Cornelius Matthes, Senior Vice-President, Dii Desert Energy

Towards a European powerfuels & hydrogen pathway

Global Alliance Powerfuels - Deutsche Energie-Agentur GmbH (dena)

9th September 2020

CONTENTS

1 Desertec 3.0

Just to give an impression of the wealth of MENA:

About 8% of the Sahara Desert alone would in theory be sufficient to power the world!

The deserts of Northern Africa and the Middle East (MENA) are a quasi unlimited source of emission-free energy. This shall in the first place benefit the region with its growing population (about 500m by 2050). We believe that MENA will eventually also become a major supplier of emission free energy to the world. Regional and international actors are challenged to take this major development jointly in their hands…..

Dii Desert Energy is an Industry Initiative founded in 2009 to connect regional and international players to make the energy transition happen in MENA and to capture synergies among regions and continents.

Dii Desert Energy Vision

Increased **competitiveness of renewables** shall swiftly lead to economic growth and secure 100% energy supply without harmful emissions or waste

Our Mission: No Emissions!

Towards a **fully emission free energy supply** in MENA before 2050 and making MENA a 'power house' for the global energy markets offering benefits to the region

Strategy

Connecting the international industry active in the MENA region with authorities and institutions. Focus on practical conditions for **'green electrons' and 'green molecules'** along the energy value chains leading to tangible and profitable projects and other benefits for local and international stakeholders

10- Years Desertec 1.0 ---> 3.0
Green Energy for North Africa, West Asia and the World

Development phases

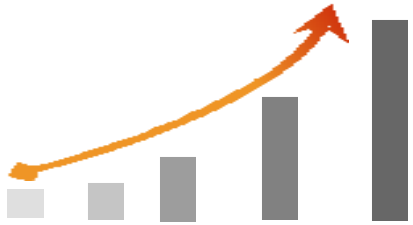
2004	2009	2015
Great Idea! Pre-phase	**It works!** Concept phase	**First Harvest!** Implementation phases

Acceleration! Green Electrons and green molecules

- Studies on the **Desertec vision** a.o. **TREC** (Trans-Mediterranean renewable energy Cooperation Studies)
- Creation of **awareness and motivation**

- **Desertec 1.0**
- **Power from the deserts for Europe**
- **Foundation of Dii GmbH** (Munich) in 2009
- **System, country and technology studies (Desert Power 2050, Desert Power: Getting Started)**
- Local adoption of idea
- **Preparation of services** for implementation phase

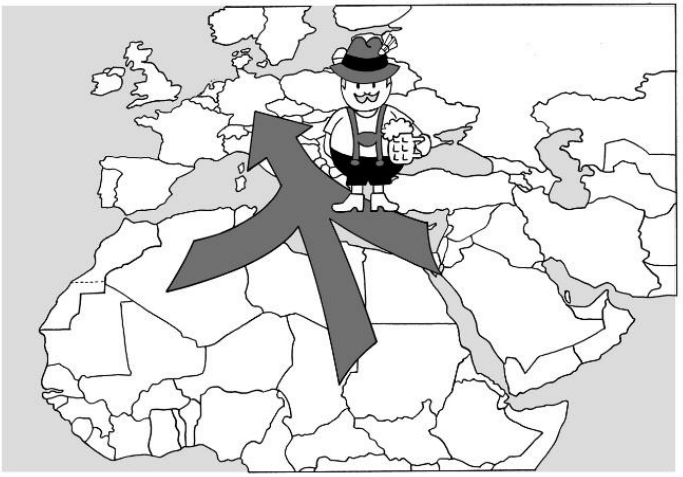
- **Desertec 2.0**
- **Development of the market in the MENA Region first**
- Dii active from Dubai, UAE
- **Identifying and solving practical hurdles** of wind/solar/grid projects
- International industry network **'Dii Desert Energy'**
- **Renewables become competitive!**



