



Paul van Son, President & CEO, Dii Desert Energy

'The MENA Green Hydrogen Alliance'

ATA Webinar, 1 September 2020



1

Desertec 3.0

CONTENTS



1

Desertec 3.0

2

The MENA Hydrogen Alliance

3

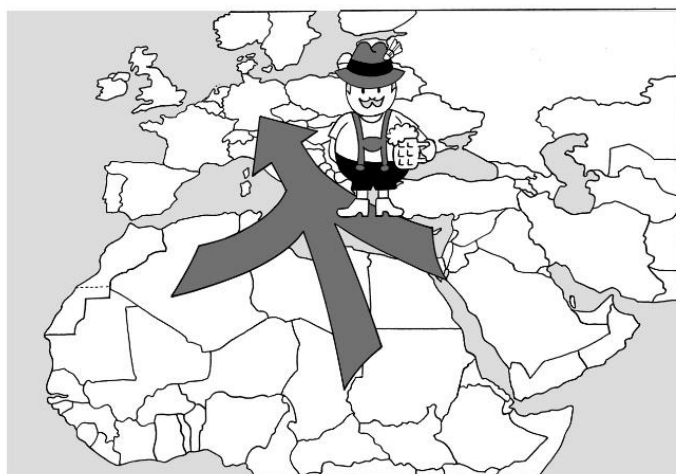
Hydrogen in the MENA Region

4

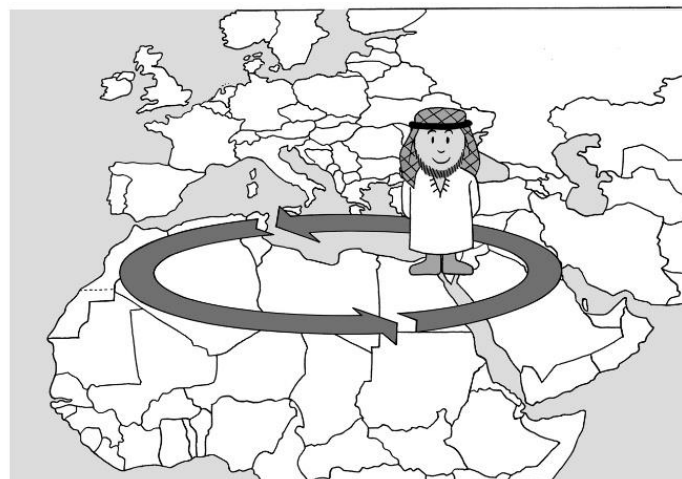
EU Hydrogen Strategy



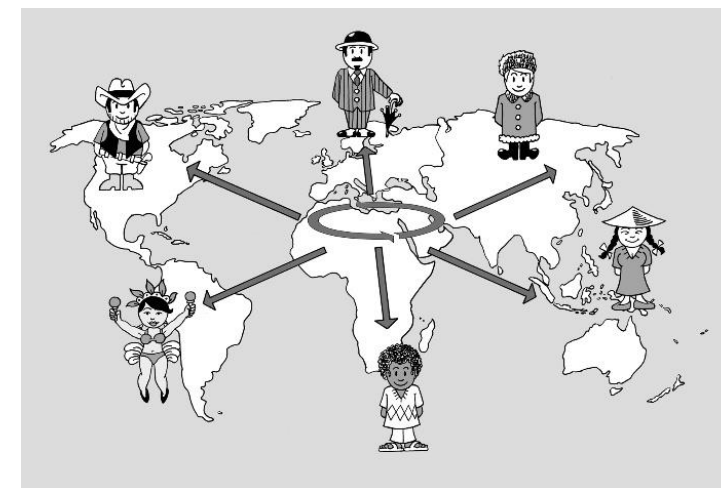
Desertec 1.0 --> 3.0: MENA to become a Powerhouse based on *Emission-Free Energy from the deserts*



Desertec 1.0



Desertec 2.0



Desertec 3.0

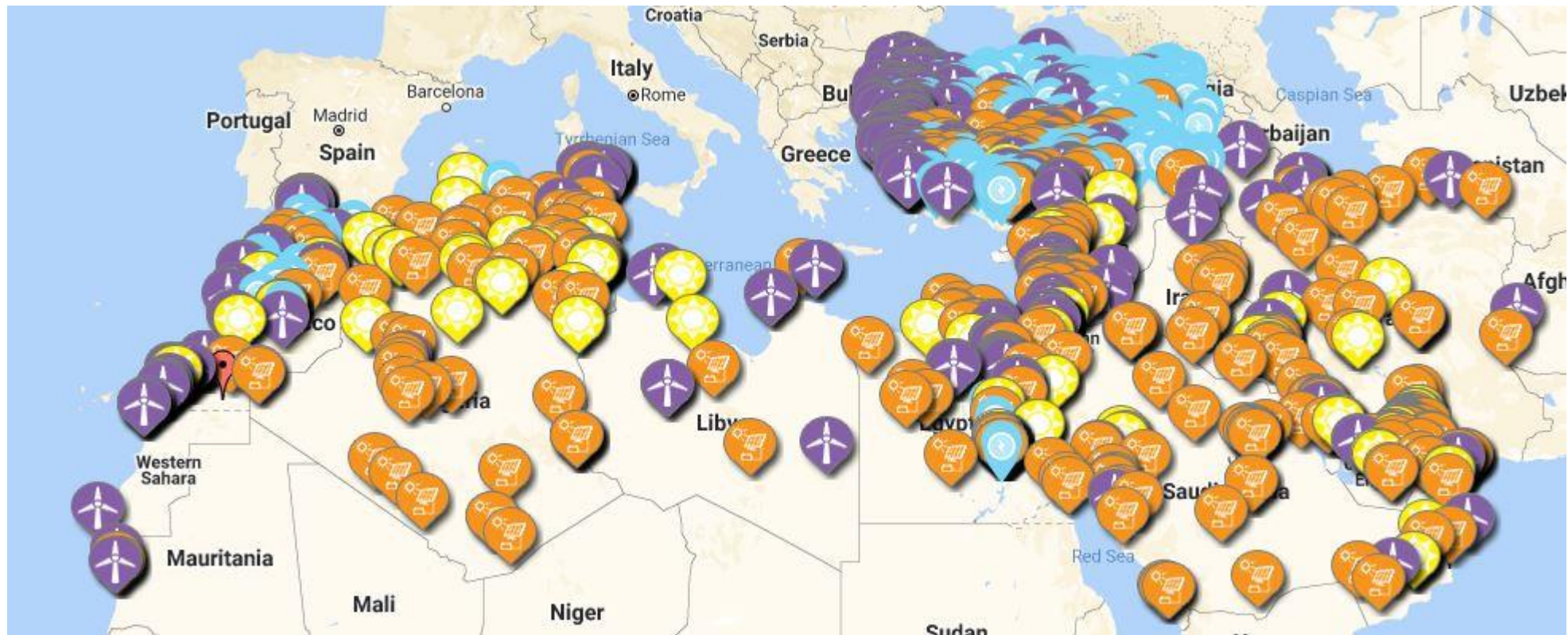
Development phases (2)

