World Bank – CMI Joint Webinar Series

Knowledge Exchange on Green Hydrogen for the Mediterranean Region

Green Hydrogen in Developing Countries: Implications for the Mediterranean Region of the World Bank's Report

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SUMMARY OF PRESENTATIONS AND KEY POINTS FROM DISCUSSION

Summary of the presentation

- Green hydrogen is a clean flexible energy carrier that offers an opportunity to decarbonize sectors that are difficult to decarbonize, such as industry, transport, and buildings, and could contribute to improve power resiliency, mitigate renewables seasonal variability and reduce reliance on expensive imported fuels. Due to the capacity of hydrogen to store energy for very long periods of time, green hydrogen could offer long-term clean energy storage for mini grids and isolated locations, such as the solar-hydrogen mini-grids in the Kyenjojo communities in Uganda or the solar-hydrogen fuel cell system at Poelano High School in Venersdorp in South Africa. Moreover, "future fuels" such as ammonia and methanol could be produced and used in various sectors and applications.
- Green hydrogen is set to become more cost-competitive with fossil fuels in a number of sectors and locations as cheaper and more efficient electrolyzers and fuel cells become available, and as the cost of renewable electricity continues to fall. Wind power of 23 USD/MWh, for example, can result in green hydrogen production cost of less than 2 USD/kg. Namibia as well as other countries

with exceptional renewable resources such as Morocco are exploring the potential to produce local green hydrogen and ammonia to decarbonize their local industry and services (e.g. fertilizer production, steel production, freight transport) and to export compressed hydrogen, ammonia, and methanol to other countries.

- Today the majority of hydrogen is produced from fossil fuels, with associated carbon emissions equivalent to the emissions of Indonesia and the UK combined, and is mostly consumed in the chemical industries.
- Challenges in the deployment of green hydrogen include the requirement of specific knowledge and capabilities, the lack of qualified engineers, high cost and poor efficiency of hydrogen technologies, lack of water and desalination requirements, the need for strategic infrastructure decisions between pipeline infrastructure or maritime transportation, and lack of national strategies to identify the green hydrogen development pathway.
- Fostering Mediterranean integration to scale-up green hydrogen investments would require regional strategies that clearly identify trade opportunities and the infrastructure requirements along with harmonized regulations and human capital development, the establishment of carbon policies aligned with the Paris agreement, and a shared system of guarantees of origin that would create a market pull for green hydrogen adding flexibility to meet Nationally Determined Contributions (NDCs). The joint promotion of clean maritime shipping fuels, such as ammonia from green hydrogen, would contribute to protection of the Mediterranean marine environment.
- The following questions could be addressed to better understand the role of green hydrogen at a country-level:
    - Is it better to be an early mover or a cautious entrant to green hydrogen?
    - Are there important competitive advantages on any parts of the value chain (RE generation, proximity to markets, existing infrastructure, value chain technology/manufacturing capability, etc.)?
    - If competitively priced green hydrogen/derivatives are available, are there applications that would be attractive for switching to it?

Statements and Key Points from Discussants

Fernando De Sisternes

- The cost to produce green hydrogen need to be evaluated on a country-by-country basis. For instance, in countries with limited access to fossil fuels, and with high-RES potential, it may be already competitive.
- Desalination is a critical factor to tackle the water scarcity problem, and in general, it represents a small part of the total cost. This could also represent an opportunity to fund additional desalination projects for local needs of water for the population and minimize the cost to procure fresh water.

Abderrahim Jamrani

- Morocco started to explore the potential to develop green hydrogen while looking at options for more grid flexibility for renewables and to maximize renewable generation and electricity storage for heat, electrical mobility, and other applications. Hydrogen allows renewable energy to replace end use of fuels as well as of electricity, thus increasing grid flexibility that is not possible with the

current grid. A preliminary analysis shows that Morocco, thanks to their great renewable energy source potential and their high competencies in developing renewable energy, could produce green hydrogen at competitive cost with blue hydrogen currently produced in Europe. Current Morocco initiatives on green hydrogen include the work in partnership with ESMAP to elaborate a program of green hydrogen production in the country, the work on a reference project to demonstrate economic feasibility and a pilot green ammonia R&D project with their German partners. Morocco is also working with several European countries to identify projects that can be developed in Morocco to allow European countries to reach their objectives on green hydrogen for the next 10 to 30 years.