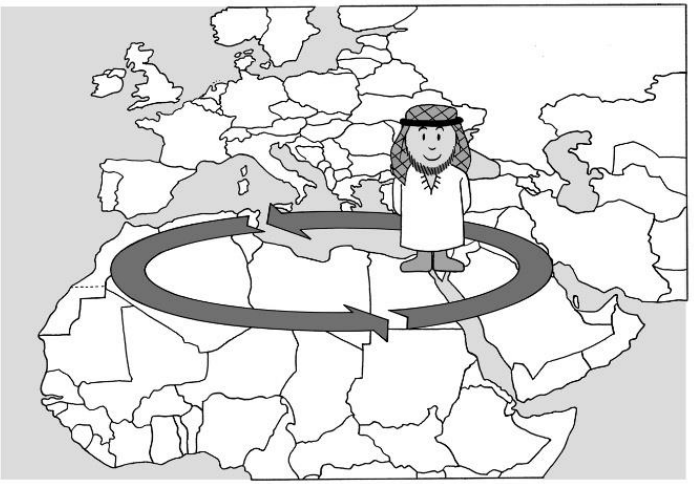
- **Desertec 3.0 Market acceleration** towards full renewable supply of green electrons and green molecules, transportation, storage and flexible demand in MENA
- **Full Market integration** throughout MENA and connected markets. MENA to become a 'Powerhouse for green electrons and green molecules for the world energy market
- **Increased focus on Industry Sector Coupling through** power, hydrogen etc.

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

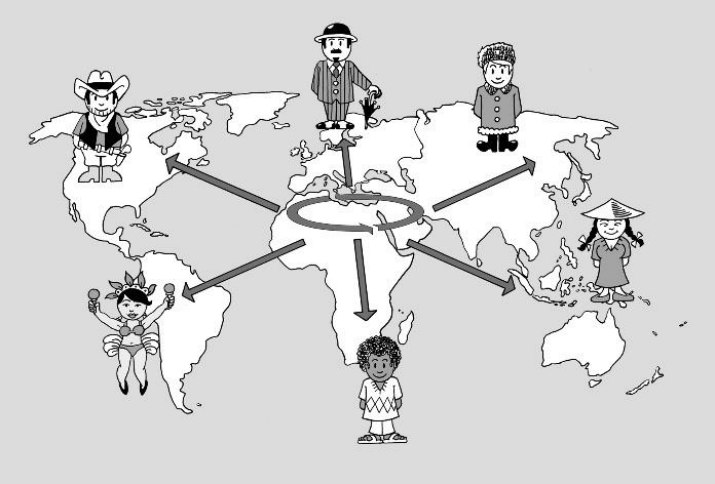
2004	Great Idea! Pre-phase	2009	It works! Concept phase	2015	First Harvest! Implementation phases	Acceleration! Green Electrons and green molecules