What does “Desertec 3.0” entail?

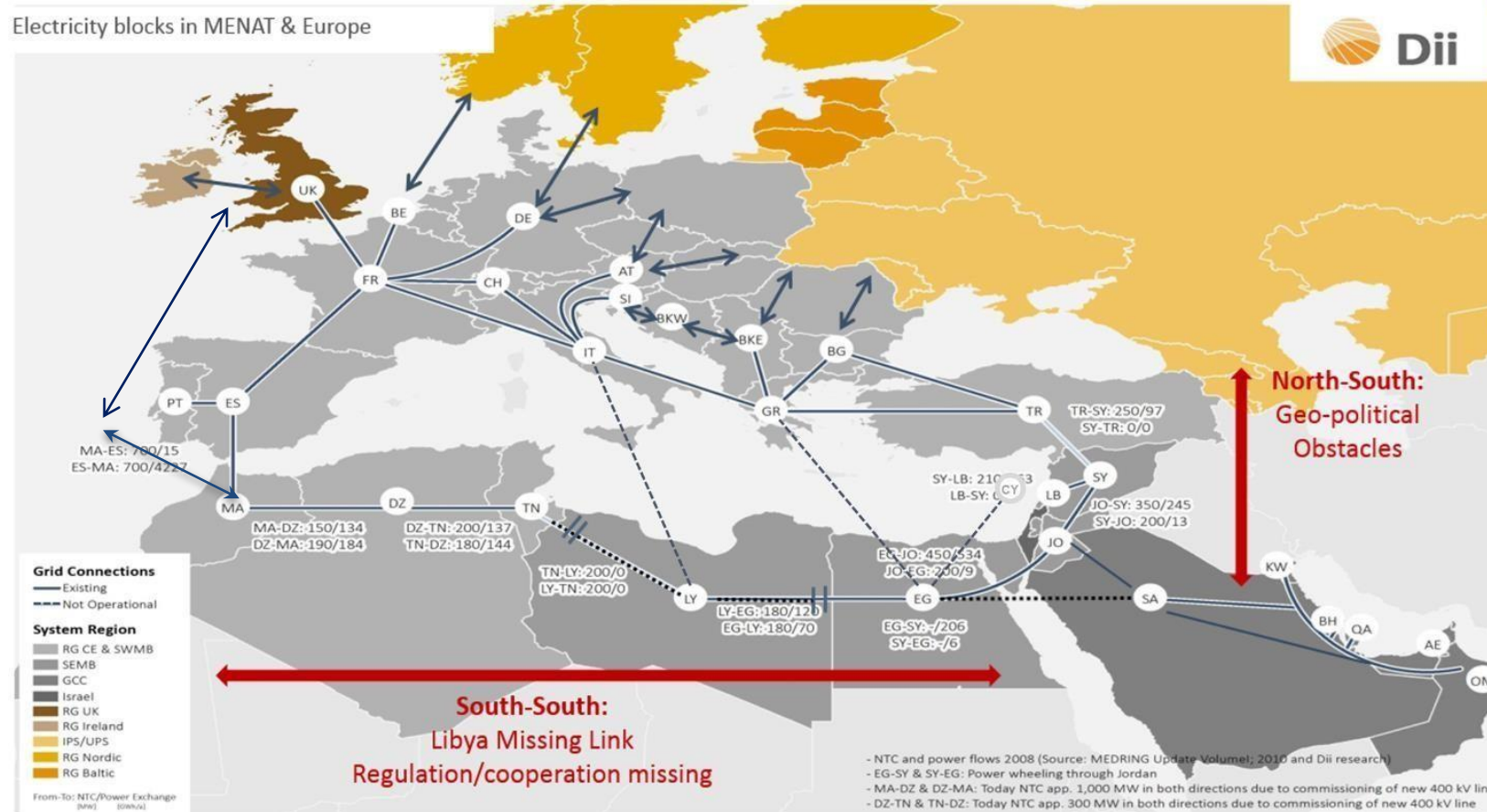
- Public and Private sector of **MENA Countries in the lead** for a swift energy transition
- MENA to become a highly scalable ‘**Green Powerhouse**’ for its own people and industry and for exporting green energy to the world energy markets
- Focus on **local benefits and synergies**
- Bankable, integrated and hybrid projects along the **entire energy value chain**:
 - Bottom-up/Top down from rooftop to industry scale solar, wind, hydro, biomass, etc
 - Flexible Demand in harmony with volatile supply
 - Conversion to ‘Green Molecules’ (a.o. Hydrogen, Ammonia)
 - Connecting Markets of ‘Electrons’ and ‘Molecules’
 - Storage of Power, Thermal Energy, Hydro Reservoirs, Gravitation etc.

in 2020 Dii identified in MENA

over 1,250 RE Projects (Dii Project Database >5 MW)



