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Addendum

Hydrogen

I. Introduction

1. In 2015, the United Nations General Assembly (UNGA) set an ambitious 2030 Development Agenda with 17 Sustainable Development Goals (SDGs). Among the interconnected SDGs are Goal 7 (affordable and clean energy) and Goal 13 (climate action). The 2016 Paris Agreement committed the signatories to keep the increase in global average temperature to well below 2°C above pre-industrial levels.

2. These commitments set the world on a quest to reduce greenhouse gas (GHG) emissions while delivering quality of life globally. Member States in the United Nations Economic Commission for Europe (ECE) region consider that achieving net carbon neutrality is an important step in decarbonization of the energy system and that hydrogen could play an important role, particularly in hard-to-abate sectors. In a future sustainable energy system, it is argued, hydrogen and other renewable and low-carbon gases could be used in transport, homes, industry, and power generation and would enable creation of an integrated, service-based society.

3. ECE's Group of Experts on Gas prepared a background document entitled "Hydrogen – an innovative solution to carbon neutrality" (ECE/ENERGY/2020/8[1]) for the twenty-ninth session of the Committee on Sustainable Energy, 25-27 November 2020. The document explores current and possible future hydrogen production and use. The document help member States understand the technical, economic, and public relation challenges that must be overcome if hydrogen is to contribute to a sustainable energy future. The gas industry and gas infrastructure can play a key role in the transition to a hydrogen economy through energy system integration.

[1] https://unece.org/fileadmin/DAM/energy/se/pdfs/CSE/comm29_Nov.20/ECE_ENERGY_2020_8_Hydrogen_final.pdf

II. Defining Hydrogen

4. Hydrogen is not new – it has been produced and used in huge quantities for many years. However, hydrogen as an energy vector is a revolutionary development. Hydrogen is clean and versatile but must be produced, transported and stored before being converted to electricity, heat, or feedstocks.

5. 95 per cent of hydrogen is produced from natural gas or other hydrocarbons. This so-called '***brown***' hydrogen is used to make fertilizers and other chemicals. Significant quantities of carbon dioxide (CO_2) are released during production of hydrogen but could be captured and stored using carbon capture and storage (CCS) technologies. With the addition of CCS, hydrogen extracted from hydrocarbons is considered '***blue***'. Hydrogen also can be produced by electrolysis of water. If the electricity used for the electrolysis is produced from renewable energy, then such hydrogen is considered '***green***'. There is also '***black***' (produced from coal) and '***yellow***' hydrogen (from electricity coming from nuclear power plants).

III Enabling a hydrogen future

6. Many ECE member States have hydrogen strategies, and many others are in the process of preparing them, for example:

(a) In June 2019, the Moscow-based Skolkovo Institute of Science and Technology published a study "The hydrogen economy – a path towards low carbon development" that analysed how to incorporate hydrogen technology into the Russian energy system and as part of low carbon development strategies;

(b) On 8 July 2020, the European Commission revealed its "Hydrogen strategy for a climate-neutral Europe". The objective is to boost clean hydrogen production in Europe and develop many possible applications that would reduce GHG emissions across the industry, transport, power and buildings sectors;

(c) In July 2020, the United States Department of Energy published its "Hydrogen Strategy – Enabling A Low-Carbon Economy" that presents its strategic plan to accelerate research, development and deployment of hydrogen technology in the United States.

7. ECE's Group of Experts on Gas has proposed a number of recommendations to ECE member States, the energy industry, and financial institutions as they strive to accelerate decarbonization through harnessing hydrogen.

IV. Recommendations for ECE member States

8. Regulations should not prescribe upfront which energy carrier or decarbonization of feedstocks should be used in which sector. Life-cycle analysis of regulatory options would allow member States to select the appropriate energy carrier(s) and feedstock(s) with a view to promoting overall system efficiency and to reducing its carbon intensity.

9. A common vocabulary on hydrogen issues could include:

(a) Comprehensive and science-based terminology for renewable and low-carbon hydrogen for use in adapting national legal definitions and providing a clear taxonomy for legal certainty and to foster collaboration and investment flows;

(b) The principle of GHG/CO_2 equivalents as an important indicator for the energy system. A transparent mechanism for tracing and tracking carbon contents would be prerequisite;

(c) A uniform methodology for calculating life-cycle GHG emissions from renewable and low-carbon hydrogen.

