The 1st Arab-India Energy Forum

Morocco: 8-9/6/2021

Green Hydrogen –The key to Energy Transition and Decarbonization in Arab Region

Dr. Nouri Alkishriwi
Energy Department - League of Arab States

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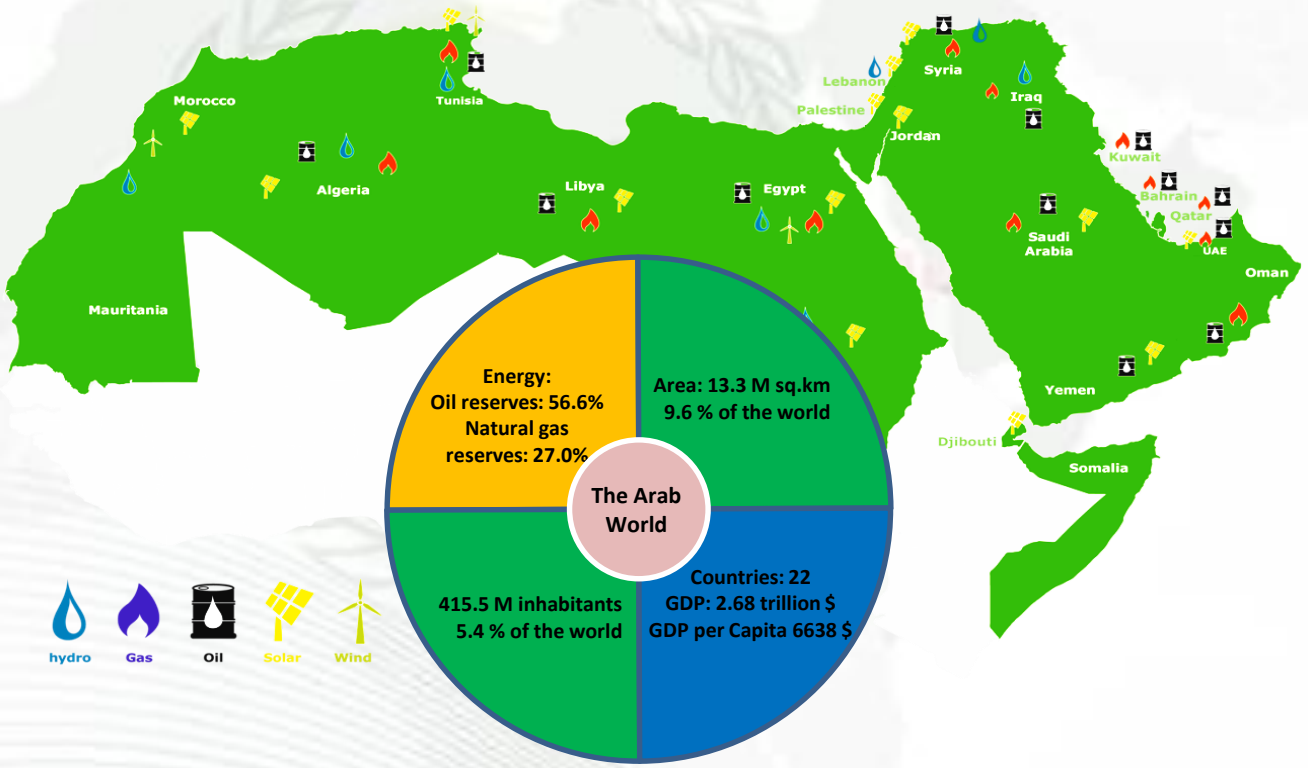
Introduction to the energy system of the Arab region

Oil, Gas and RE

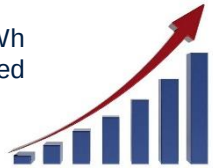


- PAN-Arab Countries Installed capacity over **288 GW**

Customer consumption,
- 46% Residential,
- 18% Industrial,
- 17% Commercial,
- 19% Other

- **190 GW** Renewable energy announced by 2035

- **1,137,644** GWh energy produced in 2017



- More than **212, 500 km** Transmission Network

Source: The Future of Hydrogen-IEA 2019

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Hydrogen in the energy transition

How can we produce hydrogen?