Power Grid Interconnections MENA and Europe are gradually expanding



Potential Connection
Morocco - UK

Potential Connections
to Sub-Saharan Africa

Potential Connections
to India



2

The MENA Hydrogen Alliance



Dii

Dii launched the MENA Hydrogen Alliance

A platform for 'H2 promotion' in the region



- Initiated by Frank Wouters. First stakeholder consultation on 15 January at World Future Energy Summit, hosted by Masdar
- Official launch at Intersolar ME in Abu Dhabi on 4 March
- 3rd (online) meeting of the MENA Hydrogen Alliance on 20 May: 400+ participants alongside the Ministry of Energy of Morocco, Masen, NEOM, ACWA, Hydrogen Europe and Dii Advisory Board member, Prof. Ad van Wijk
- **The MENA Hydrogen Alliance works within the framework of Desertec 3.0** promoting pilot projects for green hydrogen and starting hydrogen economies in MENA
 - Hydrogen MENA is working closely with Hydrogen Europe and other stakeholders like Global Alliance Powerfuels

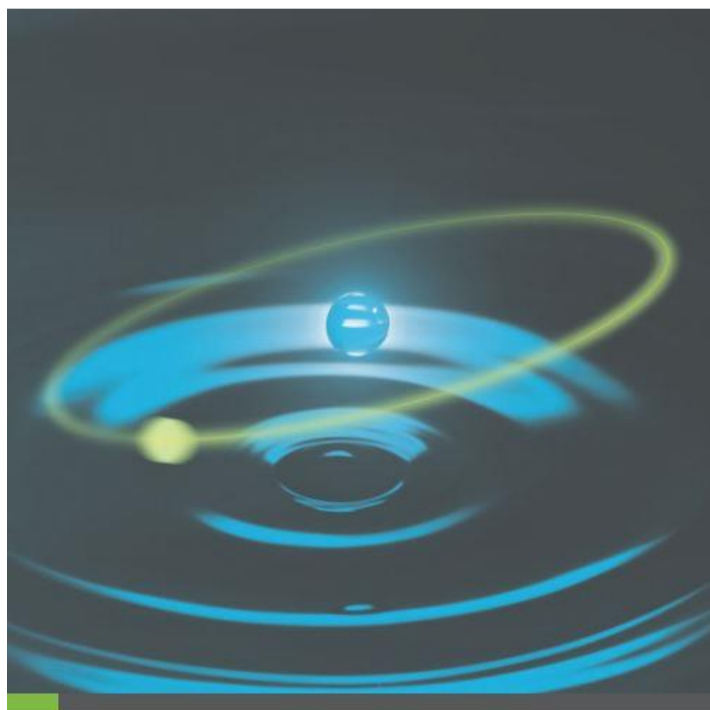
Active key promoters of Hydrogen MENA in first phase for launch – group is now growing fast



- Under the umbrella of **Desertec 3.0**, the Hydrogen MENA Alliance aims to accelerate the introduction and the growth of the green hydrogen economy
- Connecting the private-public sector and academia, promoting (pilot) projects
- Bridge between MENA and Europe, e.g. for off-takers and creating political framework e.g. for **swap deal with virtual export** in first period



Desertec 3.0 H2 studies appreciated by market with new momentum ...



Green Hydrogen for a European Green Deal A 2x40 GW Initiative

Prof. Dr. Ad van Wijk
Jorgo Chatzimarkakis



- Published **April 2020**, in cooperation with Hydrogen Europe
- **Presented to Frans Timmermans**, EVP EU Commission in charge of Green Deal and 14 CEOs of utilities and companies active in hydrogen value chain
- Discussed and partnered with **Energy Minister of Morocco**



A North Africa - Europe Hydrogen Manifesto

Prof. Dr. Ad van Wijk
Frank Wouters, MSc
Dr. Samir Rachidi
Dr. Badr Ikken

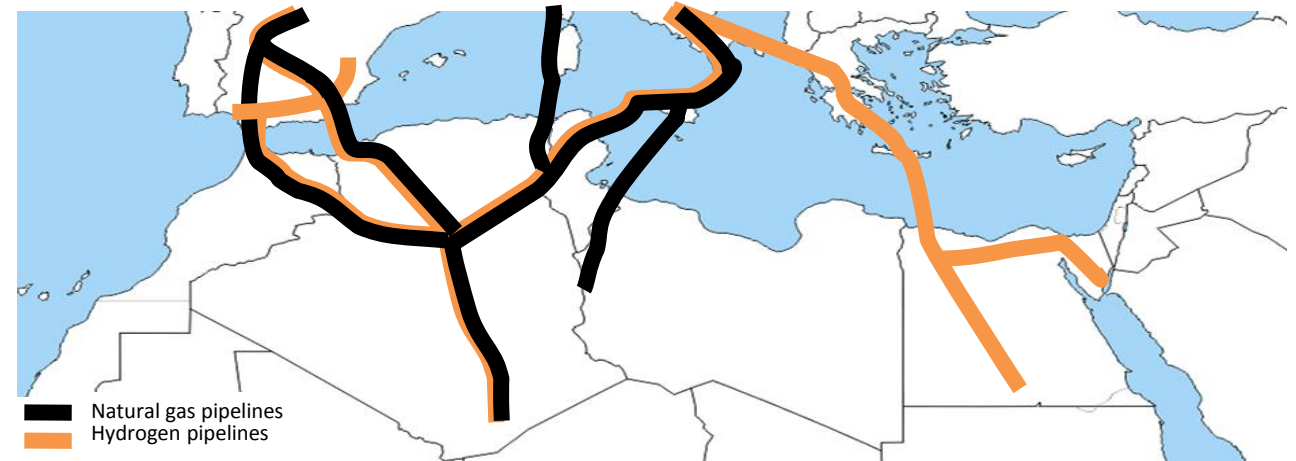


Dii Desert Energy
Dubai, London, Madrid, Munich

- Published **November 2019** in cooperation with IRESEN (Morocco)
- Presented to **Frans Timmermans**, EVP EU Commission in charge of Green Deal
- Discussed with key **stakeholders for hydrogen in Europe and MENA**

Export: Existing and new Gas Infrastructure

Eventually to be used for hydrogen



- Natural gas infrastructure Europe - North Africa (left figure) and first outline for a hydrogen backbone infrastructure Europe-North Africa (figure above)
- An existing gas infrastructure from Algeria and Morocco could be converted to a hydrogen infrastructure (grey-orange lines).
- A "new" hydrogen transport pipeline must be realized from Italy to Greece, crossing the Mediterranean Sea to Egypt, which could eventually be extended to the Middle East (orange line).