10. A critical technical step is needed for the transition to a hydrogen economy, and that is to accelerate electrolyser development and deployment. The acceleration could involve one or more of the following actions:

(a) Expanding collaboration on renewable hydrogen production across the ECE region and fostering trans-Atlantic collaboration on renewable and low-carbon hydrogen;

(b) Encouraging collaboration among ECE, the other Regional Commissions, and other UN entities (e.g. UN Conference on Trade and Development (UNCTAD));

(c) Avoiding unneeded redundancies. In some situations, double grid tariffs (electricity and gas) related to the conversion/production of hydrogen should be removed to avoid undue burdens and unfair competition.

11. In order to enable a hydrogen economy there is a need to stimulate behavioural change through market redesign. A redesign is needed on both supply and demand sides to stimulate a hydrogen market through programmes featuring quotas, targets, and targeted support to send clear signals to producers and end-users. The result would trigger investment in production to meet increasing demand. The following approaches would be possible:

(a) Promote eco-design, labelling and branding, including revising provisions for devices that process hydrogen and hydrogen blends;

(b) Promote specific branding/labelling programmes to recognize renewable and low-carbon hydrogen products;

(c) Allow low-carbon steel to be considered an eligible eco-innovation;

(d) Initiate trade in Guarantees of Origin (GO) for renewable and low-carbon hydrogen and expand it to the entire ECE region. GO harmonization is important because national bodies take different approaches resulting in a fragmented market which would hamper renewable and low-carbon trade;

(e) Support auctions/tenders for production of renewable and low-carbon hydrogen to get hydrogen volumes into the market. Establish a hydrogen price index.

V. Recommendations to the energy industry

12. Retrofit and repurpose existing gas infrastructure:

(a) Develop guidelines for ECE-wide harmonization of regulations, uniform standards, definitions and technical rules that govern natural gas and hydrogen blending;

(b) Engage a dialogue on the use of natural gas networks to transport and store hydrogen. Such discussion is needed to recognize the evolving role of infrastructure companies in operating natural gas pipelines with a view to repurpose/convert them to operate as hydrogen-only pipelines. Hydrogen pipelines and blending are not mutually exclusive options as they can co-exist.

13. Support the deployment of electrolysers connected to the electricity grid, ideally supplied with renewable or low-carbon electricity. The development of electrolysers cannot wait until 100 per cent of the electricity is renewable. They need to be deployed earlier to promote sector coupling and sectoral integration. Guarantees of Origin (GO) can also be used to demonstrate that the hydrogen produced is renewable or low-carbon with a view to:

(a) Promoting sector coupling and sectoral integration through new flexible resources to integrate more variable renewables in the power system;

(b) Promoting large-scale renewable electricity installations associated with hydrogen integrated production plants. This type of off-grid integrated model for hydrogen production should be further investigated and supported as it has potential to reduce costs whilst promoting system efficiency.

VI. Recommendations to financial institutions

14. Develop financing dedicated to scaling up the hydrogen economy.

15. Establish a one-stop-shop for funding hydrogen projects. Recognizing that there will be many different sources of funding, this will reduce complexity and avoid incompatibilities

in the combination of funds. An example of this approach is the European Clean Hydrogen Alliance.

16. Support projects from both inside and outside the region aimed at importing renewable energy from the most competitive locations for wind, solar and biomass energy. To increase cost-effectiveness, large-scale Power-to-X projects should be developed and built where environmental and economic conditions are more favourable for renewable energy generation.

VII. Further information

17. To progress work and understanding on policies needed to accelerate development, demonstration and deployment of renewable, decarbonized and low- and zero-carbon gas projects in the ECE region, ECE established a Task Force on Hydrogen comprising experts from the ECE Groups of Experts on Gas and on Renewable Energy. For further information on ECE's work on hydrogen, visit the Sustainable Energy website[2] or contact the Sustainable Energy Division: sustainable.energy.committee@un.org.

[2] https://unece.org/task-force-hydrogen