H_2 Grey Hydrogen

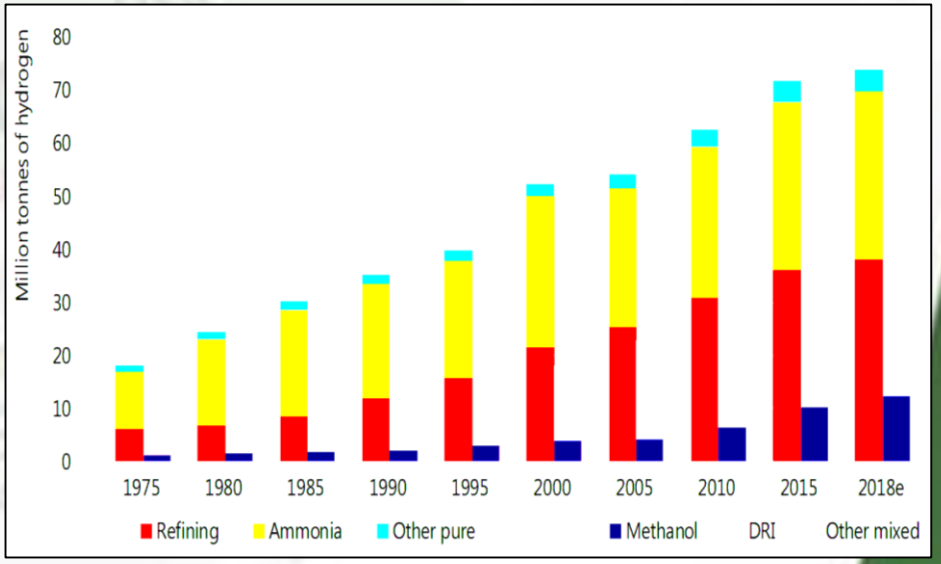
H_2 Blue Hydrogen

H_2 Green Hydrogen

Hydrogen Production

Hydrogen market is big today but not in the energy sector

- The world annually produces 70 million tons of pure hydrogen, the largest part of which is used in oil refining and ammonia processing for fertilizers
- An additional 45 million metric tons is used in impure form in the industry without pre-separation from other gases.
- 100% of current hydrogen needs are covered with fossil fuels, emitting 830 MtonsCO_2/yr