Hydrogen Value Chains

Local projects, substitution in local market, market potential for global transport chains

Current Situation

- Public and private sector are starting initiatives
- Market is gaining momentum, first business cases appear on the horizon
- Early adopters are positioning the market
- Growth of a hydrogen industry along the whole value chain will support emission reduction

Outlook

- Market potential is very high (GW scale for individual countries)
- Countries with cheap renewable energy will first substitute their local fossil use, then become exporters of hydrogen or tail products
- Global transport chains emerge on basis of locally grown supply and remote demand

Targets 2020+

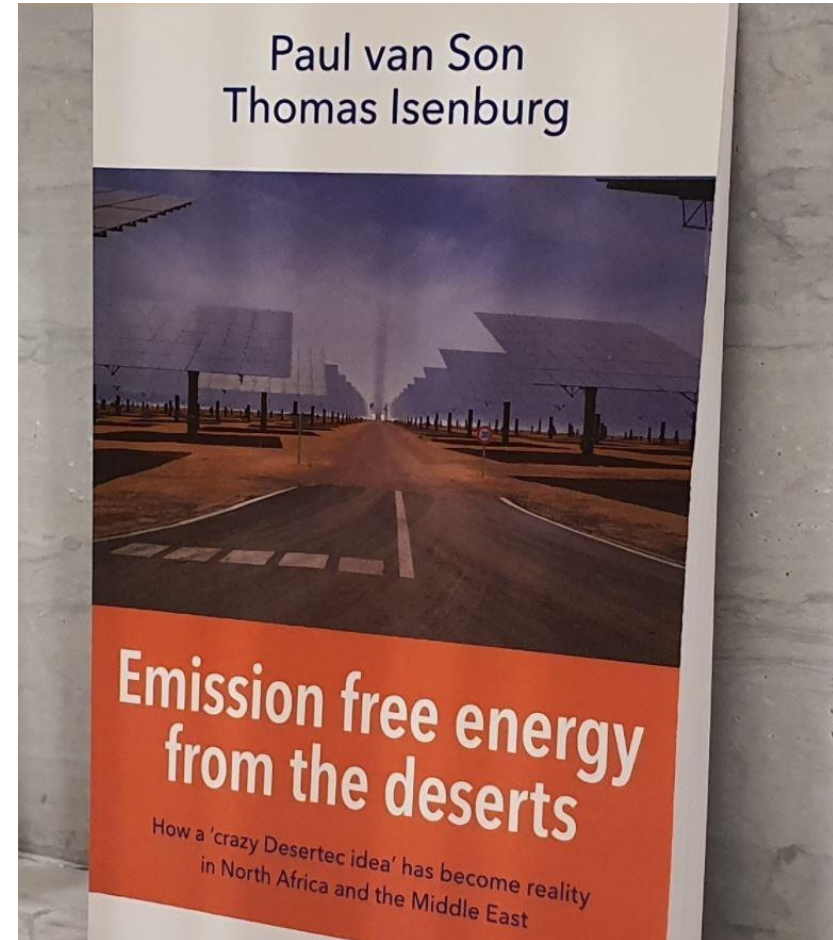
- Gather Knowledge and develop Concepts for value chains (markets, costs, business cases)
- Perform studies on the potential in selected countries in MENA
- Monitor and encourage H2 Projects
- Support development of global transport value chains

2018: Tata Steel and Dow invest in green chemicals	2018: thyssenkrupp inaugurates Carbon2Chem	2018: Gasunie, Tennet and Thyssengas announce 100MW electrolyser	2019: First hydrogen train operates D, major order of EUR 500m by Frankfurt	2019: 100 MW electrolyser in Hamburg port, GW scale projects in Australia	2019: Hydrogen strategies in different countries	2020: Pipeline of electrolyser projects doubles in few months	2020: EU / Moroc Strategies Launch of Hydrogen MENA <u>NEOM/ACWA/Air Products Green Ammonia</u>
---	---	---	--	--	---	--	--

Dii's Book on Emission Free Energy from MENA



- Published in 2019, German and English
- How a 'Crazy Desertec' idea has become **reality** in the sense of expanding renewable energy in North Africa and the Middle East and potential for massive export of green electrons and molecules
- **Update and translation into French to 'zoom' into the perspective of 'green electrons and molecules' in Maghreb (2020)**





3

Hydrogen in the MENA region



Dii

Strong need to educate different stakeholders on proposition and economics of green hydrogen

