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Carbon neutrality as a pathway to sustainable energy

Hydrogen – an innovative solution to carbon neutrality

Note by the Group of Experts on Gas

I. Introduction

1. In 2015 the United Nations General Assembly (UNGA) set an ambitious 2030 developmental agenda[1] as expressed in the United Nations Sustainable Development Goals (SDGs). Among the 17 interconnected SDGs are, for example, SDG 7 (affordable and clean energy), SDG 9 (industry, innovation, and infrastructure), SDG 13 (climate action). The 2016 Paris Agreement, reached within the United Nations Framework Convention on Climate Change (UNFCCC), committed the signatories to keep the increase in global average temperature to well below 2 °C above pre-industrial levels, and to pursue efforts to limit the increase to 1.5 °C. As of September 2020, 194 states and the European Union (EU) have signed the Paris Agreement.

2. Building on the commitments stemming from the UNGA September 2015 Resolution, as well as those from the UNFCCC instruments, in December 2019 the European Commission (EC) introduced an economic and growth strategy, the European Green Deal.[2] This strategy includes an emissions reduction target for 2030 with a 50-55 per cent cut in greenhouse gas emission to replace the current 40 per cent objective. The ambitious policy initiatives outlined in the European Green Deal will help reach the net-zero global emissions by 2050. In the European Green Deal, the EC recognizes the role of hydrogen in decarbonizing the industrial sector and integrating a higher share of renewable energy sources more quickly.

3. The above developmental, climate and political commitments pose important constraints on how the United Nations Economic Commission for Europe (ECE) region produces, trades and uses energy. Although these commitments require that all ECE member States gradually reduce reliance on the carbon-rich fuels, they at the same time provide a framework for redesigning our energy system and for reinventing the way we live, work and collaborate

[1] https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf

[2] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.

4. Importantly, these commitments are setting the world—and the ECE region—on the path to decarbonisation.[3] Hydrogen is widely recognized as the key bridge to achieving carbon neutrality of the energy system, especially in hard-to-abate sectors. In a future sustainable energy system, it is argued, hydrogen—and other renewable and low-carbon gases—will be used in transport, homes, industry, and power generation. It will enable the creation of an integrated service-based society. However, hydrogen, although clean and versatile, is not an energy source but an energy vector: it must be produced, transported and stored before being converted to other forms of energy, such as electricity or heat, or to other feedstocks.

5. This document is a summary of a longer informal document that explored hydrogen production and use, and its role in the final energy consumption, both as it is today and as it is hoped to be in 2050. The informal document tried to build a case for hydrogen in reducing emissions by helping the member States understand technical, economic, and public relation challenges that must be overcome.

6. Bearing in mind that a solution to achieving a carbon neutral energy system is to be found within the triangle "gas-renewable-energy efficiency", the Group of Experts on Gas recognizes the key role of the gas industry and gas infrastructure in the transition to a hydrogen economy through energy system integration.

7. The following recommendations offer several options available to ECE member States, the energy industry, and the financial institutions as they strive to accelerate decarbonization through harnessing hydrogen.

II. Recommendations to key stakeholders

A. Recommendations to ECE member States

8. **Be agnostic and open-minded.** This in practice means that the regulations should not prescribe upfront which energy carrier or decarbonisation of feedstocks should be used in which sector; instead, through a life-cycle analysis, such regulations should allow member States to select the appropriate energy carrier(s) and feedstock(s) with a view to promoting the overall system efficiency and to reducing its carbon intensity.

9. **Speak the same language.** This may include some of the following:

(a) Agree within the ECE, or another appropriate framework, a comprehensive and science-based terminology for renewable and low-carbon hydrogen. Then use this terminology to adapt national legal definitions and provide a clear taxonomy that brings with it a legal certainty and fosters collaboration and investment flows.

(b) Establish the principle of greenhouse gas emissions (GHG)/carbon dioxide equivalents as the new "currency" of the energy system. A transparent mechanism for tracing and tracking the carbon content is a prerequisite.

(c) Adopt a uniform methodology for calculating the life cycle greenhouse gas emissions from renewable[4] and low-carbon[5] hydrogen. An example of this could be the CertifHy project,[6] that like the existing renewable electricity Guarantee of Origin (GO) scheme, aims to put GOs for hydrogen into the market in order to decouple the physical and commercial flows of renewable and low-carbon hydrogen, allowing end-users to consumer

[3] In this context, decarbonization refers to reduced dependence on processes that emit carbon dioxide (CO_2), methane and other greenhouse gases (GHGs). This gradual process will lead to the so-called carbon neutrality which in turn means that the net emissions of GHGs from a system converge to zero.

[4] Renewable hydrogen is produced from renewable energy sources, such as wind and solar. Its carbon footprint is close to zero.

[5] Low-Carbon hydrogen is produced from other technologies, such as fossil fuels (natural gas or coal) through a process in which carbon dioxide is captured and stored. Its carbon footprint is relatively low.

[6] www.certifhy.eu.

renewable and/or low-carbon hydrogen everywhere in the EU. This may also take in account the negative emissions.

