

POWER-TO-X IN MOROCCO

Driver of
Mediterranean Energy
Market Integration

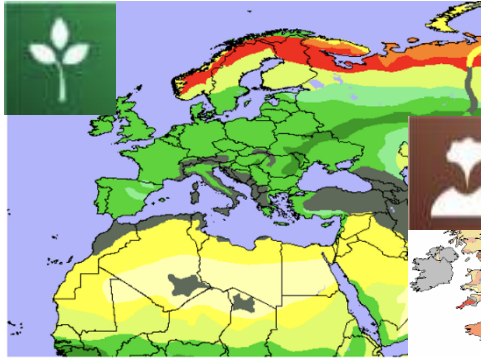
June 2020

B. Ikken, S. Rachidi, A. Hirt, N. Nabil, M. Benmeziane

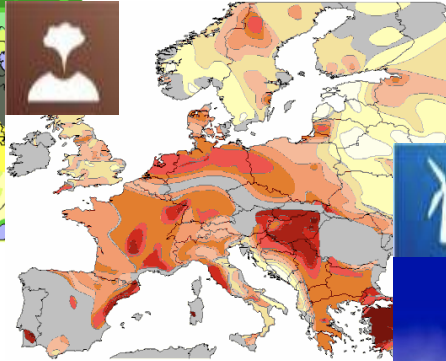


Renewable Energies Potential in EU-MENA

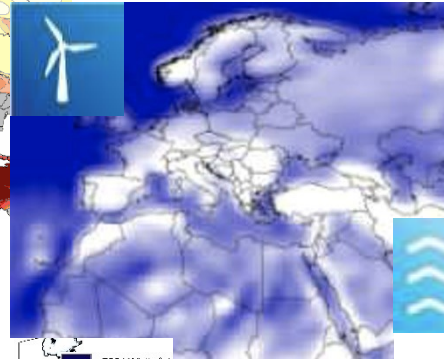
Biomass: 1.350 TWh/y



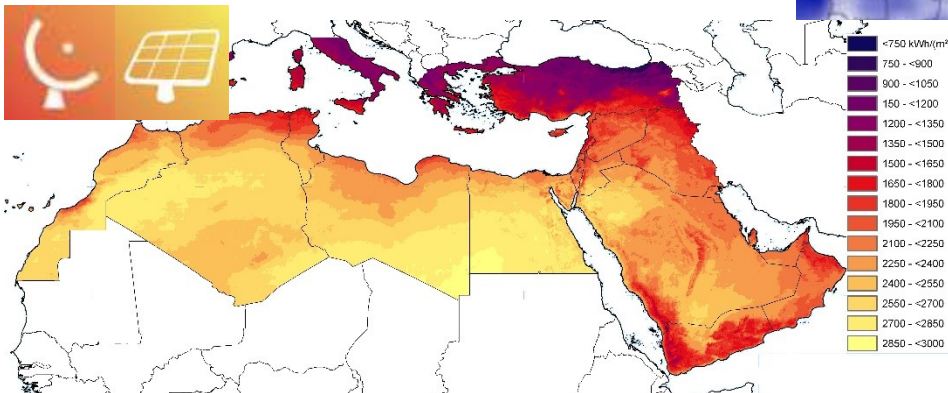
Geothermal: 1.100 TWh/y



Wind: 1.950 TWh/y

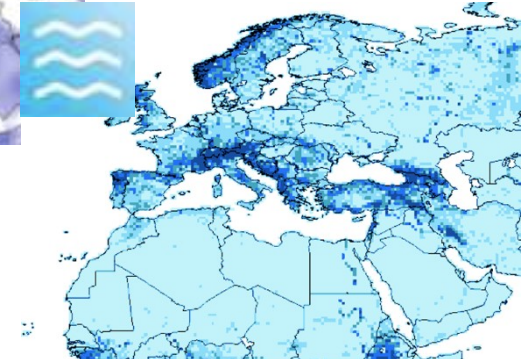


Solar : 630.000 TWh/y



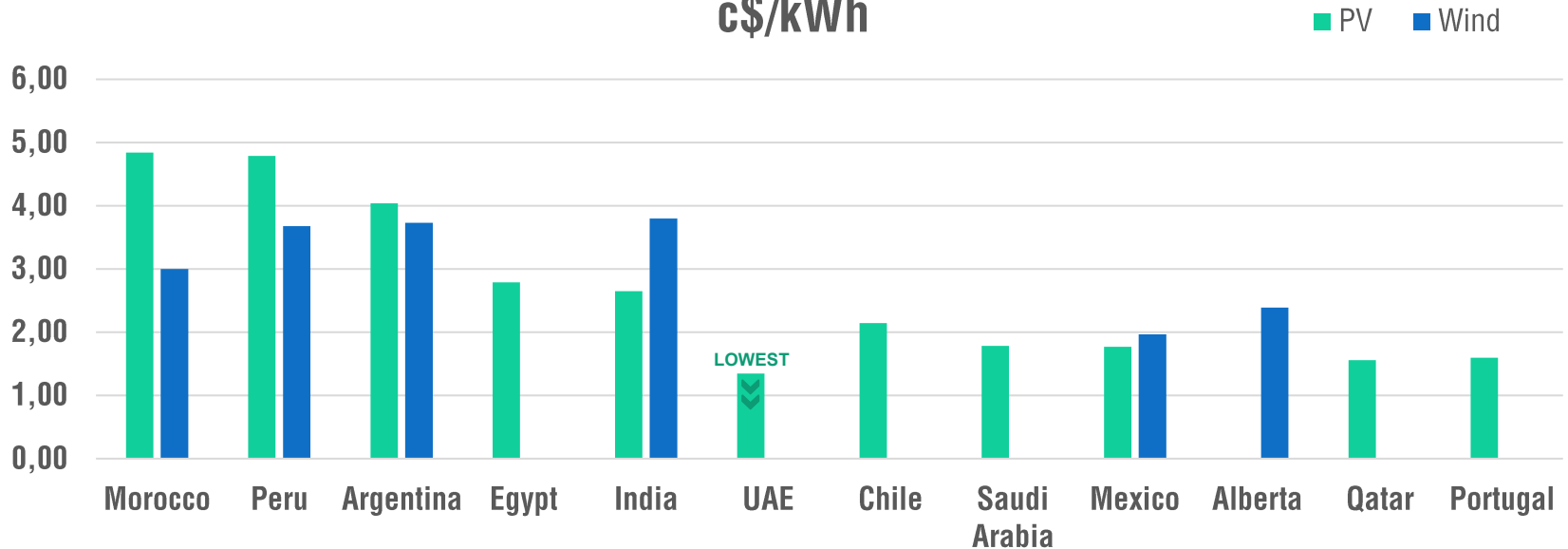
**Needs for EU-MENA
in 2050: 7.500 TWh/y**

Hydro: 1.350 TWh/y