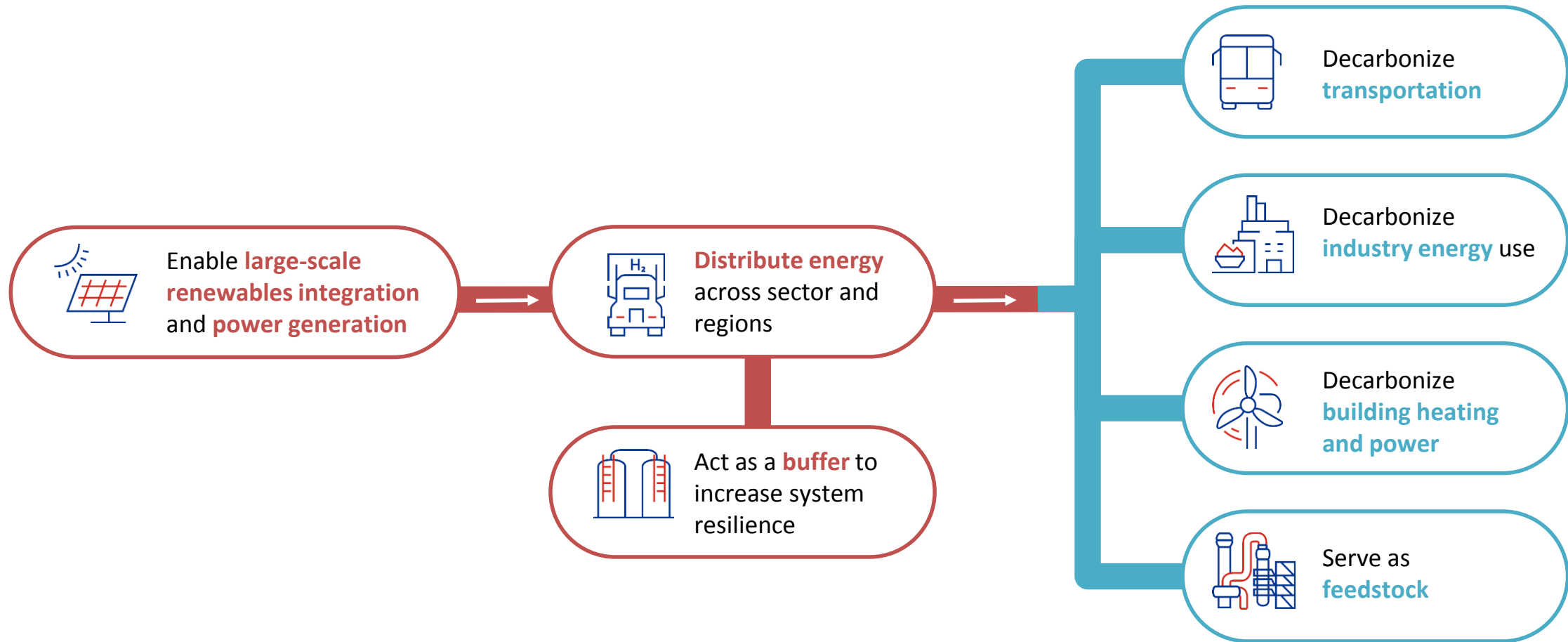


- **First Creation of local hydrogen economies** and **revenue opportunities for export**
- **Substitute fossil imports** and **leverage on existing infrastructure** like gas pipelines
- **Outline variety of hydrogen applications** to **integrate more renewables, decarbonize industry + transport. Develop potential for local job creation**
- **Develop international partnerships, also with the possibility of a swap deal (“virtual import”)**

Guide policy makers and public utilities with solid technical and economic information, e.g. on electrolyzers and business cases (e.g. postnatal costs for 1kg of green hydrogen/ammonia):

- **Capex:** capital expense for the electrolyzer (including the balance of plant)
- **Opex:** operating expenses for running the electrolyzer. Primarily this is electricity, with some costs for maintenance of the system and water.
- **Lifetime:** to assess the total cost of hydrogen, lifetime must be considered. “Lifetime” here refers to when it is optimal from a system performance perspective to replace the unit, rather than a statement that the system can no longer operate.
- **Efficiency:** the efficiency of the electrolyzer is determined by how much electricity is needed to produce a certain amount of hydrogen. The higher the efficiency, the lower the operating cost
- **Other requirements** like water quality, usage of water, implications of high temperatures etc.

What role does hydrogen and 'Green Molecules' play in the energy transition?

