Hydrogen in a 100% Renewable Energy System

Hydrogen and PtX in Morocco: Ongoing Projects

September 6th , 2023

Green Hydrogen in Morocco: First Steps, Initiatives & Drivers (1/2)

3 important studies conducted since 2018 on « H2 - Power to X in Morocco »

Market & Technologies

Fraunhofer IMWS

Keywords: Electrolysis, Green Hydrogen, Ammonia

Morocco Potential and Opportunities

Fraunhofer ISI

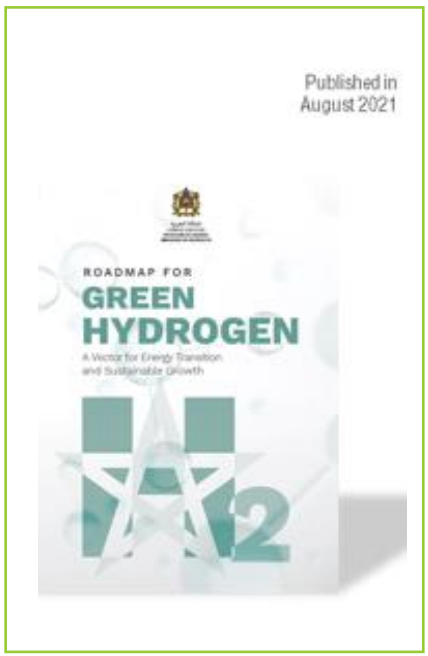
Keywords: H2/PtX potential, Grid, Infrastructures, Impact, Exports

Morocco's PtX Roadmap 2050

frontier economics

Keywords R&D, Innovation and Indsutrial opportunities

National Green H2 strategy



COMMISSION NATIONALE HYDROGENE

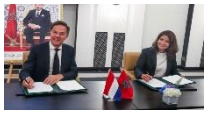
Creation of the National Hydrogen Commission by the Moroccan Energy Ministry in 2019

CLUSTER GREEN H2

Creation of the Green Hydrogen Cluster

Morocco-EU Partnership

- Morocco signed an agreement with Germany in June 2020, to develop a regionel market PtX
- Morocco signed an MOU with European Union to establish a Green Partnership on October 18, 2022, in Rabat
- Morocco and the Netherlands have signed an agreement to establish a €300 million (MAD 3.2 billion) investment fund to finance projects in the fields of infrastructure, water, agriculture, and renewable energy.



Royal instructions

The Sovereign has given his instructions for the development of a Moroccan offer covering the entire green Hydrogen value chain on November 22, 2022, in Rabat

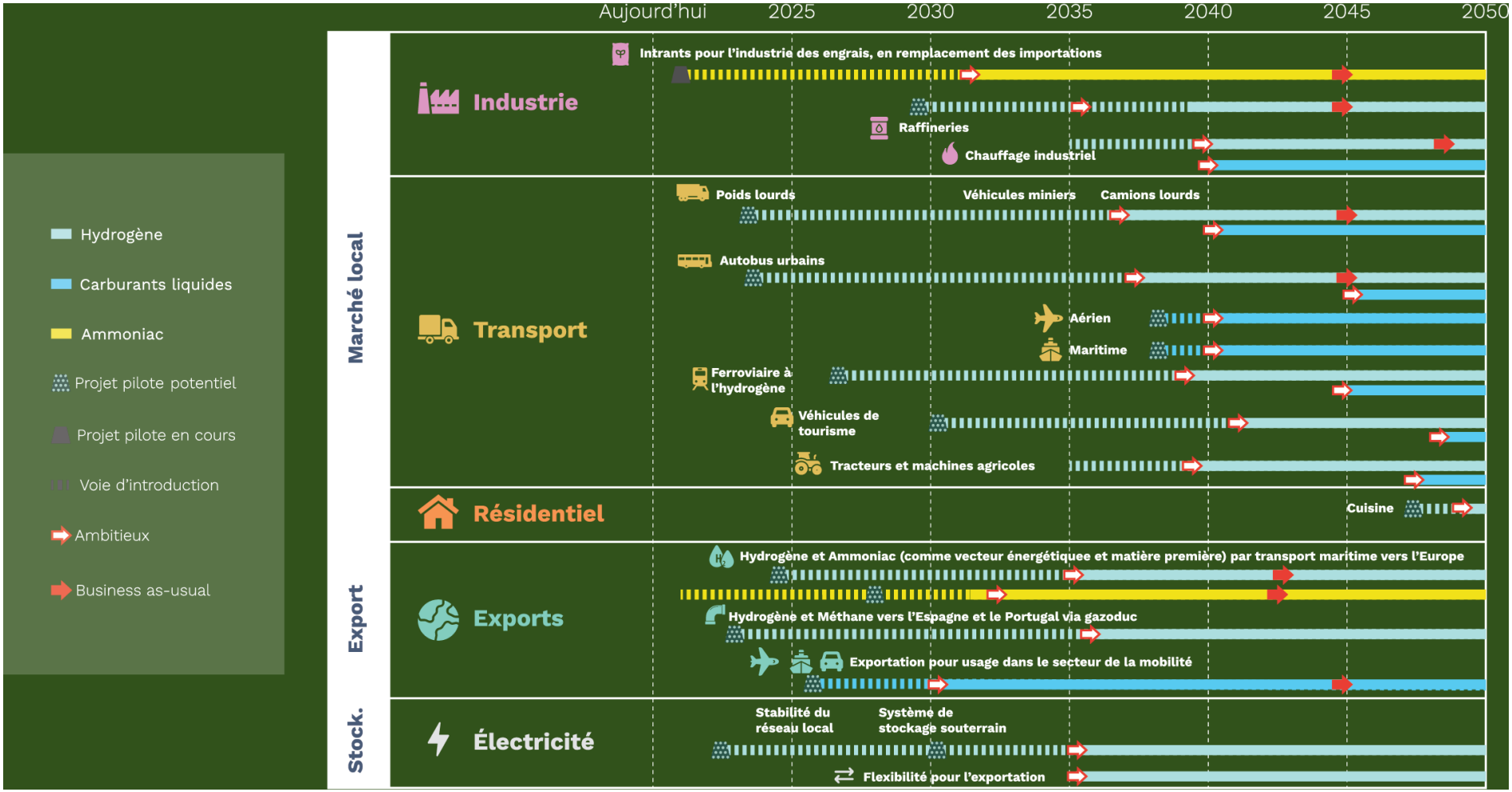
Green Hydrogen in Morocco: First Steps, Initiatives & Drivers (2/2)