Desertec 1.0



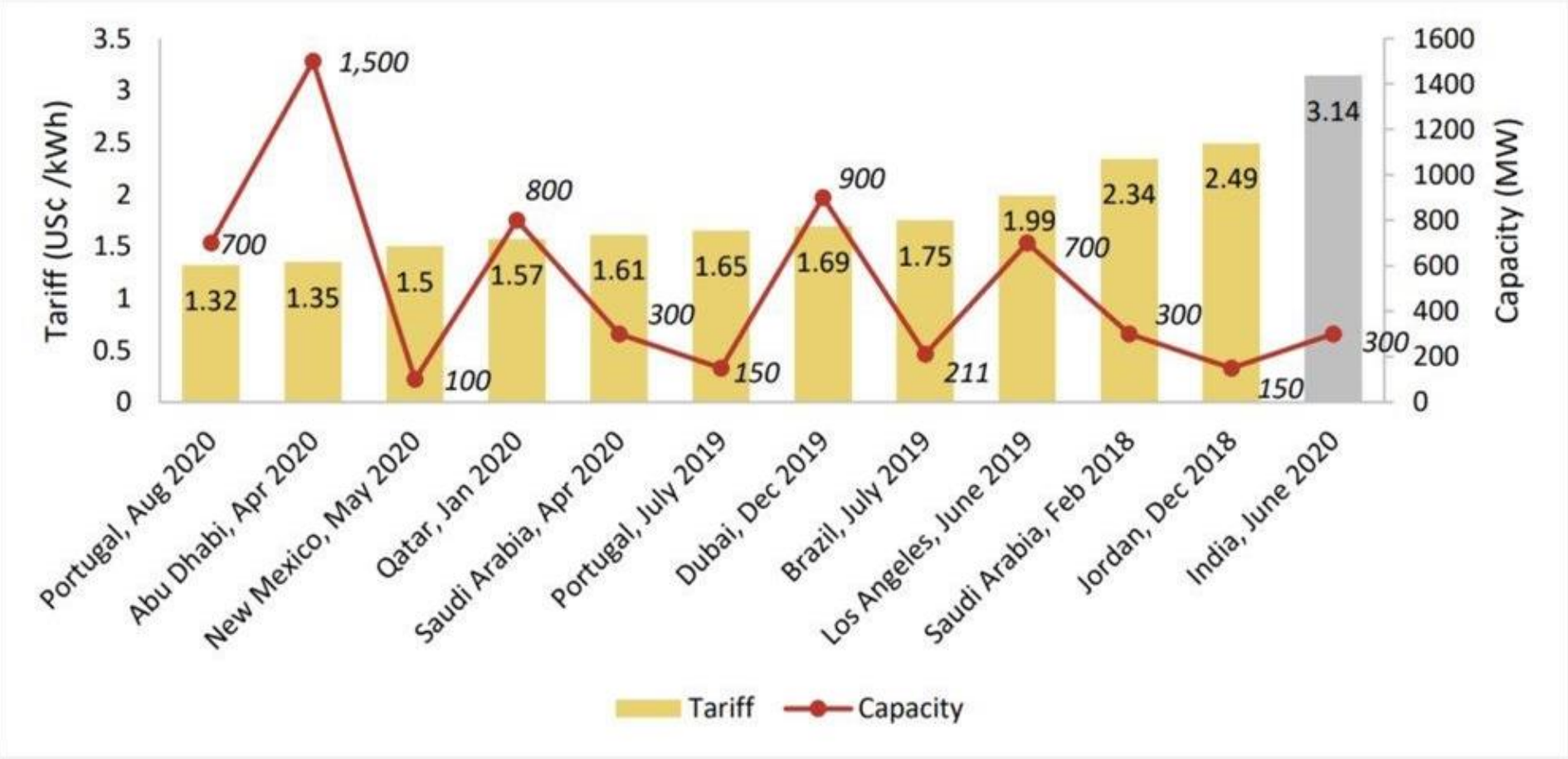
Desertec 2.0



Desertec 3.0

Development phases (2)

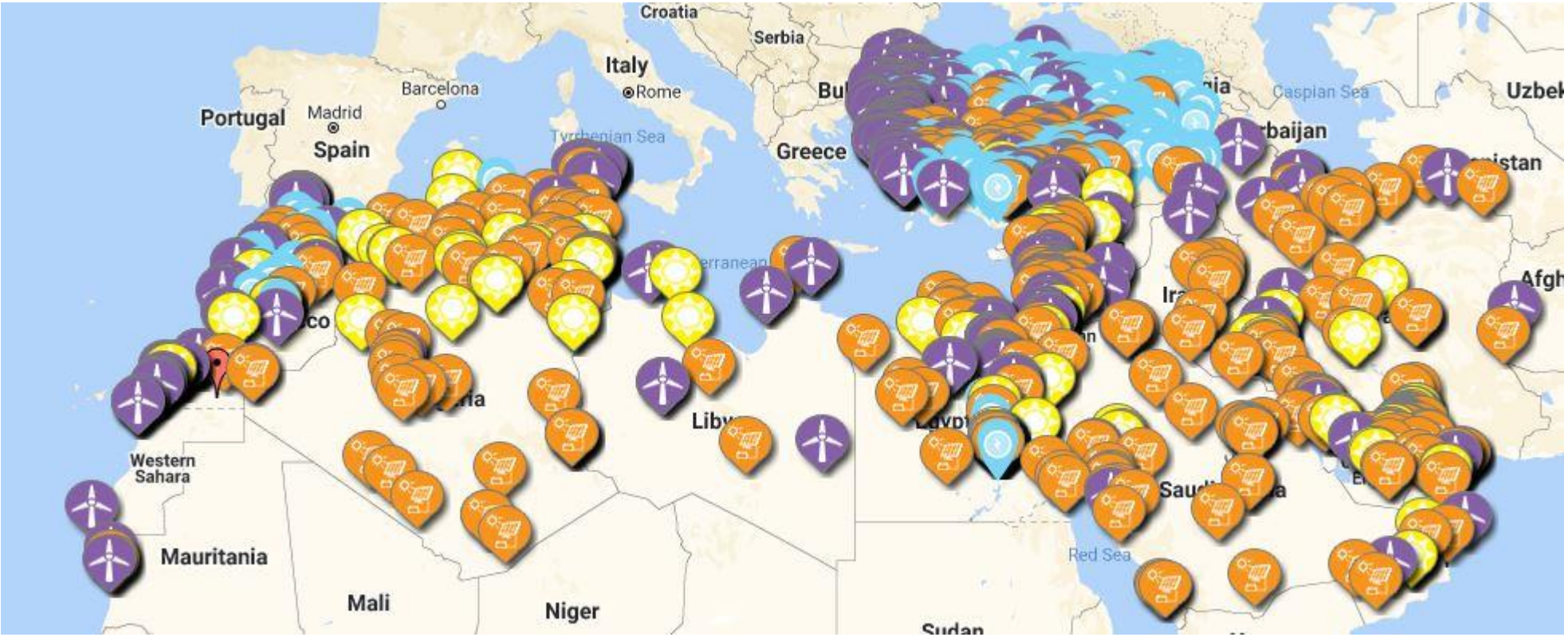
Lowest Solar Tariff Trends Across the World