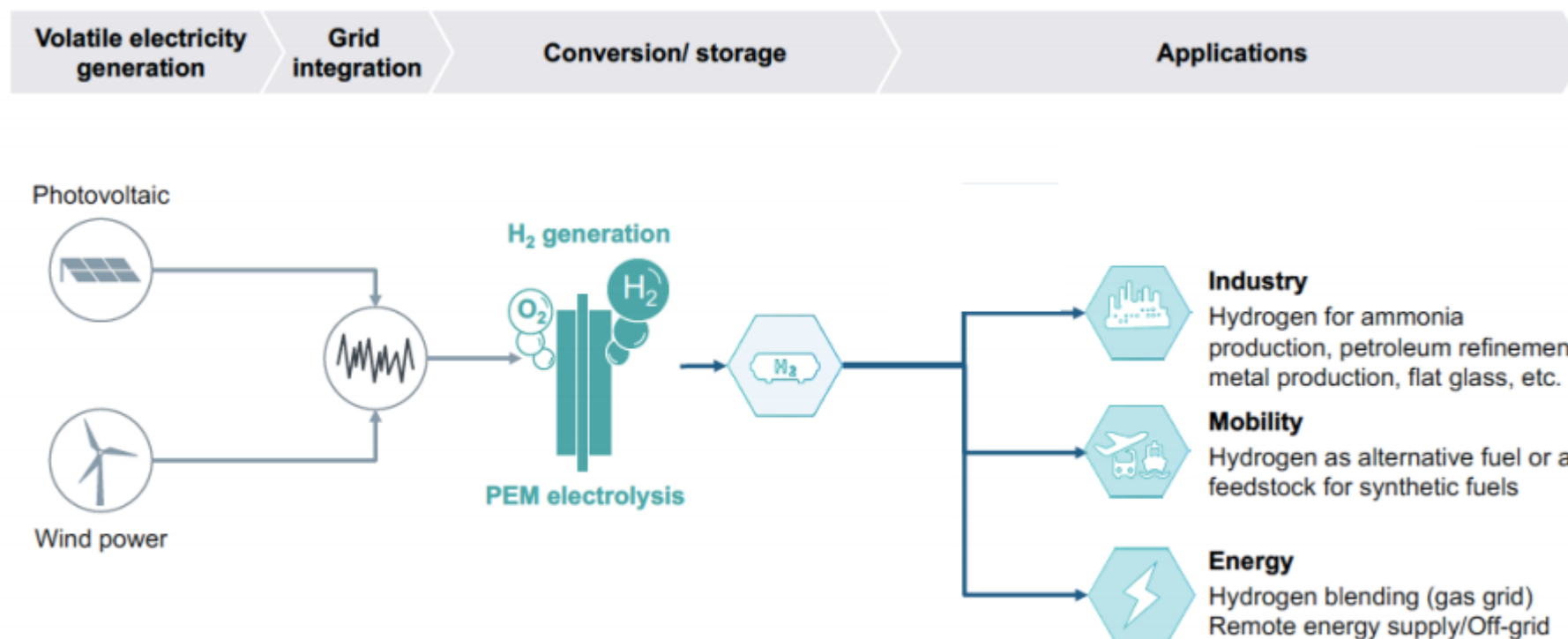


Enable the renewable energy system



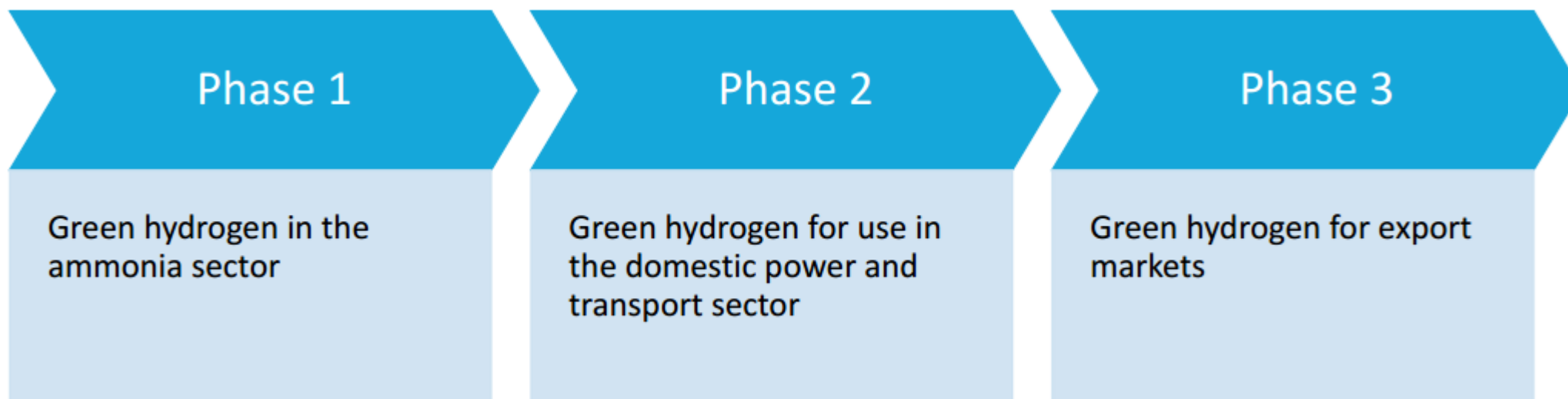
Decarbonize end uses

Domestic hydrogen pathways



Unrestricted © Siemens AG 2018

Green Hydrogen Roadmap e.g. Morocco, KSA/Neom

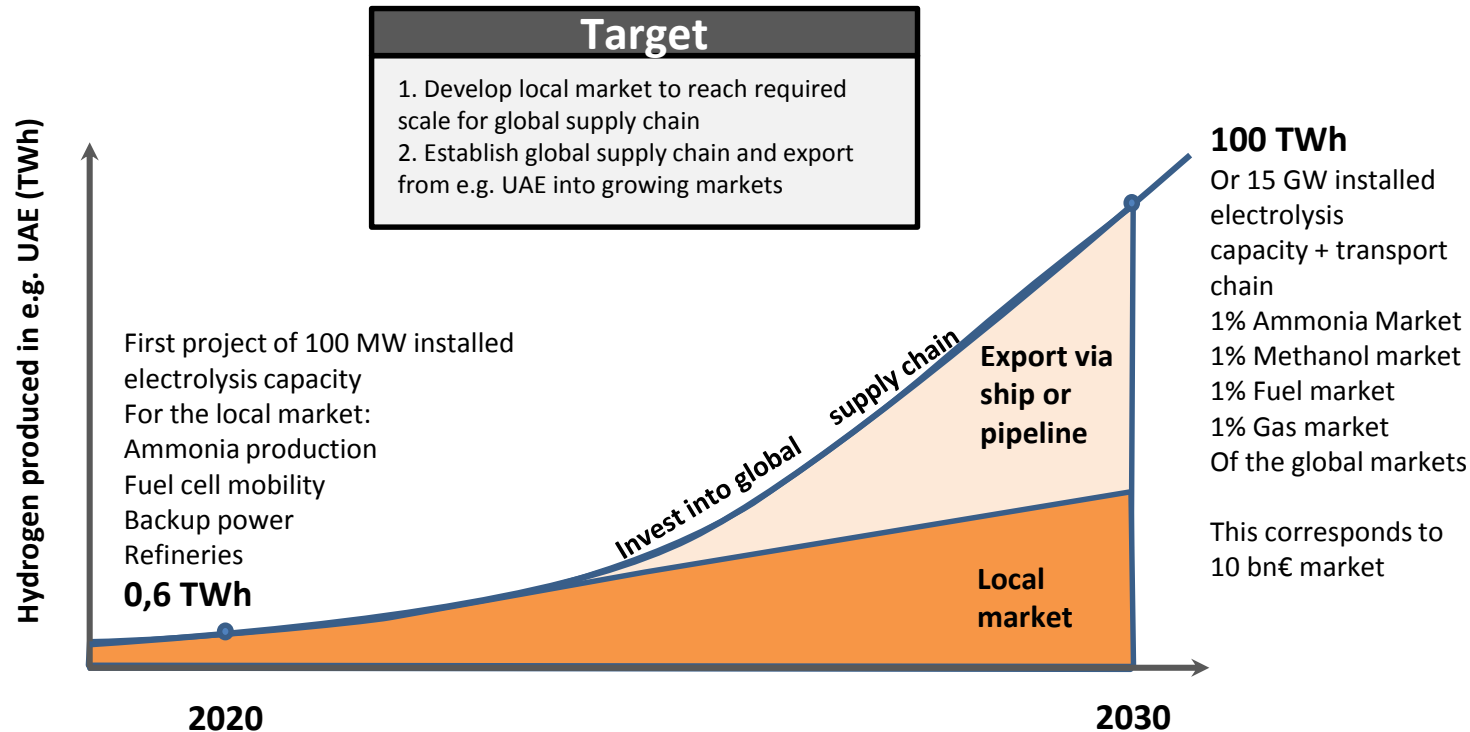


Hydrogen: Initiating and Scaling Up

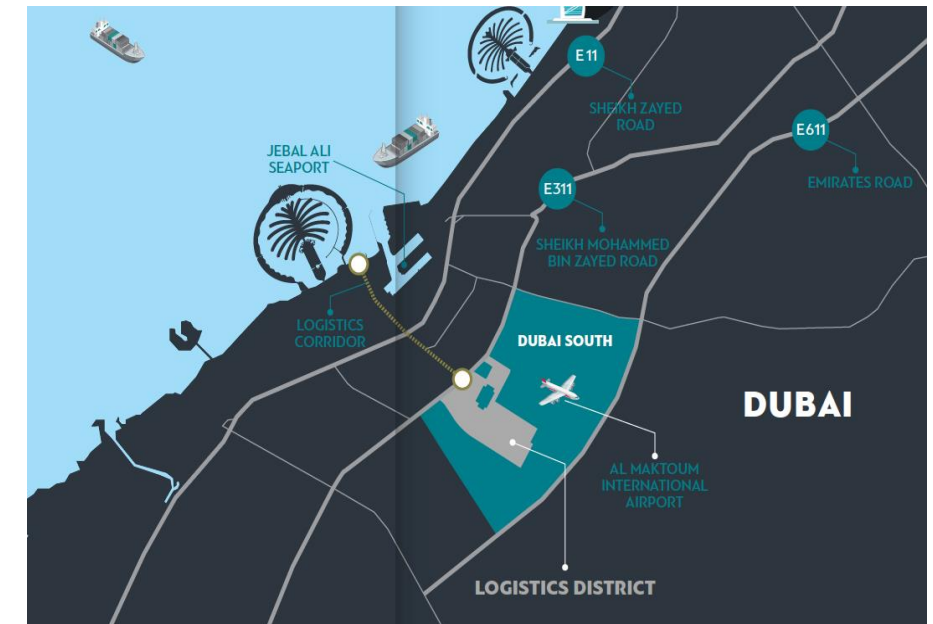
Idea to look at the opportunities for hydrogen at Dubai South



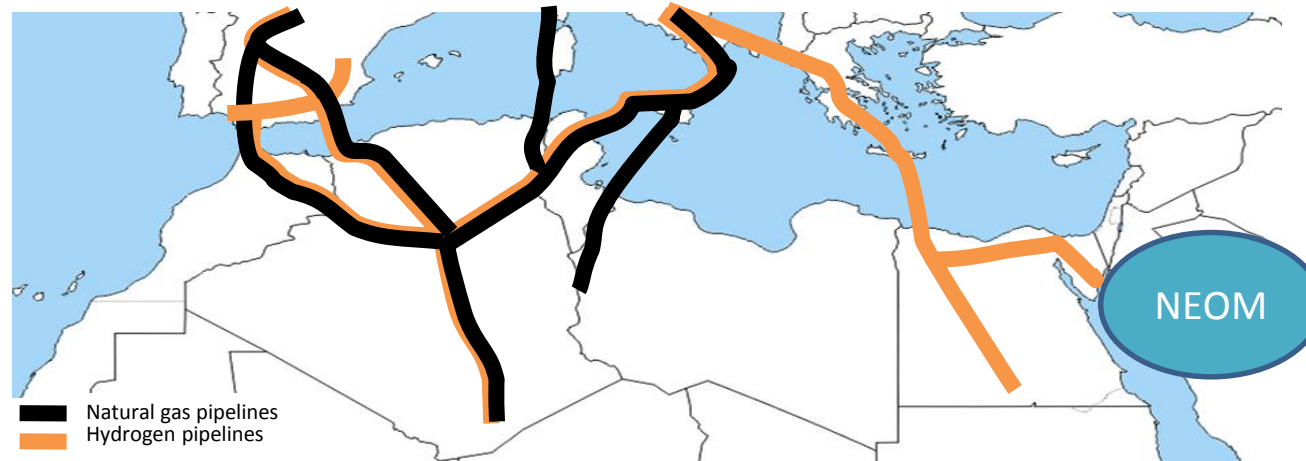
1. Global hydrogen supply chain South



2. Hydrogen Master Plan Dubai



Hydrogen South-Nordstream



- A hydrogen “South-Nordstream” could link Egypt and KSA to Greece and Italy
- 2 pipelines of 48 inch each - 2,500 km - similar capacity as the actual Nordstream (66 GW)
- Investment of € 16.5 billion.
- 300 TWh or 7.6 million ton hydrogen per year can be transported.

NEOM (KSA) has strong interest in green hydrogen



- New city, the size of Belgium (26,000km²)
- One of three strategic projects of Saudi Agenda 2030
- Saudi's Public Investment Fund and others have committed \$500 billion
- NEOM will be powered by 100% low-cost renewable energy (40 – 60 GW)
- Given the availability of competitive and low-cost renewable energy, NEOM will produce **green hydrogen** at scale for local and world markets
- NEOM, ACWA Power and Air Products signed in July an Agreement for 5 Billion\$ Solar based Green Hydrogen for producing 1.2 mln tons of Green Ammonia per year

Building on long term partnership with Morocco to develop local and export market for green molecules



- First Creation of local hydrogen economies and revenue opportunities for export
- Close interaction with all relevant stakeholders in Morocco on green molecules
- Participation of Moroccan Energy Minister in the video-call with EVP of EU Commission in charge of Green Deal for the presentation of « Green Hydrogen for a European Green Deal A 2x40 GW Initiative » and first global e-convention



Royaume du Maroc

Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement
Département de l'Energie et des Mines



Dii with Aziz Rabbah, Minister of Energy, Mines, Environment of Morocco at IRENA's 10 Assembly

Morocco's Green Hydrogen Strategy interactions with the EU Green Deal



A key player for the Green Hydrogen Economy

1. Green hydrogen is a technological solution to decarbonize our industry, especially for the production of fertilizers
2. Significant logistical infrastructure and an industrial fabric the large-scale deployment of green hydrogen
3. Deployment of large renewable energy projects with significant potential for solar and wind power
4. Morocco is widely qualified to become a key player in the development of green hydrogen, due to its geographic location, its energy interconnections and its exceptional renewable resources.