Costs of generating renewable electricity as fundamental driver of synthetic fuel costs

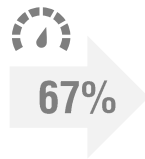
Renewable Energy recent bidding prices c\$/kWh



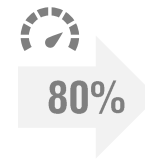
Source : Agora Energiewende and Frontier Economics



ELECTRICITY
Approx. **1.5**
c\$/kWh



HYDROGEN
Approx. **2.3**
c\$/kWh

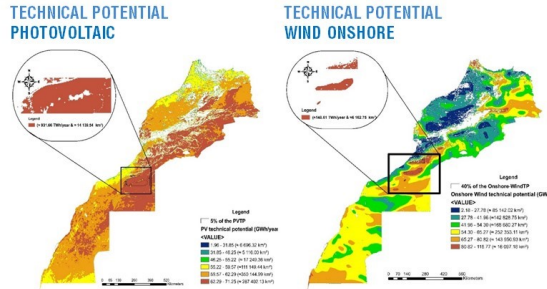


METHANE
Approx. **2.8**
c\$/kWh

POTENTIAL OF MOROCCO



HIGH REN. POTENTIAL



	Photovoltaic (PV)	Wind Onshore
Technical Potential (TWh)	49 000	11 500
Technical Potential (GW)	20 000	6 000
5% of the Tech. Pot. (GW)	1 000	300

SUCCESSFUL DEPLOY. OF REN.