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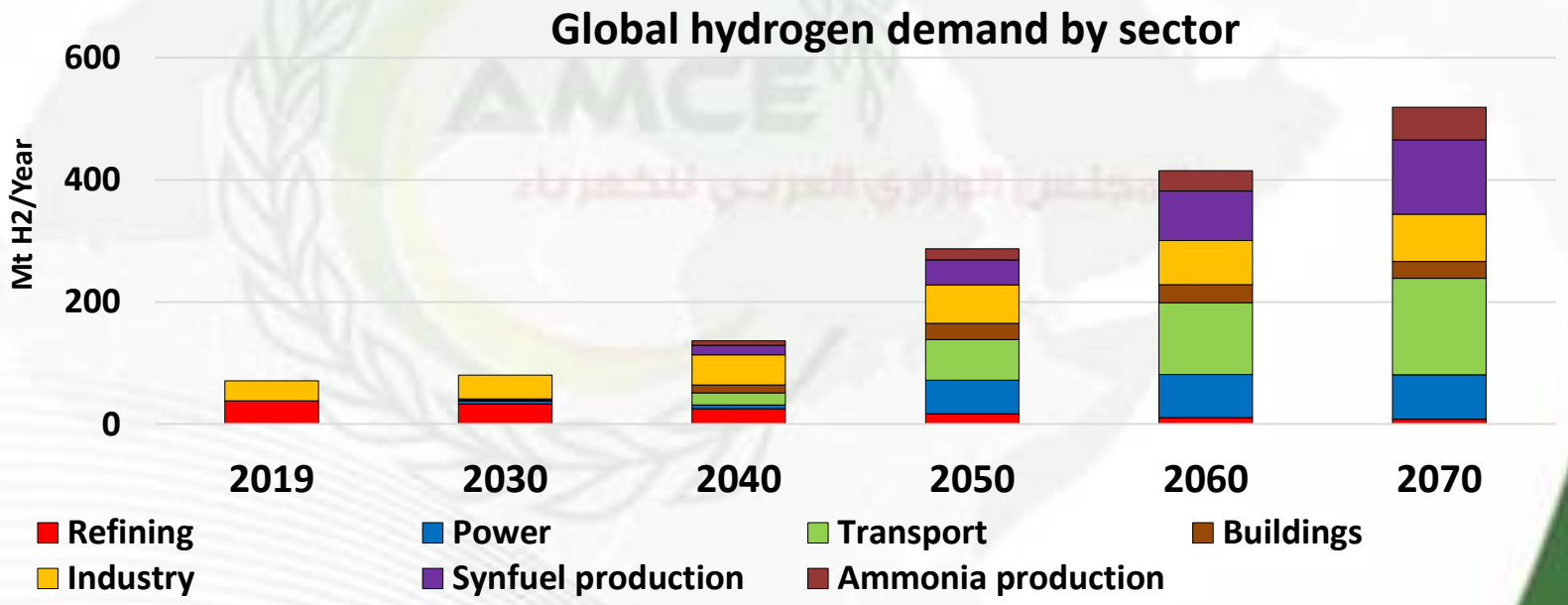
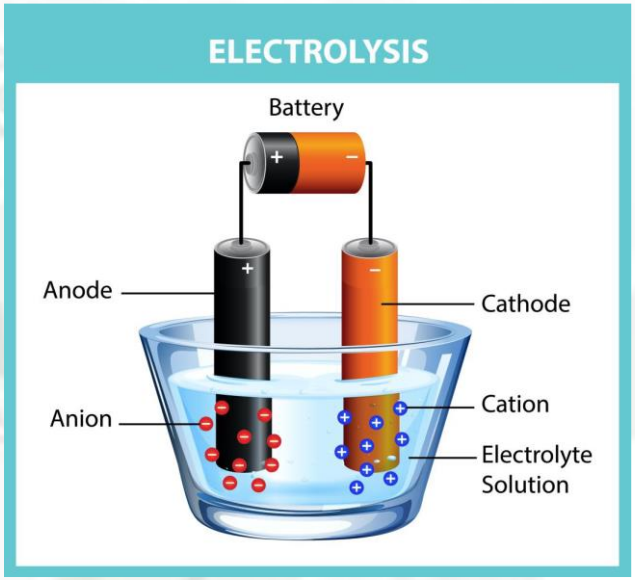


Source: IEA, 2019

Renewable Hydrogen

Green H_2



$$2H_2O \longrightarrow 2H_2 + O_2$$

That means:

Each ton of hydrogen needs 9 tons of pure water

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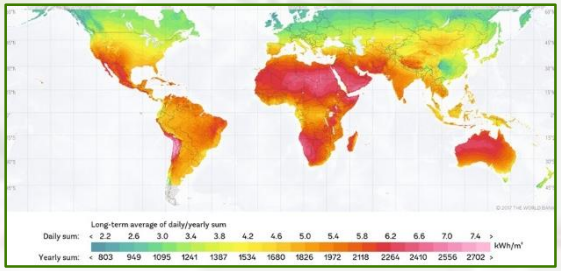
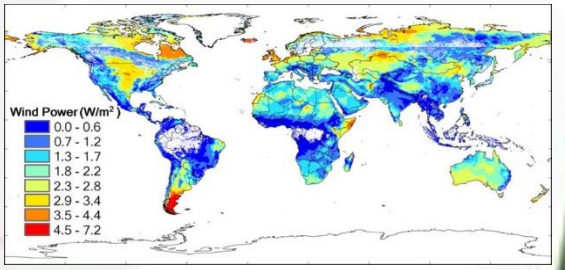
Renewable Hydrogen Production Costs