Main actions carried out by the Kingdom of Morocco

1. Establishment of the National Green Hydrogen Commission, bringing together public and private actors
2. Launch of a study to develop the Green Hydrogen Road Map, which is scheduled for completion in May 2020
3. Work in progress for the realization of a pilot project for the production of green ammonia
4. Development of an integrated program for the production of green ammonia, by deploying renewable energies
5. Preparations for the organization of a large scientific and technological conference dedicated to "Green Hydrogen".

Current green hydrogen activities in Morocco



GREEN ENERGY PARK:

Solar Photovoltaic and Thermal energy



GREEN & SMART BUILDING PARK

Green building, energy efficiency, smart grid and electric vehicles



NEXUS WATER-ENERGY:

Marine energy, water treatment



BIOENERGY & STORAGE PARK:

Bio energy, biomass and energy storage

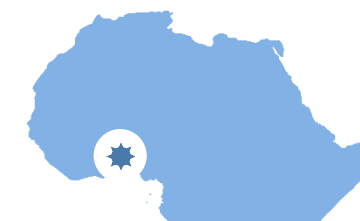


GREEN H2A:

Green molecules



Masen is starting a 'reference project', which is an industrial size project to produce green hydrogen and ammonia with around 100 MW of electrolyzer capacity.



GREEN ENERGY PARK MCI

Solar energy, hybrid systems, agriculture applications,...

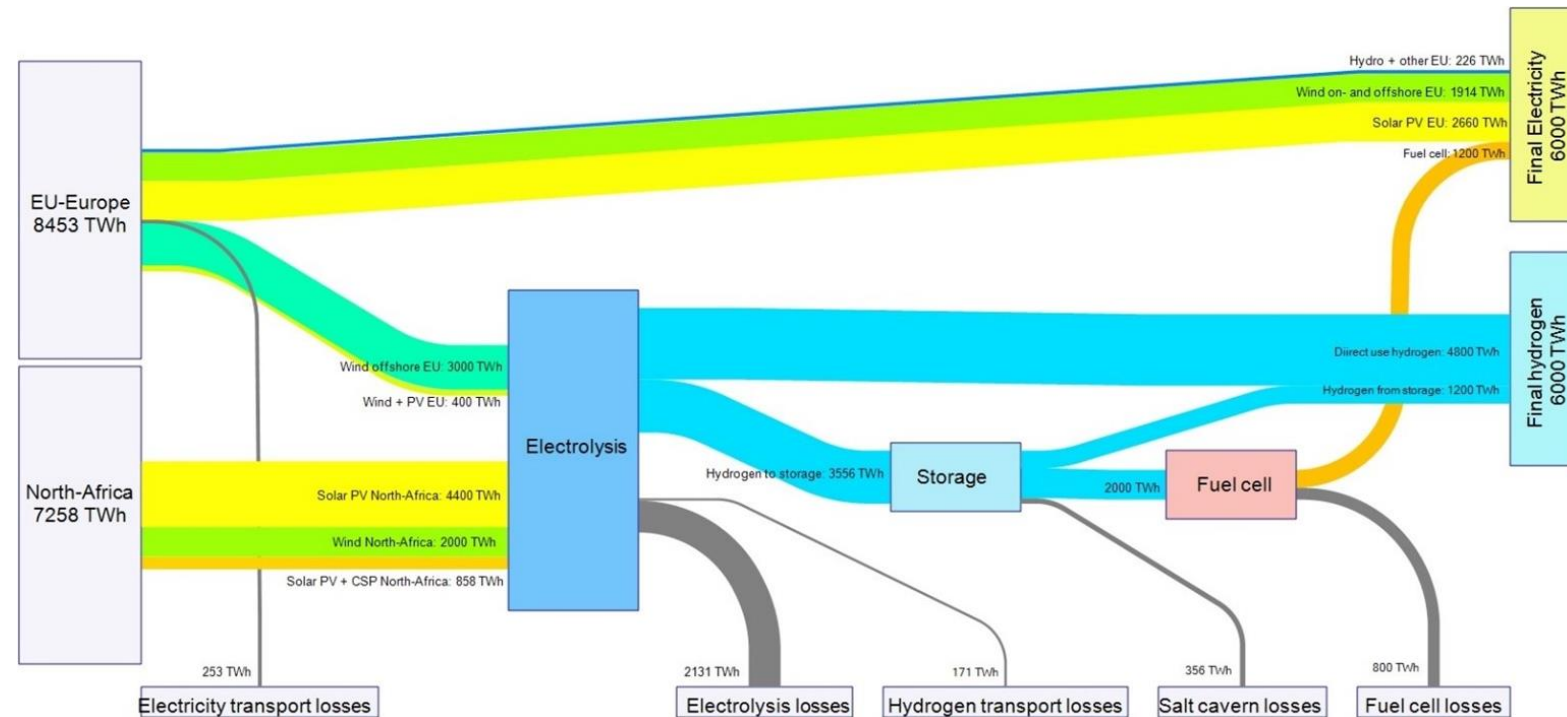


The European Hydrogen Strategy



Dii

A Study Scenario Outlook: Energy Balance European Union – North Africa 2050



Big support by European “Green New Deal”



“In my dreams, I would create a partnership with North-Africa and we would help and store huge capacity of solar energy in Africa and transform that energy into hydrogen and transport that hydrogen to other parts of the world and Europe through existing means we already have. (..) This is my dream of the future energy.”

Frans Timmermans, designated Executive Vice President of the European Commission, responsible for the ‘European Green Deal’.

European Hydrogen Strategy – 8th July 2020



- Priority focus on green hydrogen
- At least 6 GW of electrolyzers by 2024 and at least 40 GW installed by 2030
- Role for import from neighboring regions
- By 2030, the Commission estimates that €13-15bn could be invested in electrolyzers across the EU, in addition to €50-150bn for a dedicated wind and solar capacity of 50-75 GW.



Revival of Dii is leading to a wave of new prominent Associated Partners (some key additions highlighted)





Thank You!

Contact Us

Valeria Aruffo
Director External Relations
valeria@dii-desertenergy.org