STRONG POLITICAL SUPPORT & INTERNATIONAL PARTNERSHIP



GROWING R&D INFRASTRUCTURE AND CAPACITY BUILDING



INVOLVMENT OF THE INDUSTRY AND THE PRIVATE SECTOR

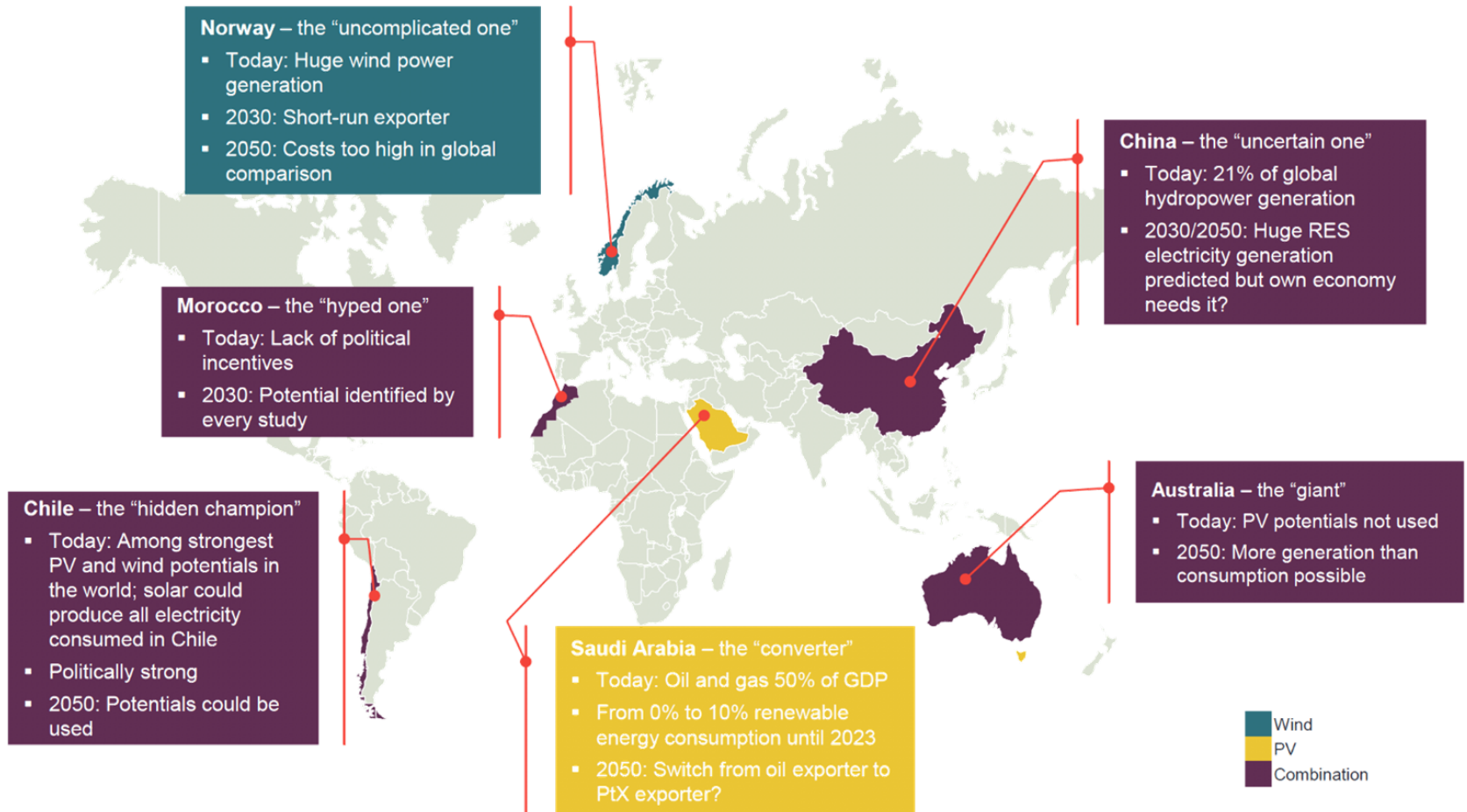


STRONG PROXIMITY + MARITIME & GAS CONNECTIVITY WITH EU



Export Potential for PtX products: Frontrunner position

Source : World Energy Council Germany, Frontier Economics 2018 Study
Fraunhofer ISI, Etude Opportunités PtX pour le Maroc, 2019