Source: JMK Research

in 2020 Dii identified in MENA

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



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

Dii

ABB
AMANA
Ecolog
Emirates Electrical Engineering
ENARA ENERGY
enerwhere
Envirofina
EUROPAGRID
Fraunhofer
HALDOR TOPSOE
Higeco More
ibvogt
ILF CONSULTING ENGINEERS
Invent
KRINNER The Solar System
MAN Energy Solutions
Masdar
masen
MAURI SOLAIRE
MYTILINEOS
MEYER BURGER
mustakbal clean tech
NAREVA
NAVIGANT
NEOM
NOMADD
PostScriptum
SAIPEM
SIEMENS
sonelgaz
SQM THE WORLDWIDE BUSINESS FORMULA
STERLING & WILSON
SUNTECH
thyssenkrupp
TSK
Worley
YELLOW DOOR ENERGY

2

The MENA Hydrogen Alliance

Dii launched the MENA Hydrogen Alliance

A platform for 'H2 promotion' in the region

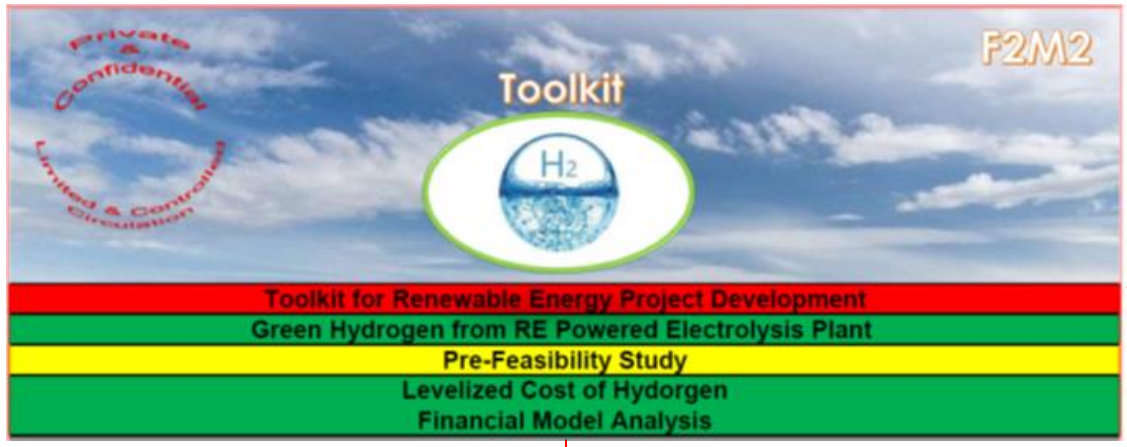
- **Initiated by Frank Wouters. First stakeholder consultation on 15th January at World Future Energy Summit, hosted by Masdar**
- Official launch at Intersolar ME in Abu Dhabi on 4th March
- 3rd (online) meeting of the MENA Hydrogen Alliance on 20th May: 400+ participants alongside the Ministry of Energy 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

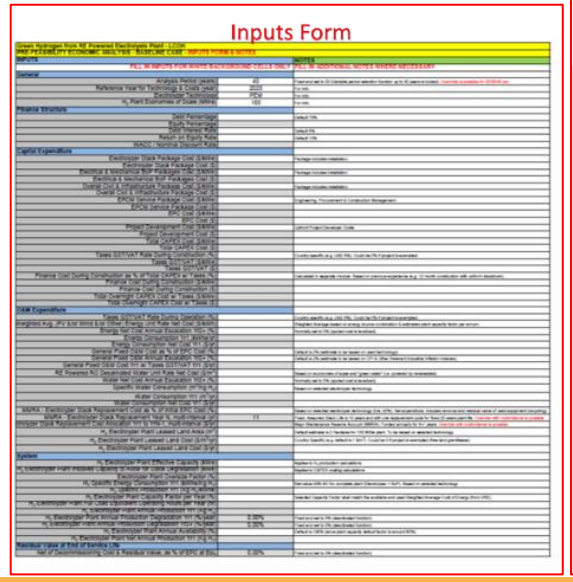
- Under the umbrella of **Desertec 3.0**, the Hydrogen MENA Alliance aims to accelerate the introduction and the growth of the green hydrogen economy
- Connecting the private-public sector and academia, promoting (pilot) projects
- Bridge between MENA and Europe, e.g. for off-takers and creating political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