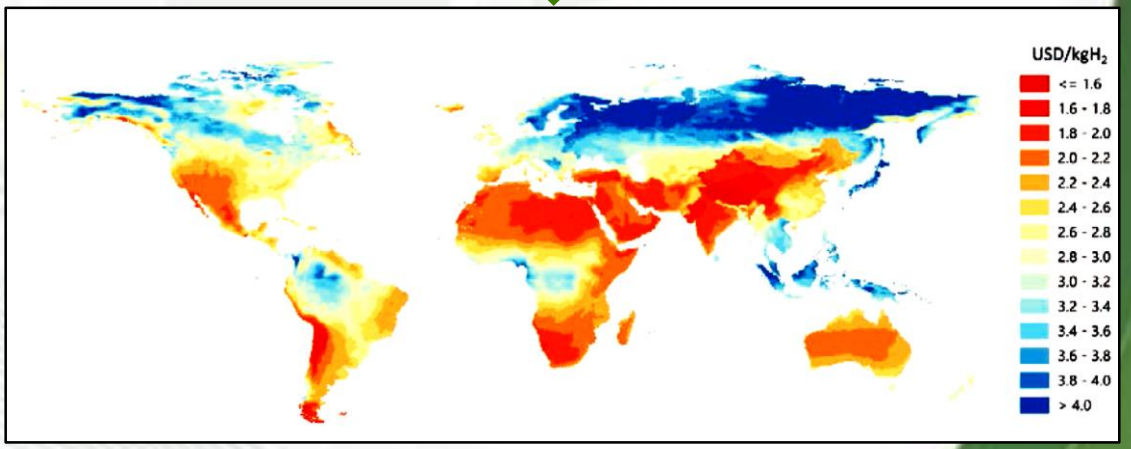
Challenge: Cost

Declining cost of renewable energy favors future H2from water electrolysis

- The decrease in the prices of electricity generated from photovoltaic and wind energy will contribute effectively in the Arab region in reducing the costs of producing hydrogen.