Export Potential for PtX products: Frontrunner position



- Morocco Identified and Short-listed among 6 Countries as a “Front Runner” Potential for the “Power-To-X” Sector
- Main advantages:
 - Renewable Potential (Combined: wind and solar),
 - Leadership in Energy transition and
 - Geographic proximity to Europe
- **Morocco will be able to capture up to 4-8% of the global ‘Power to X’ market**

≈ 100 - 400 Md€



Power-To-X in Morocco: Studies and Roadmap

2 Preliminary Studies conducted in 2018 on « Power-To-X in Morocco »



MARKET & TECHNOLOGIES

With  **Fraunhofer**
IMWS

Key-Words Electrolysis, Green
Hydrogen & Ammonia



OPPORTUNITIES & POTENTIAL FOR MOROCCO

With  **Fraunhofer**
ISI

Key-Words Key-Words: PtX Potential, Grid,
Infrastructure, Impact, Exports



MOROCCO'S PTX 2050 ROADMAP

3rd more in-depth study is launched to assess R&D, Innovation and Industrial opportunities for Morocco, Evaluation of the socio-economic impact of the PtX economy, Focus on the environmental impact of the PtX industry, **Elaborate a sectorial Roadmap for PtX in Morocco 2050**



COMMISSION
NATIONALE
POWER-TO-X

Creation of a National Commission for Power-to-X by the Moroccan Energy Minister on Feb. 11th, 2019



MOROCCO-GERMANY ALLIANCE

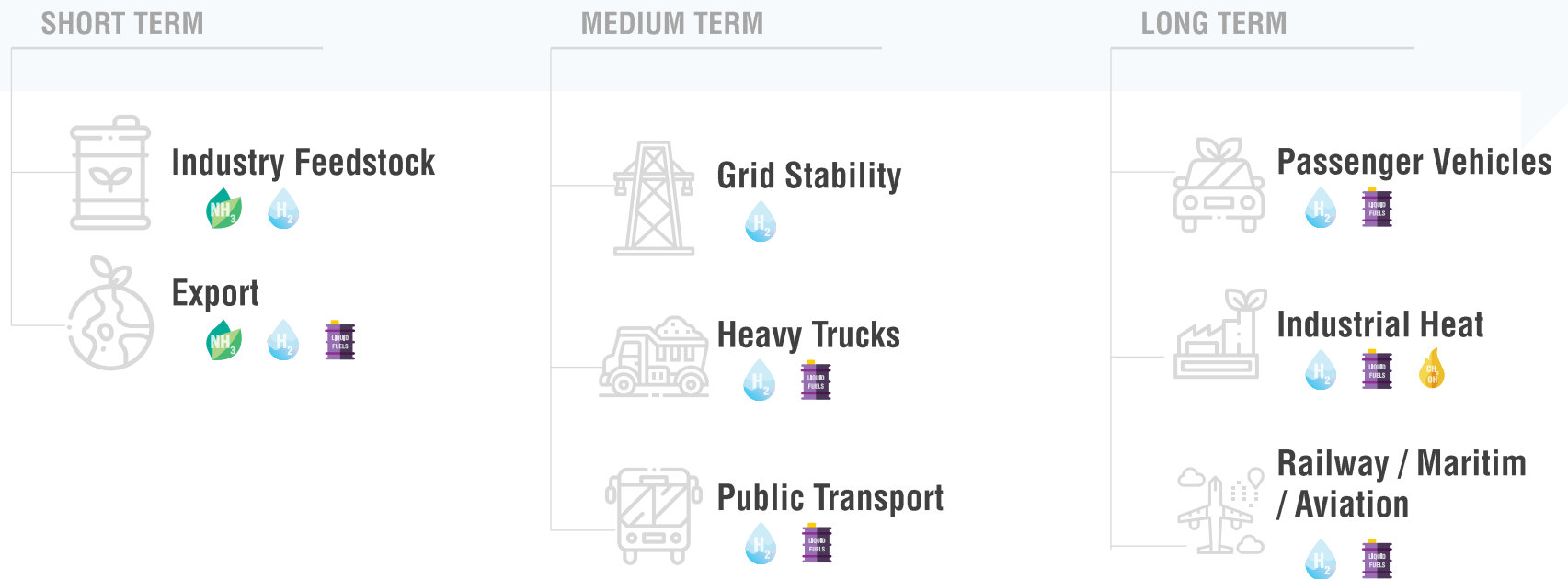
Morocco signed an agreement with Germany in June 2020 , to develop a regional market of Power to X



