and the environmental and social impacts of the resource development. It would also allow for the evaluation of the management system in facilitating the sustainable development, production, transportation, storage and use of hydrogen and other energy resources.

34. Similarly, a pilot project for a hydrogen taxonomy based on the LCA approach would evaluate the effectiveness of the metrics proposed in assessing the carbon intensity of hydrogen production pathways, identifying the most sustainable pathways governance considerations, and supporting informed decision-making in the hydrogen sector. A pilot project for a GOH would evaluate the certification process's effectiveness in providing transparency and traceability for hydrogen and ensuring that hydrogen is produced from sustainable and ethical sources. It would also allow for the evaluation of the efficacy of the GOH in providing consumers with information about the social and environmental performance of the hydrogen products they are purchasing and in supporting the development of renewable hydrogen markets.

B. Proposed pilot project

35. A proposed pilot project that applies the UNFC and UNRMS hydrogen framework would involve implementing a specific project or group of projects. Consideration should be given to different hydrogen source products and technologies.

36. The pilot project would involve evaluating, classifying, and sustainable management and governance considerations of a specific hydrogen project using UNFC and UNRMS. The classification would involve the identification of the stage of development of the hydrogen project, from production to end-use, and evaluating the resource potential and the level of knowledge and understanding of the resource. This includes an evaluation of the technical feasibility, economic, environmental and social viability and impacts of hydrogen resource development.

C. How to implement a pilot project

37. The steps for implementing a pilot project on UNFC and UNRMS application to hydrogen projects include:

- Identify and select suitable pilot project site(s)
- Develop the pilot project plan and timelines
- Secure funding for the pilot project
- Select a project team and engage key stakeholders
- Implement the pilot project with ongoing monitoring and evaluation
- Analyse the results and identify any challenges or limitations
- Continuously monitor and evaluate the pilot project to ensure the business case remain relevant and effective in promoting sustainable hydrogen production and use
- Communicate the results and recommendations to relevant stakeholders
- Incorporate the learnings from the pilot project into the future development and implementation of the UNFC and UNRMS based framework and associated specifications
- Identify other hydrogen production sites and potentially to other countries or regions for further pilot projects
- Collaborate with Member States and other organizations to share knowledge and experiences on applying the UNFC and UNRMS based framework to hydrogen projects.

38. The pilot project should engage stakeholders, such as UN, intergovernmental organizations, governments, hydrogen producers, capital allocators, regulators, consumers, NGOs and civil society, to ensure that their perspectives are considered and that the relevant stakeholders will receive the pilot project results.

VI. Recommendations and Conclusions

39. The following recommendations are proposed for future work on applying a UNFC and UNRMS based framework to hydrogen projects (Figure I):

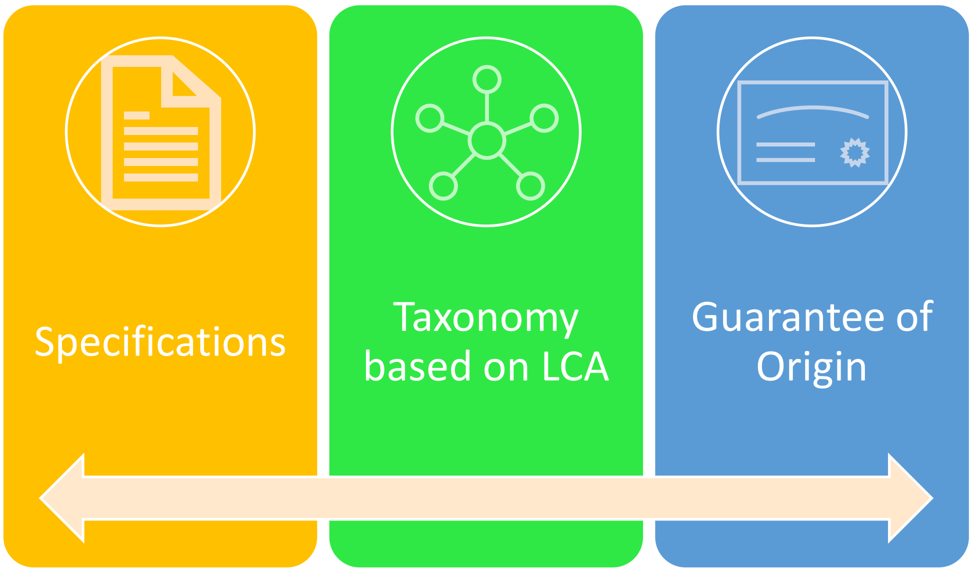
- Develop the Specifications for applying UNFC and UNRMS to hydrogen projects, incorporating feedback from the proposed pilot project and other relevant stakeholders

- Expand the proposed taxonomy, also aligned to EU Taxonomy[17] and similar initiatives, on hydrogen based on the LCA approach to cover a broader range of hydrogen technologies and incorporate feedback from the proposed pilot project
- Work towards developing a Guarantee of Origin for Hydrogen (GOH) that can be used to track the origin of hydrogen and support the development of sustainable hydrogen production and use
- Develop additional pilot projects to test the application of the UNFC and UNRMS frameworks to hydrogen projects in different locations and under other conditions
- Collaborate with member States and other organizations to share knowledge and experiences about hydrogen projects.