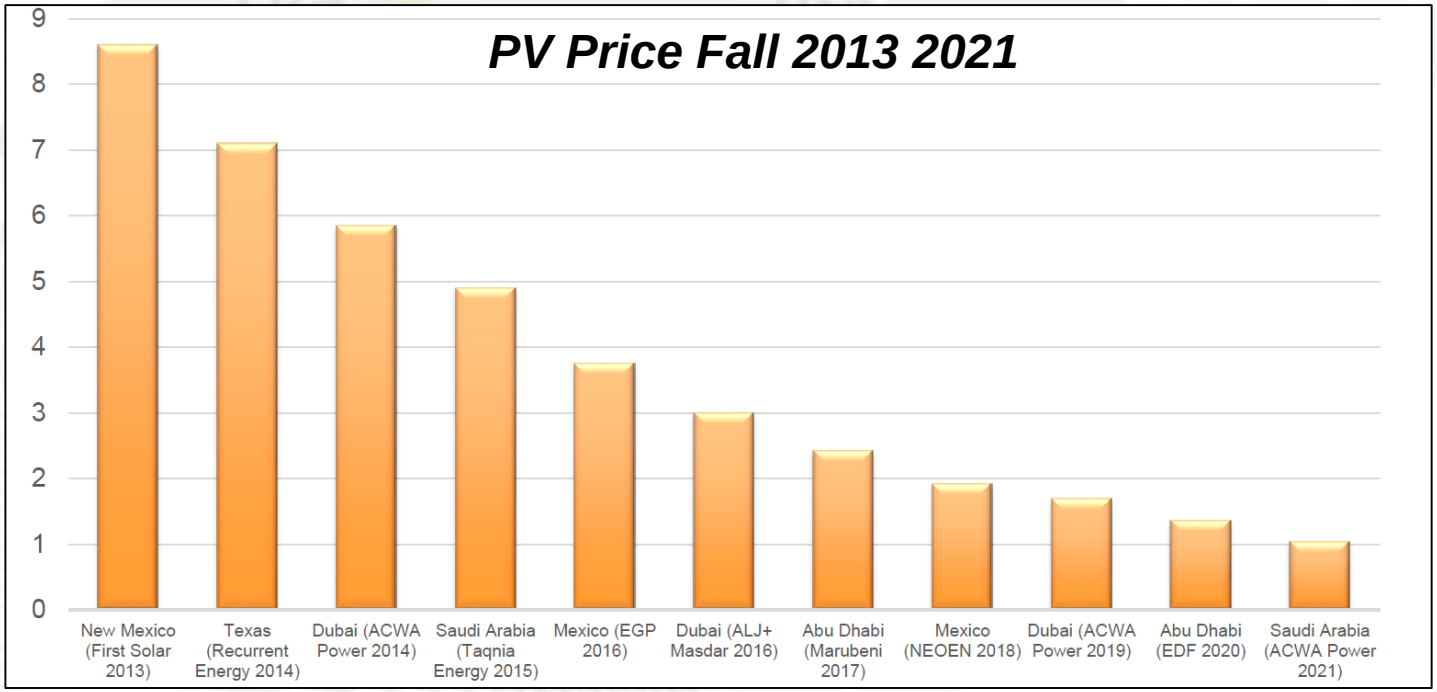






Challenge: Cost

Massive drop in prices for unsubsidized PV systems, led by the Middle East

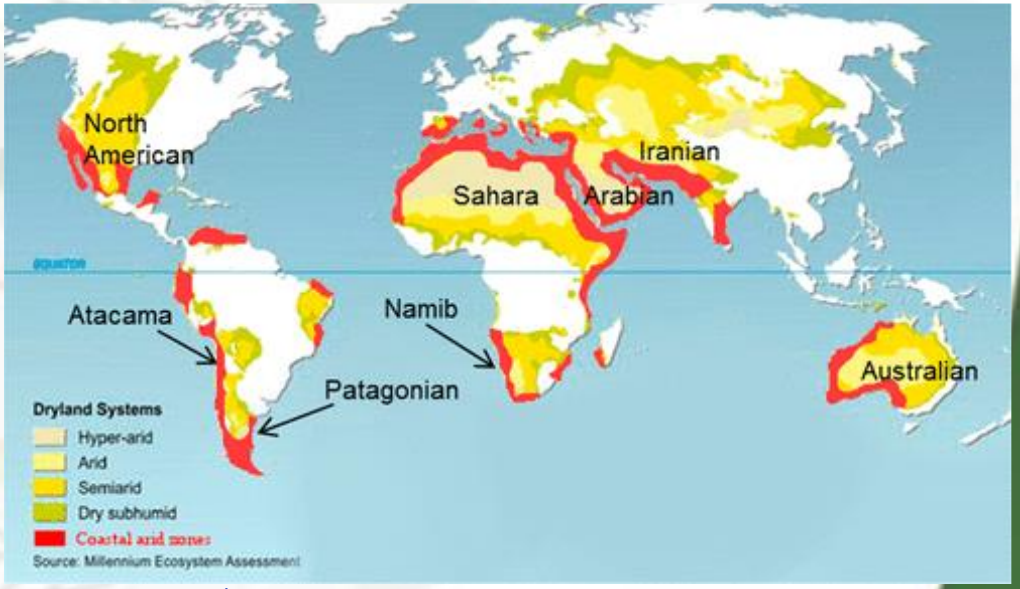


Source: Dii, Clean Technica, ©Dii Desert Energy

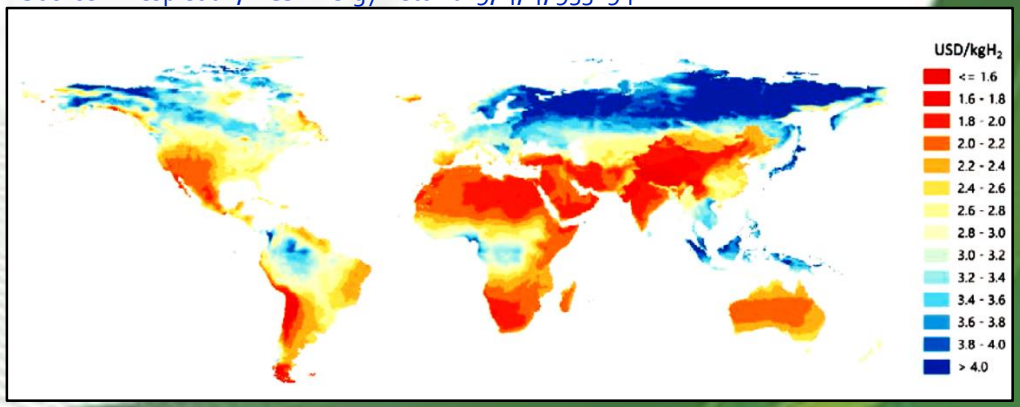
Challenge: Water