PtX Market Domestic and Export Opportunities

Domestic demand for PtX as a raw material for industry and Exports are the sectors where the industry could start to develop.

Source : Frontier Economics



Legend



Hydrogen



Ammonia

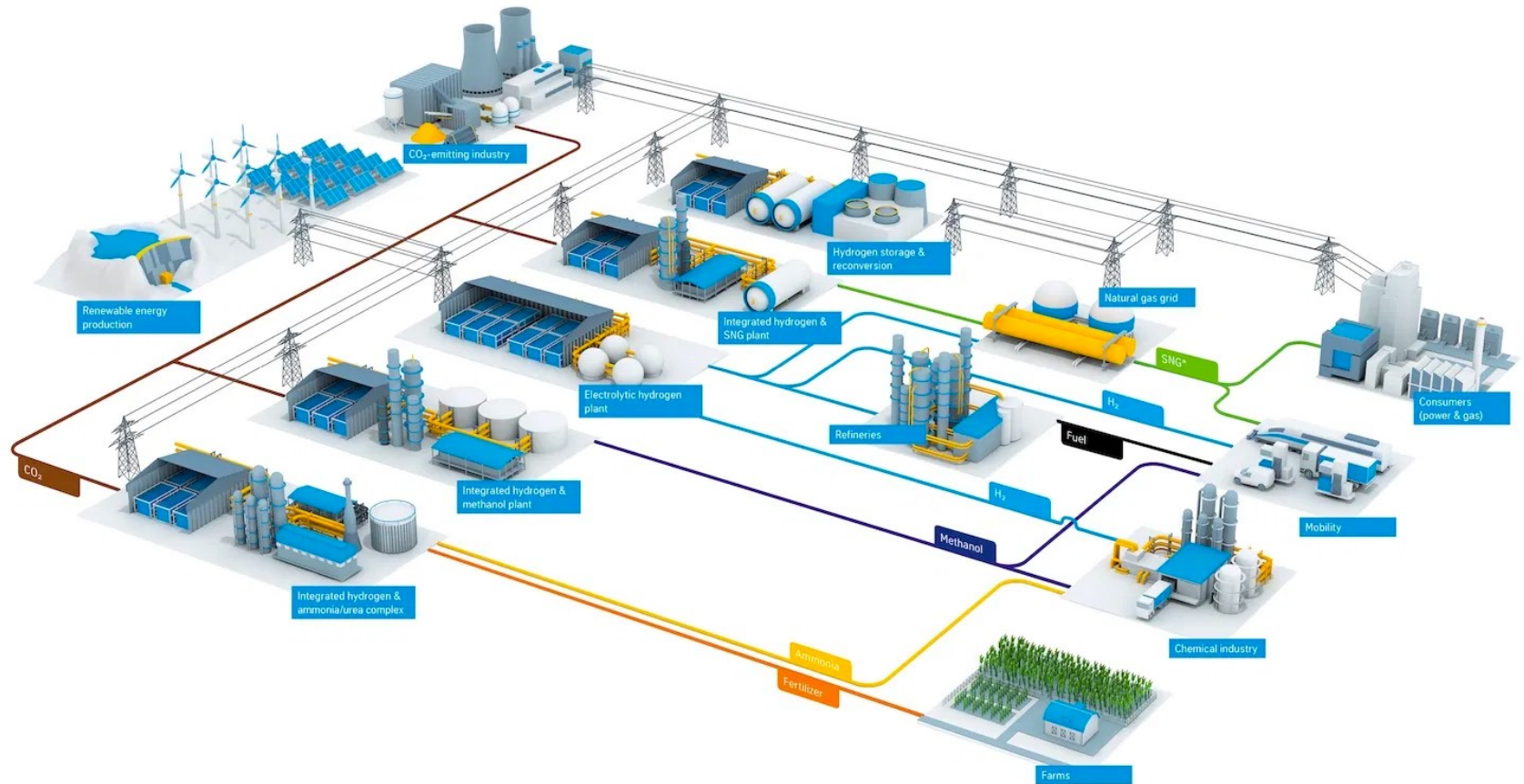


Liquid Fuels



Methanol

Green Hydrogen and Green Ammonia Value Chain



Source : Thyssenkrupp

RESEARCH & INNOVATION

Source: SERC Architects - SmithGroup - Photographs: Bruce Damonte



With almost \$50M already dedicated for R&D in Morocco, IRESEN is also setting the most important network of platforms in the field of Research and Innovation in Africa



GREEN ENERGY PARK *Inaugurated in January 2017*

Concentrated photovoltaic and thermal solar energy



GREEN & SMART BUILDING PARK *finalized in 2020*

Green buildings, energy efficiency, networks intelligent and sustainable mobility