40. Applying UNFC and UNRMS to hydrogen projects should assist with the following:

- Consistency and evaluation rigour – By applying a UNFC and UNRMS based framework to hydrogen projects, it will be possible to ensure that these resources are evaluated and classified to be comparable with other resource projects. Technical feasibility and lifecycle social, environmental and economics are considered, and hydrogen production, storage, transport and use are managed sustainably, ethically and efficiently, also with respect to balances and energy efficiency
- Increased transparency and accountability – The UNFC and UNRMS based framework would provide a way to track and report on the technical feasibility, economic viability and environmental and social impacts of hydrogen production. This will help increase transparency and accountability in reporting hydrogen resources
- Informed decision-making – By applying UNFC and UNRMS to the hydrogen economy, it will be possible to have a common framework for the classification and assessment of hydrogen resources, which will facilitate the sharing of information and support informed decision-making in the energy sector.

Figure I
Proposed UNFC and UNRMS Hydrogen Framework



41. To assist in achieving the above, the development of specifications for the application of UNFC and UNRMS to hydrogen production technologies, the establishment of a

[17] EU taxonomy for sustainable activities https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en

taxonomy on hydrogen based on an LCA approach, the proposal of a Guarantee of Origin for Hydrogen, and the development of pilot projects to test the framework should be undertaken.

42. Additionally, a proposed pilot project(s) would provide valuable data and insights on how the UNFC and UNRMS based framework can be effectively applied to hydrogen projects and will allow for adjustments and improvements to be made to the frameworks as needed. Furthermore, the pilot project is crucial as it will help to identify challenges and limitations in the application of the UNFC and UNRMS based framework and to inform the development of the next steps in the implementation in the hydrogen sector.

43. It is important to note that the work proposed in this concept note is ambitious and requires inputs from several experts, organizations and technical and administrative coordination. To achieve all the proposed recommendations, significant extrabudgetary funding will be required. Support from external experts, organizations and funding agencies will ensure that the proposed work is carried out comprehensively and is technically sound. Establishing a robust coordination mechanism that brings together all stakeholders will also be essential to ensure that the proposed work is aligned with the overall goals of sustainable energy production and use.

44. The above work is critical to help to build resilient energy systems and facilitate low-carbon energy transitions. It will help promote sustainable and integrated management of natural resources.

45. The success of this work will depend on the availability of adequate funding, technical expertise, administrative and coordination support, and the engagement of all relevant stakeholders. As hydrogen projects are gaining broader acceptance as one of the pathways to the transition to a low-carbon energy system, it is imperative to establish a robust, scientifically and ethically sound framework for its reporting, management and usage. Guidance is urgently required to ensure that hydrogen resources are sustainably developed and accountable to all stakeholders.

Acknowledgements

46. The drafting and review of the document was done by: S.F. (Serge) van Gessel, TNO, Netherlands; Barbara Pribyl, Santos Ltd, Australia; Teresa Ponce de Leão, LNEG, Portugal; Julian Hilton, Aleff Group, United Kingdom; Branko Milicevic, ECE; Dario Liguti, ECE; Charlotte Griffiths, ECE; and Harikrishnan Tulsidas, ECE. Valuable comments were received from the Technical Advisory Group of the Expert Group on Resource Management.

References

International Energy Agency (2022) Global Hydrogen Review 2022 https://iea.blob.core.windows.net/assets/c5bc75b1-9e4d-460d-9056-6e8e626a11c4/GlobalHydrogenReview2022.pdf

Hydrogen Council (2022). Hydrogen Insights 2022. https://hydrogencouncil.com/wp-content/uploads/2022/09/Hydrogen-Insights-2022-2.pdf

United Nations Economic Commission for Europe (2019) United Nations Framework Classification for Resources Update 2019 https://unece.org/DAM/energy/se/pdfs/UNFC/publ/UNFC_ES61_Update_2019.pdf

United Nations Economic Commission for Europe (2022) United Nations Resource Management System: Principles and Requirements https://unece.org/sites/default/files/2022-12/UNRMS%20Principles%20and%20Requirements_0.pdf