10. **Accelerate electrolyser development and deployment.** This is possibly the critical technical step in transition toward hydrogen economy. It may involve some of the following:

(a) Expand collaboration on renewable hydrogen production across the ECE region and foster trans-Atlantic collaboration on renewable and low-carbon hydrogen, particularly between its Eastern (Belarus, Kazakhstan, Russian Federation, Ukraine) and Western parts (the European Union, the United Kingdom, Norway). An example of such initiative is the International Partnership for Hydrogen and Fuel Cells in the Economy[7] and ECE member States that have not joined it yet might consider doing so.

(b) Encourage collaboration between ECE and other Regional Commissions, such as ECA and ESCWA, and other UN entities (e.g. UNCTAD). This in practice may mean to implement joint projects on electrolyser deployment in North Africa and the Middle East, on hydrogen transportation infrastructure between the regions, and on related investment flows.

(c) Avoid unneeded redundancies. In some situations, double grid tariffs (electricity and gas) related to the conversion/production of hydrogen is unjustified and should be removed so as not to impose an undue burden and unfair competition.

11**.** **Stimulate behavioural change through market design.** This is applicable to both supply and demand side and may involve some of the following:

(a) Support hydrogen market stimulation programs including quotas, targets, dedicated programmes and support schemes. This will send a clear signal to both producers and end-users and trigger investment in production to meet the increasing demand. The following type of quotas/targets could be set as:

(i) An industrial quota/target (a percentage of total production) for carbon free or low-carbon steel, ammonia, methanol and other chemical products;

(ii) A transport quota/target (a percentage of total volume) for low-carbon/carbon-free kerosene, shipping and aviation bunkering fuels, hydrogen powered trains, and for hydrogen in heavy-duty and light road transport;

(iii) A quota/target for gas suppliers as percentage of energy in total gas supply. This may include physical blending if member States choose to do.

(b) Promote eco-design, labelling and branding. This may include revision of the provisions for devices that process hydrogen and hydrogen blends. The current revision of eco-design and energy labelling of space heaters should set out a framework for market transformation towards devices capable to process hydrogen blends and hydrogen, and uptake of hydrogen in gas networks. It should drive innovation and support synchronization of decarbonisation across the gas value chain, towards a decarbonized building stock in 2050, ensuring that most of the future end-use appliances are capable of processing methane, hydrogen-methane blends, or pure hydrogen;

(c) Promote specific branding/labelling programmes to recognise renewable and low-carbon hydrogen products. This is similar to Energy Star programme;[8]

(d) Allow low-carbon steel to be considered an eligible eco-innovation. Low-carbon[9] and carbon free, steel can reduce the CO_2 performance of vehicles of 6-7g CO_2/km per vehicle. Investments in low-carbon and carbon free steel could take off immediately, because the additional costs of steel produced with either low-carbon or renewable hydrogen are lower than the effective carbon price created by the fleet regulation;

(e) Start-up trade in Guarantees of Origin (GO) for renewable and low-carbon hydrogen and expand it to the entire EC region. A GO harmonization is important because

[7] https://www.iphe.net/

[8] For more info on the Energy Star programme: https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-products/energy-star_en.

[9] In this context, low-carbon does not refer to iron alloys with low percentage of carbon; it refers to steel produced by using low-carbon hydrogen in place of coking coal as the reducing agent.

different approaches of national issuing bodies to it may lead to fragmentation and hamper renewable and low-carbon trade. GO should be supported by a robust track and trace and auditing system. Blockchain technology could have an important role in ensuring security and data privacy in both financial and trading transactions as they relate to trading of guarantees of origin and certificates that prove the renewable and/or low carbon content of hydrogen produced and consumed by end-users. Since hydrogen imports will become important, the member States may consider possible role for the ECE in facilitating both exports and imports;

(f) Support auctions/tenders for production of renewable and low-carbon hydrogen to get hydrogen volume in the market. Start up a hydrogen price index e.g. based on a pricing panel whereby market parties on a regular basis give their hydrogen trading prices.

B. Recommendations to the energy industry

12. **Start immediately retrofitting and repurposing of the current gas infrastructure**. This may involve some of the following:

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

(b) The energy industry from both the EU and non-EU member States should discuss within ECE context the implications of relevant EU gas directives (such as the updated 2009 Gas Directive[10]) that foresee the use of natural gas networks to transport and store hydrogen. Such discussion is needed to recognise the evolving role of infrastructure companies in operating natural gas pipelines with a view to repurpose/convert them to operate as hydrogen-only pipelines. The hydrogen pipelines and blending are not considered mutually exclusive options; they can also co-exist in a Member State.

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) Promote sector coupling and sectoral integration through new flexibility resources to integrate more variable renewables in the power system;

(b) Promote 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.

C. Recommendations to the financial institutions

14. **Develop dedicated financial engineering needed to scale 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 the complexity and avoid incompatibilities in the combination of funds. An example of this is the EU's Clean Hydrogen Alliance.[11]

16. **Support projects from both inside and outside the UNECE 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

[10] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02009L0073-20190523.

[11] https://ec.europa.eu/growth/industry/policy/european-clean-hydrogen-alliance_en

developed and built where environmental and economic conditions are more favourable for renewable energy generation.