Declining cost of renewable energy favors future H_2 from water electrolysis

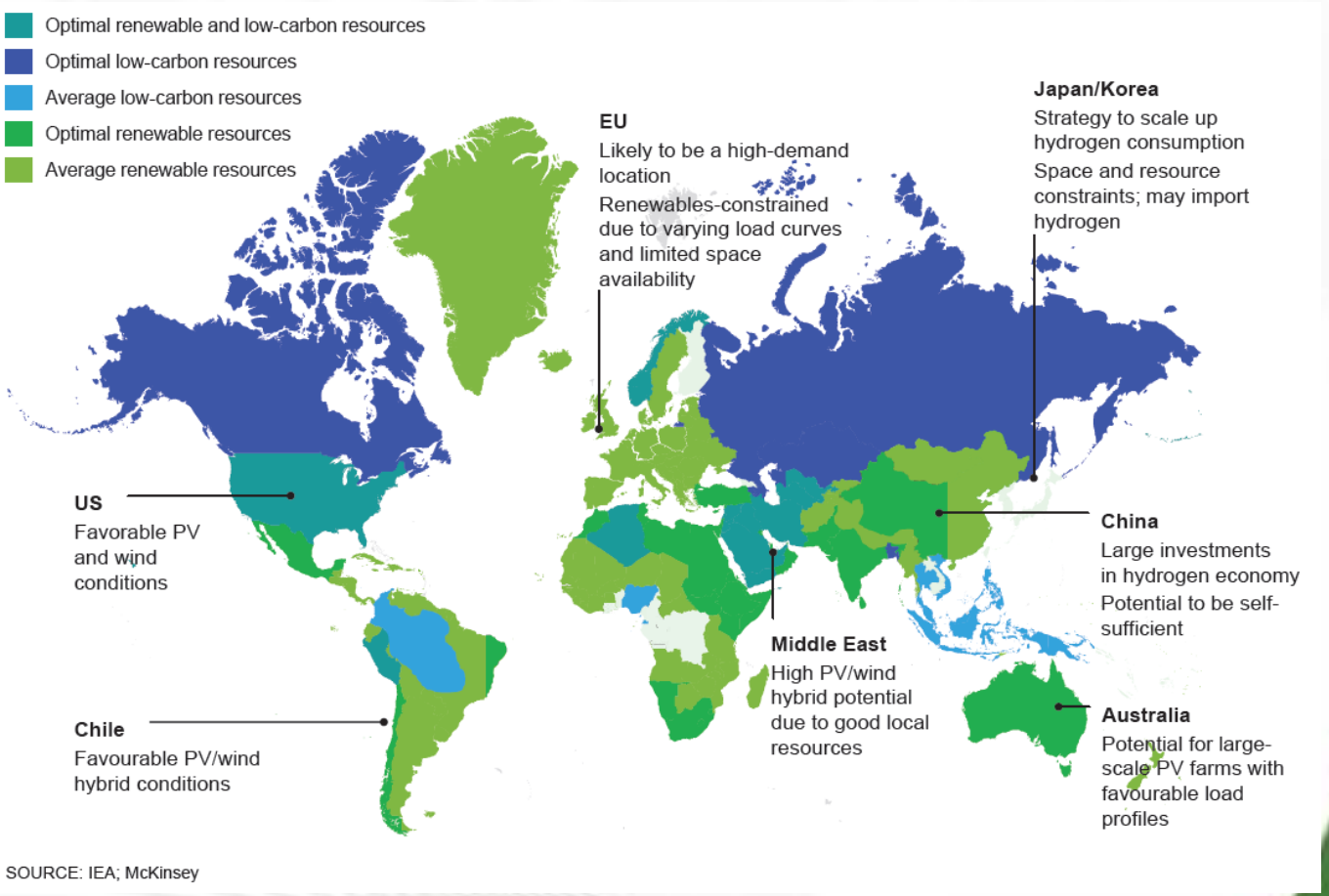
- Applications of water electrolysis have been limited to pure and fresh water resources
- Using fresh water is not a viable option in water-scarce countries
- Seawater is an inexhaustible source