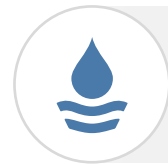
GREEN H2A *2021*

Production of green fuels based on renewable energy and energy storage



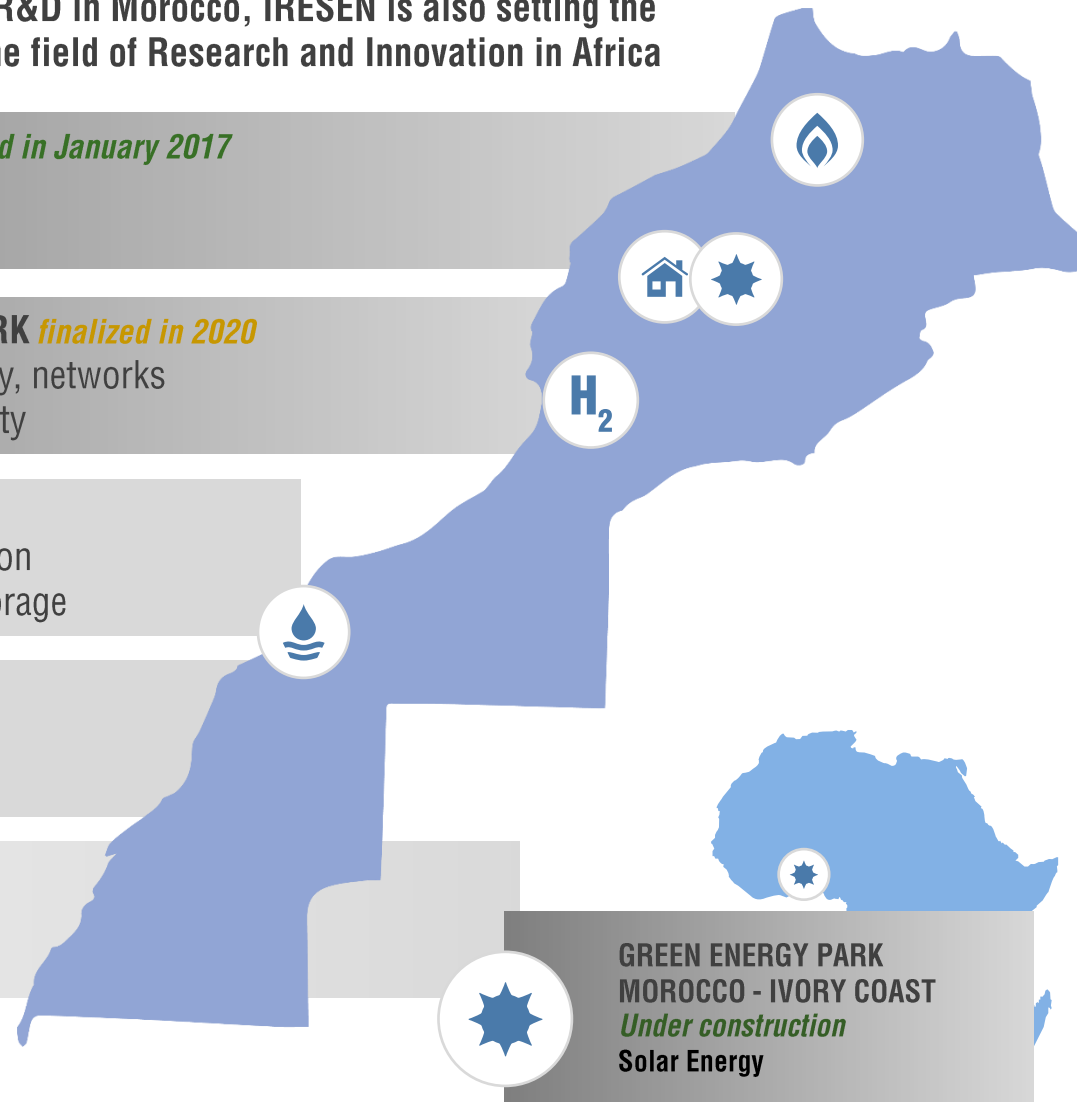
AGRO ENERGY TIC *2022*

Biomass and nexus energy-agriculture



WATER ENERGY NEXUS *2021*

Desalination, water treatment and water-energy nexus



GREEN ENERGY PARK
MOROCCO - IVORY COAST
Under construction
Solar Energy

from R&D to industrial scale

TRL 1 - 3

Test range:
1kW - 50kW
1g - 1kg

TRL 4 - 7

Test range:
~5MW
~1 tpd
2021

TRL 8 - 9

Test range:
~10MW - 100MW
~100 tpd - 1000 tpd
mid term

Med- integration

>1GW
>1000 tpd
long term



R&D
UM6P / IRESEN



R&D pilot projects
GreenH2A



INDUSTRIAL
Up-Scaling



other
industries

Pilot Projects and labs

« Water Splitting »
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



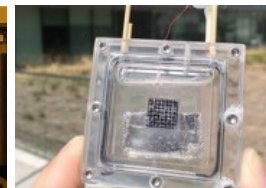
Electrolysis & High
Temp. Fuel Cell Lab.
SOEC-SOFC



Synthetic Fuels Lab.
PtL



Combustion Lab.
COMB



Water Splitting Lab.
WATER SPLITTING



Hydrogen Mobility
Lab.
E-H₂



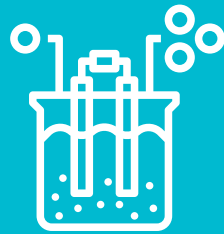
Chemistry &
Materials
Formulation Lab.
CHEM

DEVELOPMENT OF A NEW TECHNOLOGICAL ECOSYSTEM BASED ON GREEN MOLECULES



RENEWABLE ENERGY HYBRIDIZATION