Members of the Green Hydrogen National Commission

- Members of the National Commission of Green Hydrogen are as follows :
  - Ministère de l'Industrie, du Commerce et de l'Economie Verte et Numérique
  - Ministère de l'Enseignement Supérieur et de la Recherche
  - Ministère de l'Economie et des Finances
  - Ministère de la l'Equipement, du Transport, de la Logistique et de l'Eau
  - CGEM
  - ONEE
  - OCP
  - MASEN
  - ONHYM
  - IRESEN

Green Hydrogen in Morocco: Roadmap

Market Opportunities & Applications



Green Hydrogen in Morocco: Roadmap

Sustainable framework to develop the **PtX industry** in Morocco & **Action Plan**

1. **Facilitating costs reduction** along the PtX value chain.
2. **R&D:** Setting-up a **Moroccan** and **international research cluster**.
3. Defining the relevant measures for **local content**.
4. Setting-up an industry cluster and develop related **infrastructure masterplan**.
5. **Securing financing** to developing the PtX industry.
6. Creating the **conditions for exporting PtX** products from Morocco.
7. **Assessing** in detail a **storage** plan for the electricity sector.
8. Developing **domestic markets.**

Green Hydrogen in Morocco: Roadmap

CLUSTER GREEN H2

RECHERCHE - INNOVATION - INDUSTRIE

The main object of the GreenH2 Cluster is to promote the hydrogen sector in Morocco through the initiation, support and coordination of innovative collaborative projects in the field of green hydrogen in the Kingdom of Morocco and abroad, in order to encourage innovation and contributing to the emergence of a competitive hydrogen sector.

- Strengthen the technical and technological capacities of national players to produce, use and enhance hydrogen
- Develop innovation in the hydrogen sector
- Supporting national industries
- Support the National Hydrogen Commission in creating a regulatory and incentive framework for the development of the hydrogen industry
- Encourage and develop the production of hydrogen in Morocco
- Contribute to the promotion of Moroccan hydrogen on a regional and international scale

Kingdom of Morocco
Ministry of Energy, Mines and Environment

Kingdom of Morocco
Ministry of Industry, Commerce and Green and Digital Economy

Kingdom of Morocco
Ministry of National Education, Vocational Training, Higher Education and Scientific Research

Kingdom of Morocco
Ministry of Equipment, Transport

“GreenH2 Maroc” Cluster

Members of the GreeNH2 cluster

For more info & to Join:
http://www.greenh2.ma/

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Green Hydrogen in Morocco: Ongoing Pilot Projects

Green H2A R&D Platform
Innovation to co-localize PtX Industry

RENEWABLE ENERGY HYBRIDIZATION | HYDROGEN PRODUCTION, TRANSPORT & STORAGE | GREEN CHEMISTRY | CARBON CAPTURE STORAGE AND APPLICATIONS | MOBILITY ON HYDROGEN

Green H2A

IRESEN Institut de Recherche en Energie Solaire et en Energies Nouvelles

MOHAMMED VI POLYTECHNIC UNIVERSITY

LOHC Platform

(Oxy-) Combustion Platform: Mobility & Electricity Production (Hydrogen, Ammonia, eFuels, etc.)

