Green Hydrogen and Pt-X: Future and Potential Opportunities in Egypt

Dr. Ahmed Elguindy, Hagar Abdelnabi, Dr. Wessam El-Baz
The business opportunity (I)
The What, the Why, and the How?

What is green hydrogen?
- **Green Hydrogen**: a clean energy carrier, with zero net carbon footprint used as a fuel for power
- Produced through the **electrolysis process** in which water (H\textsubscript{2}O) is split into hydrogen and oxygen using electricity
- Plays an integral role in sector coupling under the umbrella of the so-called **Power-to-X (Pt-X)**

Why green hydrogen?

- **Green Energy**: Carbon neutrality using renewable energy sources (RES)
- **Transportation**: Easily transported over long distances using **existing** infrastructure
- **Storage**: Hydrogen has high energy **density** when compressed
- **Safety**: Safety considerations similar to natural gas or petroleum
- **Versatility**: A green energy source with a **wide range** of applications

Source: Nexus Analytica own diagram
The business opportunity (II)
The What, the Why, and the How?

This illustration is by no means exhaustive, but rather gives a generic overview about the different opportunity of integrating green hydrogen into the Egyptian energy ecosystem.

The Egyptian electricity sector can leverage and benefit greatly from the existing generation surplus.

Light Mobility (Pt-H₂)
Fuel cells cars, trains, public transport

Direct Use Pt-H₂

Buildings (Pt-Gas / Pt-CH₄)
Heating, cooking, natural gas stations

Heavy Mobility (Pt-Liquid)
Trucks, marine, aviation

Industrial sector
Refining, steel production, chemical reactors

Source: Nexus Analytica own diagram

Source:
- Electricity
- Hydrogen
- Methane / Methanol
- CO₂

© Nexus Analytica July 2020 // Dr Elguindy, Abdelnabi, Dr El-Baz
Benefits towards adopting Hydrogen in Egypt
How would a hydrogen fit within the SDS2030?

- Adhere to Paris Agreement
  - Green H₂ as with its zero net carbon footprint and integration into a wide range of application can reduce the country GHG emissions

- Socio-Economic Development
  - H₂ can be obtained from surplus electricity (conventional or vRE) then stored in large amounts for extended periods of times. Could potentially reach up to 1 TWh.

- Leverage Generation Surplus
  - Acting as H₂ regional hub

- Competitive market
  - Given its exceptional geographical location, favorable wind and solar resources, and the existence of an infrastructure.
  - A competitive North African market with unhindered cross-border trade shall lead to important benefits for competition, affordability, and security of supply.

According to various studies, it is estimated that the hydrogen value chain would potentially create at least 1 million jobs by 2050 (EU market).

Source: Nexus Analytica own analysis
Challenges for Egypt towards H₂ adoption
What are the anticipated challenges along the way?

Technology and economic benefits
Fossil fuels still remain the primary resource for hydrogen production due to the low price of fossil fuels along with the high costs and technical challenges related to the use of vRE.

Exporting to the EU
A new pipeline is to be built that would begin in Egypt, pass through Greece, and end in Italy with a length of 2,500 km and an investment of €16.5 billion. This pipeline would allow the transportation of 7.6 million tons of hydrogen per year.

Subsidized sector
The energy transition towards adoption of green hydrogen requires subsidies lifting of electricity and liberalization of energy market.

Water required for H₂ production
It is estimated that 1 kilogram (kg) of Hydrogen requires 9 liters (l) of water. With a shortage of 30 billions cubic meters (m³), Egypt would need to increase its share via water desalination. Currently Egypt owns 44 stations with a generation cost of 10-15 EGP / m³.

Morocco and Saudi Arabia are in discussion for strategic partnerships with EU and Asia

Market liberalization according to electricity law 2015

Estimated at 9 liters of water to produce 1 kg of H₂ during the electrolysis process

Source: Nexus Analytica own analysis
International best practice (I)

Existing strategies and roadmaps

Japan
✓ The first country to announce a basic hydrogen strategy early on in 2017.

The European Union
✓ In September 2018, the European Commission adopted a European hydrogen initiative and announced its strategic interest in hydrogen technology and systems.
✓ The European Commission is adhering to a phased approach towards the scaling-up of Hydrogen production.

Support the installation of at least 6 GW of renewable hydrogen electrolysis in the EU, to produce up to 1 million tonnes of renewable hydrogen.

Hydrogen needs to become an intrinsic part of Europe’s integrated energy system, with at least 40 GW of renewable hydrogen electrolyser and the production of up to 10 million tonnes of renewable hydrogen.

Renewable hydrogen technologies to reach maturity and be deployed at large scale across all hard-to-decarbonise sectors, such as chemicals and steelmaking.