- Example of opportunities from the development of green hydrogen in Morocco include, among others, the production of green ammonia for its fertilizer industry and for export on a competitive basis.
- Water scarcity in the region is a real issue, with fresh water facing competition for domestic uses and in agriculture. The key for Morocco is to use desalination to produce green hydrogen, which has less impact on the environment and represent a minor additional cost compared to the overall hydrogen production cost.

Bariş Sanli

- Important factors to consider for the development of green hydrogen in developing countries are 1) engineering challenges, as hydrogen infrastructures are much more dangerous that methane infrastructures, 2) the importance to develop inter-seasonal storage due to the limits on how the system can integrate renewables, and 3) the need to involve R&D centers to better understand hydrogen security, safety, human resources, etc. Turkey adopted the strategy of blending hydrogen in methane as a first step as it has already gas infrastructure in place, which represent an excellent opportunity for countries like Turkey that have high dependency on gas imports. Turkey also has an R&D research center at the university that does burning tests and investigate how these fuels impact the system. The biggest challenge is perhaps to create a market for hydrogen. It is important to define the needs of the end users of green hydrogen while developing a national strategy (be an early mover but be a cautious new entrant).
- Green hydrogen could help solve the problem of inter-seasonal storage and the integration of renewable energy in the system.
- Water usage may not be a problem if green hydrogen is done at small scale, however, if it is done at scale as it is envisioned by the EU for instance, it needs to be carefully addressed.

Ruud Kempener

- Green hydrogen is seen as a key enabler to achieve Europe's objective for climate neutrality. The "EU strategy for system integration" identifies the need for to use renewable and low-carbon fuels, including through hydrogen, for end-use applications where direct heating or electrification are not feasible, not efficient or have higher costs. The priority for the EU, as stated in its "Hydrogen strategy for a climate-neutral Europe", is to develop renewable hydrogen, produced using wind and solar energy. In the first phase, from 2020 up to 2024, the strategic objective is to install at least 6 GW of renewable hydrogen electrolyzers in the EU and the production of up to 1 million tons of renewable hydrogen, to decarbonize existing hydrogen production, e.g. in the chemical sector, and to facilitate take up of hydrogen consumption in new end-use applications such as other industrial processes and possibly in heavy-duty transport. The vision is to install 40 GW of renewable hydrogen electrolyzers by 2030. Several EU countries have already prepared national strategies for hydrogen which will contribute to this goal. In the long term the EU is

looking at a wider application of hydrogen, including through repurposing existing pipeline infrastructures for hydrogen transportation.

- One of the key areas for the EU for the development of green hydrogen is the international dimension, which foresees an increased cooperation with both southern and eastern neighboring countries. Though there will not be massive imports in the next couple of years, it is particularly important to cooperate in term of future infrastructure need, R&D, technology development, etc.
- Another crucial element will be the certification of green hydrogen. The EU plans to introduce a comprehensive terminology and European-wide criteria for the certification of renewable and low-carbon hydrogen by June 2021.
- The EU has already some funding and financing in place through its Horizon 2020 research program, including a call specifically focused on renewable energy development in Africa.
- Green hydrogen has a critical role for all, it will be important to bring together all the international fora as the IEA, G20, IRENA, World Bank, etc. Under IRENA, the EC and Morocco are co-facilitating the collaboration platform on hydrogen to advance policy discussions on the use of hydrogen with its members.

Dr Ramabhadran (RB) Balaji

- A key factor of green hydrogen is that it has various applications in the industrial sector as raw material but it can also be used as an energy carrier, for instance the local production of green hydrogen for energy is of particular importance for isolated locations. In the short-term green hydrogen sees immediate uses to decarbonize the chemical industry, while emerging applications include steel production. In the long-term green hydrogen has a massive potential at scale, for instance in the transport sector for applications where electrical energy is not practical. The key is to achieve cost-effective production of green hydrogen.
- The import vs export nexus is an important question. While using green hydrogen for local uses may not need so much infrastructure, the potential for a future global market would depend on cost-competitive storage and transportation infrastructure development; competitiveness against conventional hydrogen for chemical uses and competitiveness against alternative forms of energy storage and transport for mobility markets would be critical factors.
- Green hydrogen production can be more distributed around the world because of the renewable energy sources availability in several countries, compared to the production of oil and gas, which is concentrated in a limited number of countries.