Hydrogen Refueling Station

Green Ammonia Platform

Green Methanol Platform

PtL Platform: Carbon Capture / Fischer Tropsh / Refining

MAIN BUILDING Indoor Laboratories & Offices

H2 Multi-Technology Electrolysers Platform (Alcalin, PEM, SOEC, etc.)

Low Temp. Electrolysis & Fuel Cell Lab. ***PEM-ALC***

Electrolysis & High Temp. Fuel Cell Lab. ***SOEC-SOFC***

Synthetic Fuels Lab. ***PtL***

Combustion Lab. ***COMB***

Water Splitting Lab. ***WATER SPLITTING***

Hydrogen Mobility Lab. ***E-H_2***

Chemistry & Materials Formulation Lab. ***CHEM***

Green Hydrogen in Morocco: Ongoing Pilot Projects

TRL 1 - 3	TRL 4 - 7	TRL 8 - 9	Med-integration
Test range:	Test range:	Test range:	
1kW - 50kW	*~5MW*	*~10MW - 100MW*	*>1GW*
1g - 1kg	*~1 tpd*	*~100 tpd - 1000 tpd*	*>1000 tpd*
	2021	***mid term***	***long term***

R&D
UM6P / IRESEN and other universities

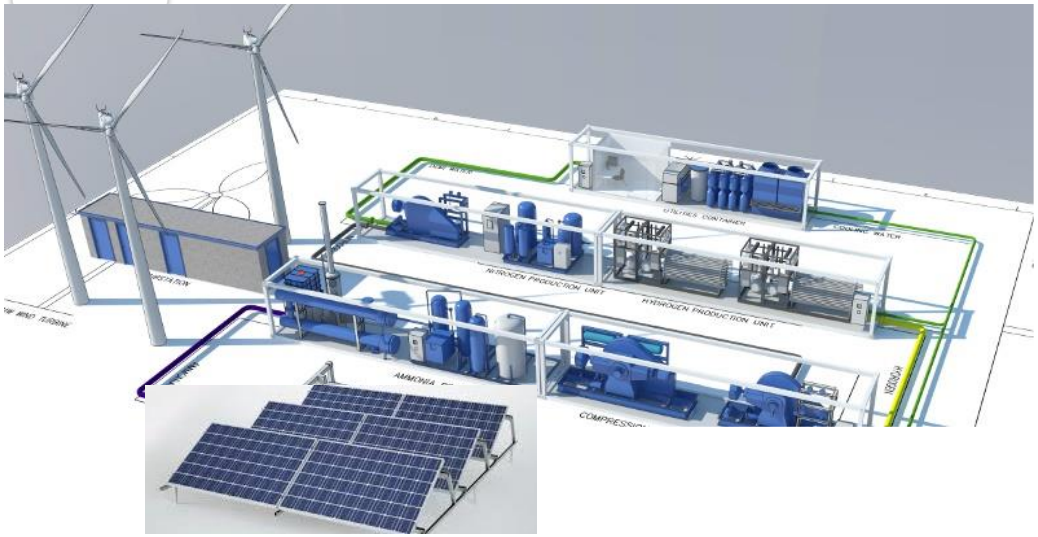
R&D pilot projects
GreenH2A

INDUSTRIAL
Up-Scalling

MOHAMMED VI POLYTECHNIC UNIVERSITY
Park green energy
IRESEN Institut de Recherche en Energie Solaire et en Energies Nouvelles
OCP
other industries

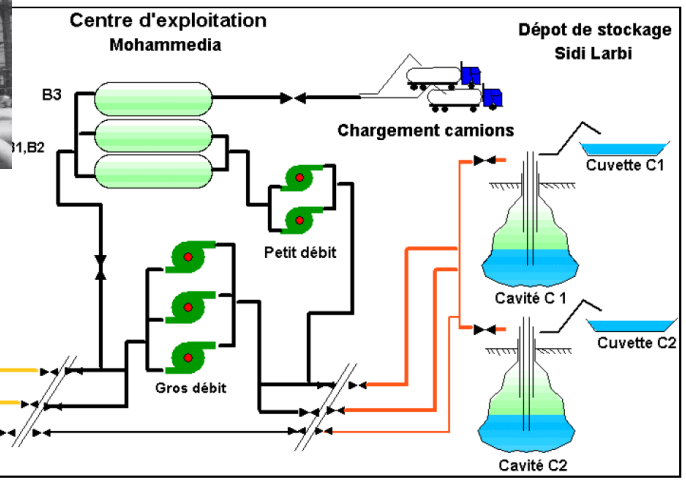
Green Hydrogen in Morocco: Ongoing Pilot Projects

