Hydrogen

as a Green Energy Source in the MENA Region

Brief

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Hydrogen is a promising energy concept for commercial use. The abundance of this element and the ability to produce it from water through electrolysis makes it an attractive and cleaner choice to replace fossil fuels and solves the decarbonization challenges of the following areas:

1. **Transport:** By combining hydrogen with oxygen in a fuel cell, electricity can be produced and the byproducts of this process are water and heat. The electricity produced can run an electric motor and substitute internal combustion engines working on fossil fuels as a low-carbon mobility alternative. It has certain advantages compared to the existing electric vehicles, as it provides longer ranges and only a few minutes for refueling.

2. **Industries:** Hydrogen will be necessary as raw material to decarbonize high carbon industries such as the steel, cement and chemicals sector. In the steel sector for example, CO2 is produced along the reduction of iron ore to pure iron. If the iron ore is reduced to pure iron through hydrogen, no direct carbon emissions will occur.

3. **Storage:** Hydrogen can be used as a long term electricity storage solution, for example it can be used to utilize peak electricity production from renewable energy to power the electrolysis process to produce hydrogen from water, and then it can be transported in vessels or pipes over long distances and used elsewhere.

Production and Transport of Hydrogen:

Hydrogen can be produced in various ways and has different origins, the main distinction is whether CO2 is emitted while producing it, which leads to four types of hydrogen:

Green hydrogen: The production of hydrogen using electricity generated from renewable energy, it is carbon emission-free and the most environmentally friendly option. The electricity powers the electrolysis process to produce hydrogen from water. Green hydrogen also benefits the electrical grid by reducing variable renewable energy curtailment and providing grid-balancing services.

Grey hydrogen: The production of hydrogen using energy input from fossil fuels, which is high in carbon emissions. Hydrogen that is produced from natural gas for example, is widely used in many different industrial processes. Currently hydrogen from fossil fuels accounts for 94% of the hydrogen production worldwide.

Blue hydrogen: It is grey hydrogen in which the emissions emitted during the process are captured, stored or reused (CCS). This type of hydrogen end results are environmentally clean depending on the technology used and the efficiency of the process. More research is needed on the carbon capture and reuse.

Turquoise hydrogen: The production of hydrogen through a process called pyrolysis, in which natural gas (methane) is heated up leading it to break up into hydrogen gas and carbon solids. The main distinction from blue hydrogen is that there is no carbon emitted in the process, the carbon resulted is in solid form.

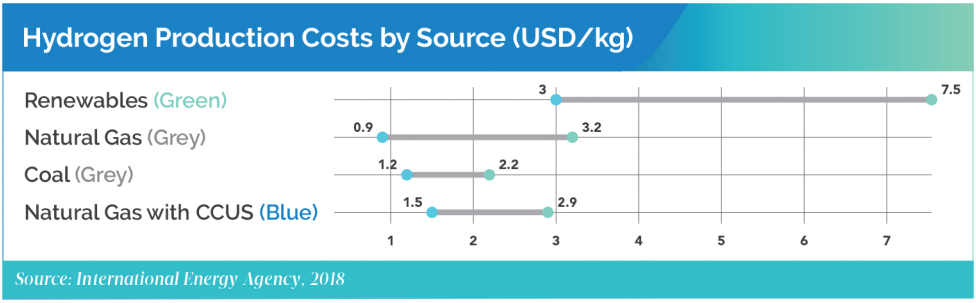
Consequently, for hydrogen to be a potential part of the energy transition into more sustainable energy economies, only the green hydrogen energy is an option. Hydrogen will only be as sustainable as the power we use to produce it is.

The use and demand for Green hydrogen energy produced with renewable electricity, is projected to increase rapidly in the coming years worldwide. It is said to be one essential part of the full decarbonization processes of the industrial and transport sectors. Without green hydrogen carbon neutrality in 2050 in the EU for example, will not be achievable.

Transportation of hydrogen follows the same principles of the transportation of natural gas. It can be transported by vehicles in gas or liquid forms in special containers, it also can be transported through pipelines that are very similar to the pipelines used for natural gas. According to experts, the established gas infrastructure can be utilized to transport hydrogen.

Obstacles of Hydrogen Production:

Production of hydrogen from renewables is still more expensive than other sources, the most commonly used production source at the moment is natural gas.



In addition to this, there are more obstacles that need to be tackled to accelerate the development of hydrogen:

1. Power to hydrogen efficiency is 50-70%, improving this factor will help reduce production costs.
2. Renewable energy shared in the electricity mix must be above 70% for hydrogen to be more climate friendly than current production processes.
3. High infrastructure costs of facilities and logistics, current estimates including production are at 8-10$/kg.
4. Resources: Sun, wind, land, water needed which is not abundantly available in many countries.

Exporting Hydrogen From the MENA Region to Europe:

Opportunities of exporting hydrogen in the MENA region:

1. Its geographical location as a neighbor of the European Union makes the MENA region the perfect place to supply the fast growing demand for green hydrogen in the EU.
2. The region has an abundance of renewable energy potential with the highest irradiance of solar as well as good wind power potential. Introducing green hydrogen can solve current challenges, such as generation peaks from renewable energy projects and energy storage.
3. Hydrogen can be injected into natural gas grids in the MENA countries. The already existing infrastructure can be used for more green energy solutions to reduce natural gas consumption and carbon emissions.
4. Hydrogen is a great opportunity for diversification of the economy especially for oil and gas exporting countries. Hydrogen based energy in the MENA region can be used for transitioning from oil and gas to renewable and green energy.
5. For the Maghreb region, the already existing gas pipelines connecting North Africa to the EU at multiple points can be used for hydrogen export. From Libya, Tunisia and Algeria to Italy, and from Morocco and Algeria to Spain.

Risks of exporting hydrogen in the MENA region

1. The MENA region is one of the most water scarce areas, sourcing water for green hydrogen production while also covering the region's need of water can be challenging. Desalinating sea water in order to protect the ground water supply will be very energy intensive.
2. Hydrogen is a new topic to the region. The high ambitions of countries such as Germany aiming at 5 Gigawatt of hydrogen capacitiesby 2030 could be stopped by a lack of expertise, knowledge, private sector engagement and investors.
3. Many parts of the MENA region suffer from political instability, conflicts, and various disputes that can jeopardize infrastructures and development plans of green hydrogen.
4. Focusing on exporting green hydrogen to Europe could take the attention away of the energy transition processes in the MENA countries themselves.

Spotlight on Hydrogen projects in the MENA:

- **UAE:** A solar-powered green hydrogen project is to be operational in 2020. and an operational hydrogen fueling station for cars since 2017. And a project to research the establishment of a Hydrogen-Based Society,
- **Saudi Arabia:** Hydrogen fueling station for cars, operational since 2019,
- **Oman:** A new hydrogen center that aims to build an economy around 'green hydrogen' started at the beginning of 2020 and plans are under way for a 500 MW Hydrogen production facility,
- **Morocco:** Partnership to research the synthesis of green hydrogen started in 2019,
- **Jordan:** Investment plans for a green hydrogen production facility.

Sources, and more information on hydrogen and energy: 1, 2, 3, 4, 5, 6