Source: Nexus Analytica own diagram based on EU Hydrogen Strategy

© Nexus Analytica July 2020 // Dr Elguindy, Abdelnabi, Dr El-Baz
International best practice (II)
Published strategies and roadmaps

**Germany**
- Considered by many the natural extension to Energiewende (Energy transition strategy).
- Ultimately aims to end the country’s reliance on coal.
- Considers heavily sector coupling and applications of H₂ in a wide range of industries.
- Consists of **38 measures**

**Targeted markets**
- Hydrogen production
- Heat
- Industrial sector
- Infrastructure/Supply

**Collaborative EU market strategic elements**
- Transport and distribution infrastructure in Germany and abroad
- Research, education, innovation
- International hydrogen market and external economic partnerships

**Laying down the basis for a well-functioning domestic hydrogen market.**

**Stabilizing the newly emerging domestic market, molding the European and international dimension of hydrogen, and using it for German industry.**

Source: Nexus Analytica own diagram based on the German BMWi Hydrogen Strategy

© Nexus Analytica July 2020 // Dr Elguindy, Abdelnabi, Dr El-Baz
Recommendation and upcoming steps (I)
The Hydrogen Strategic roadmap (2020-2030)

Positioning Egypt as a potential PtX producer/exporter

Frontrunners (e.g. Norway, Germany and Japan)
- Well established key players on the international scene
- PtX on the political radar with strategy in place
- Evident export potential is evident given trade environment

Hidden Champions (e.g. Sub-Saharan Africa)
- Unexplored RES potential
- PtX could potentially become an important topic on the energy scene if facilitated using the appropriate policies frameworks

Upcoming Market Giants (e.g. USA and Australia)
- Enormous resource availability
- Massive land areas paired with extensive RES power
- Still in facilitation phase (political decision)

Converters (e.g. Gulf Oil)
- Long-term conversion from fossil to green energy sources
- PtX to diversify portfolio as alternative long-term growth strategy
- Strong motivation for PtX export technology development

Strategic Partners (e.g. Morocco, Egypt)
- Energy partnerships with Europe supported through development aid

Potential pillars marking the foundation of strategic roadmap

01 Technologies
Scaling-up PtX industries focused primarily on green hydrogen will be a key pillar in the strategic roadmap.
This will be supported by complementing technologies such as H₂ from steam reforming (based on natural gas) or the temporary capturing of CO₂ (required for synthetic fuels) from biomass or industrial processes.

02 International investments
The framework for investments in PtX plants have to be appropriate in order to attract the necessary global investments.
Politics should also pave the way towards exploring the PtX export/import potential of countries with huge potential in size but more difficult current investment conditions

03 Market Supply and Demand
Established and facilitated market is needed in order to ensure that the product is demanded.
The development of a substantial PtX industry will only be successful if consumers are willing to pay for green PtX. Therefore, the green value of PtX has to be transferred into monetary terms, e.g. in countries importing or exporting synthetic fuels (Europe/Germany).

Source: Nexus Analytica own diagrams adopted from the Frontier Economics International aspects of a PtX roadmap final report

© Nexus Analytica July 2020 // Dr Elguindy, Abdelnabi, Dr El-Baz
Recommendation and upcoming steps (II)
The Hydrogen Strategic roadmap (2020-2030)

2020
- Market assessment and pre-development phase
- Analyzing Hydrogen market potential in Egypt, i.e., positioning Egypt as a potential PtX exporter.
- Develop in-country knowledge through capacity building associated with PtX as an emerging

2020/2021
- Developing the Egyptian Hydrogen strategic roadmap on the short- and medium-term, until 2030. Study to be owned primarily by MoERE and including the stakeholder map
- Identifying strategic partnerships in the regions in close cooperation with MoIC

2021/2022
- Initiate the market introduction phase via market surveillance, market support through attractive financial incentives
- Put strategic partnership and roadmap short-term goals into motion.

2022-2030
- Market growth can be supported through targeted policy measures for creating markets in specific sectors and segments
- Identify potential energy exports versus domestic energy use
- Revise roadmap considering market uncertainty post COVID-19

Source: Nexus Analytica own analysis
Thank you
Looking forward to staying in contact with you

Address: BUE Science and Innovation Park
Building 7, office 314
Cairo Suez Desert Road, Cairo, Egypt

Phone: +20 120 764 7494
       +20 114 414 5566

E-mail: info@nexusanalytica.com

Website: https://www.nexusanalytica.com
LinkedIn: https://www.linkedin.com/company/nexus-analytica

Dr. Ahmed Elguindy
elguindy@nexusanalytica.com

Dr. Wessam El-Baz
wessam@nexusanalytica.com