Source : Dresp et al., ACS Energy Lett.2019, 4, 4, 933–942



Best source of low-carbon hydrogen in different regions



SOURCE: IEA; McKinsey

4 Hydrogen: the Power Sector

Green Hydrogen: Stabilizing the Power Market

- Hydrogen produced with excess solar PV and wind power can be stored for later use – as a fuel for transport, industry and other sectors.
- Hydrogen production can be used as a ‘smart’ load to increase power system flexibility and help to decarbonize the overall economy.

Local (on-site) use of RE energy provides a solution to increasingly loaded electricity grids

With the increase in installed capacities of renewable energy ...

It makes electricity grids increasingly under pressure

The solution: local use of green electricity to generate hydrogen

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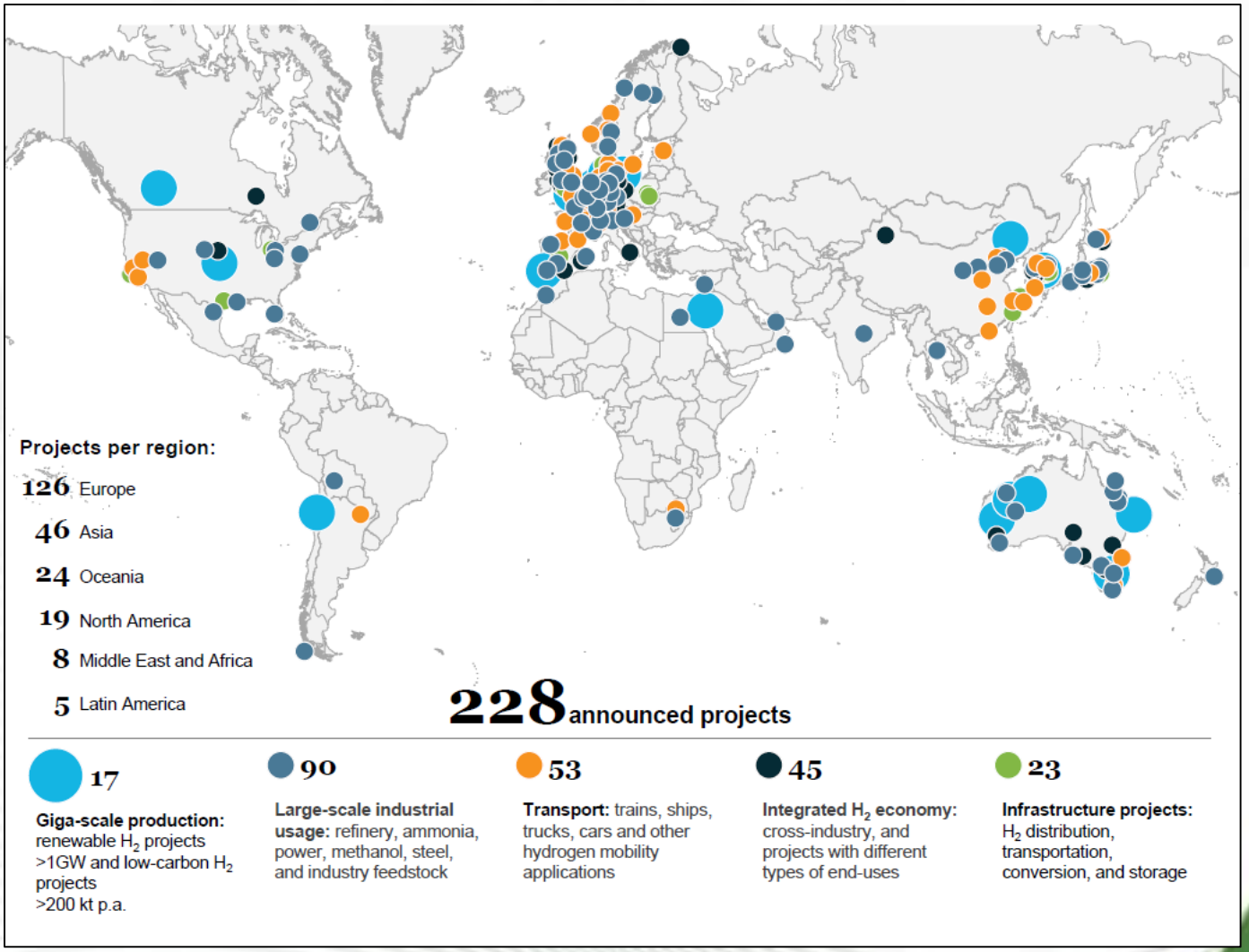
Hydrogen: Initiating and Scaling Up