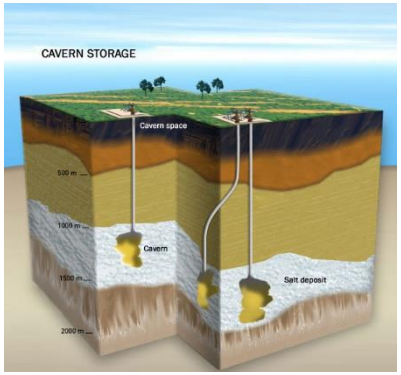
Green H2A

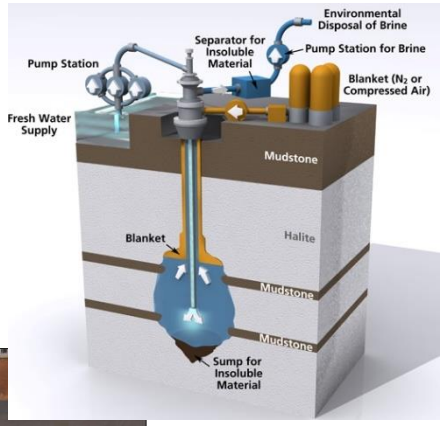


- Project « Green Ammonia Pilot Plant »
- Capacity : ~ 4 MWe || ~4Tonnes/jour
- Objectives:
  - Assessment of technologies
  - Scale-Up feasibility

Green Hydrogen in Morocco: Ongoing Pilot Projects

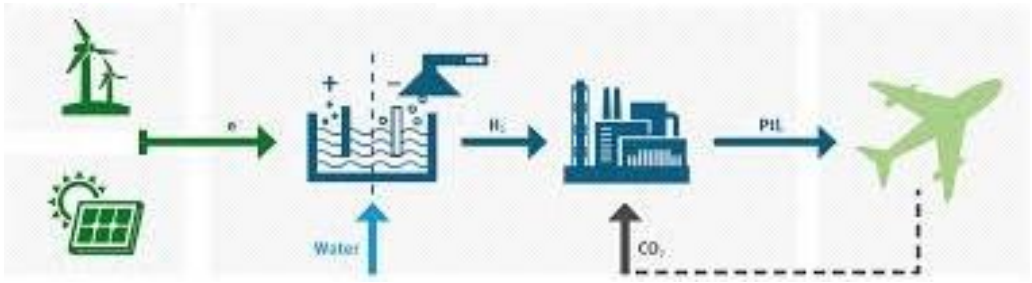






- Projevt « MELHY »
- Objective: Feasibility Study of Storing Green Hydrogen in Moroccan Salt Caverns

Green Hydrogen in Morocco: Ongoing Pilot Projects



- Project « PtX Pathways » (Power-To-Liquid – PtL)
- Capacity: ~ 1 MWe || ~100kg-1ton/day
- Objectives:
  - Technology Assessment
  - Scale-Up Perspectives
  - Applications: Local Market and Exports

Green Hydrogen in Morocco: Ongoing Pilot Projects

PtX µPilot unit: Research & Capacity Building

Just Transition to green Hydrogen in Africa: H2020 project

WP1 - Scenario definition also thanks to stakeholders elicitation and valorisation of existing policies

WP2 - Modeling the identified scenarios

WP3 - Impact assessment of modelled scenarios and development of roadmaps

WP4 – Training and Capacity Building

WP5 – Dissemination and Communication

OVERALL OBJECTIVE

Develop mutual benefit joint green hydrogen roadmaps

Green Hydrogen in Morocco: Capacity Building

Capacity Building & Training: MEA Clean Tech Academy

Green Hydrogen in Morocco: International Collaboration

Morocco, via IRESEN is part of the following alliances & Collaboration Frameworks

- Hydrogen Europe Reasearch (HER)
- Power Fuel Alliance
- Hypos Alliance
- Mission Innovation (Mission Hydrogen & Mission Shipping)
- Hydrogen TCP
- Flagship Event: **World-PtX-Summit.com**

Green Hydrogen In Morocco: Key Drivers

- Morocco has a **strong potential** to produce **competitive Clean Hydrogen & Molecules**
- Morocco is preparing a **positive ground** for **doing business in « Power-To-X »**
  - Preliminary Studies
  - National Commission on Green Hydrogen (mainly public sector)
  - Country's Roadmap published
  - Green Hydrogen Cluster (mainly private sector)
  - Further indepth studies to be launched, with priority on:
    - Markets Perspectives,
    - Regulation Aspects,
    - Infrastructure Masterplan
- Key Drivers:
  - **Exports**
  - Domestic **Economy Decarbonization**
  - **Co-Localization** of **PtX Industry** and **Innovation**
- Ongoing R&D-Innovation, Demonstration and Capacity Building Activities → Green H2A Platform
- Involvement in international collaboration schemes and frameworks on Hydrogen