Increase the load factor of renewable electricity to run the electrolyzers



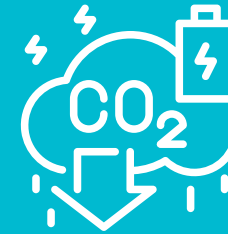
HYDROGEN PRODUCTION, TRANSPORT & STORAGE

Comparing at different scales PEM, Alkaline and SOEC High Temperature Electrolysis



GREEN CHEMISTRY

Focus on green molecules: ammonia, methanol and synthetic fuels



CARBON CAPTURE STORAGE AND APPLICATIONS

Investigate the various CO₂ capture techn. & their local applications



MOBILITY ON HYDROGEN

Foster green mobility solutions based on powerfuels for public transport and heavy-duty vehicles (mining...)

New model of Energy partnership: Clean Energy Union Europe-Africa





*THANK YOU
for your kind
attention*

***“PROVIDING
A CLEAN
ENERGY
FOR OUR
PLANET”***



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KINGDOM OF MOROCCO
Ministry of Energy, Mines
and Environment



SAVE THE DATE
1-3 DECEMBER 2020
MARRAKECH - MOROCCO

The World Power-to-X Summit 2020

World
S U M M I T



■ 1-3 December 2020

www.worldptxsummit.com

The World Power-to-X Summit 2020 is a must-attend event to witness the start of a new clean energy era. A cross road for policy-makers, industry leaders, research experts and global innovators to discuss PtX opportunities and challenges.

GUEST COUNTRY GERMANY 

www.worldptxsummit.com