Global hydrogen projects across the value chain

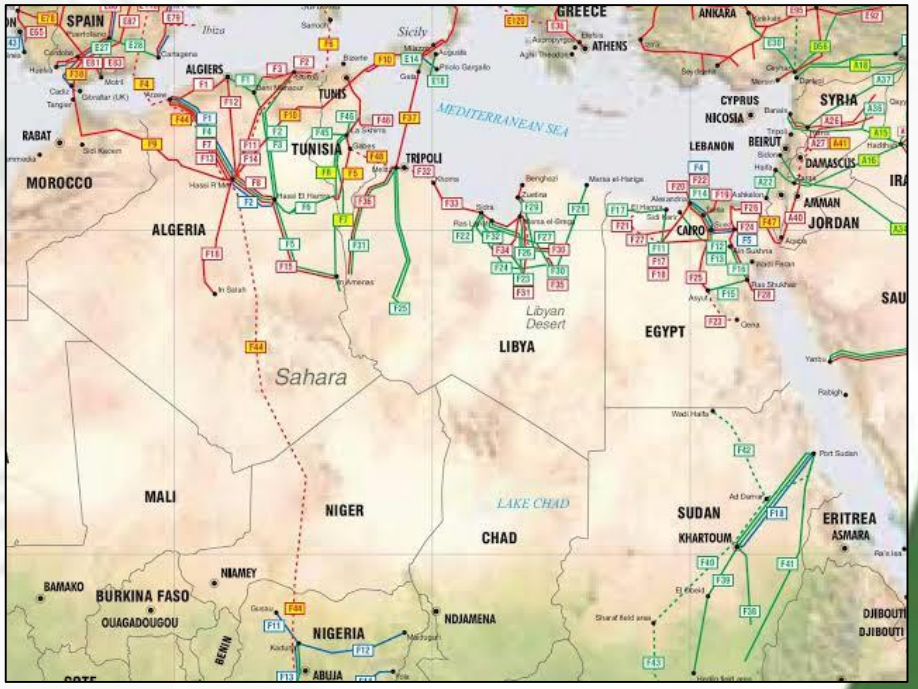


Source: Hydrogen Council, Mckinsey & Company

LNG / Hydrogen Synergies

- A great opportunity in the Arab region to export hydrogen on a large scale

- Green hydrogen can be produced in electrolysis using renewable electricity, can be transported using the natural gas grid.



North Africa Pipelines Map

Hydrogen: Initiating and Scaling Up

Thank You

Dr. Nouri Alkishriwi
Senior Expert
Renewable Energy and Energy Efficiency
Economic Sector, Energy Department
League of Arab States

1, Tahreer Square, PO Box 11642 Cairo, Egypt
M: +218 918409205 & +2 (0) 10 62 16 64 79
Email : n.alkishriwi@gmail.com