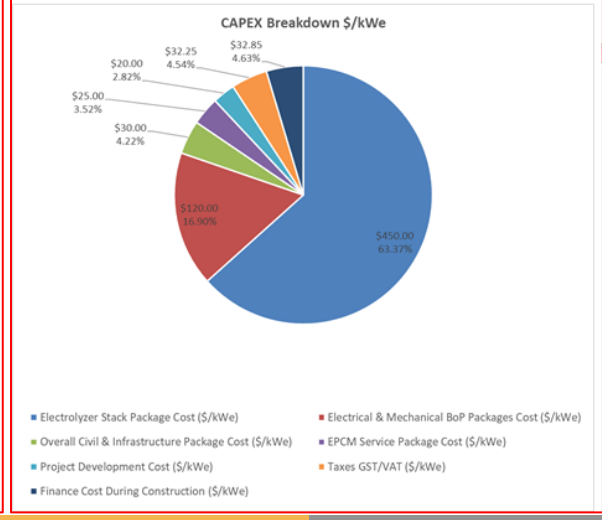
Note: participants at consultation and launch meeting in Jan-Mar 2020

Desertec 3.0 H2 studies appreciated by market with new momentum …



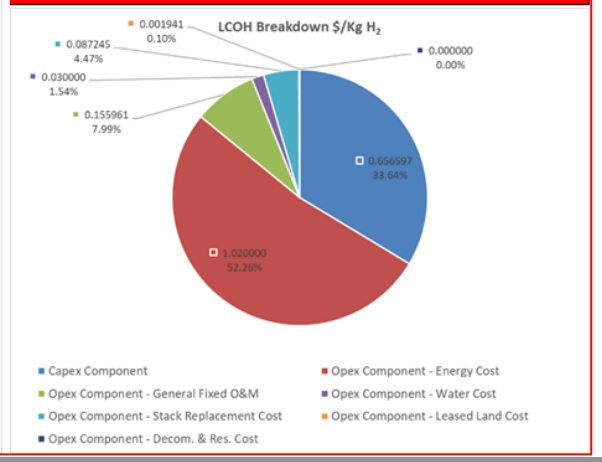
GREEN HYDROGEN
Innovative Financial Model Toolkit for Analyzing Levelized Costs (LCOH)

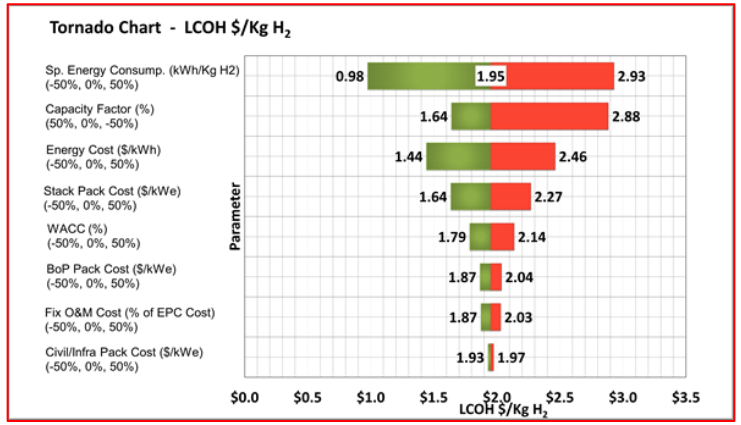


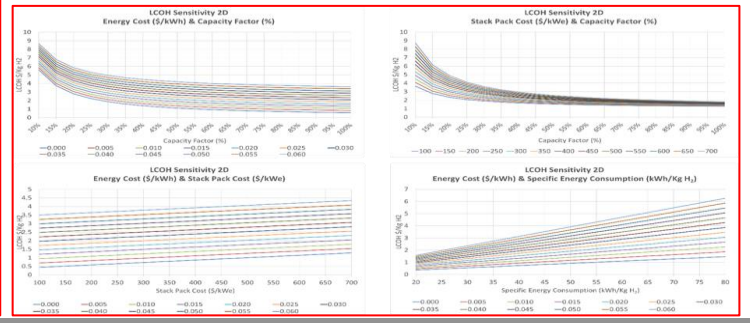


OUTPUTS - 20 Years

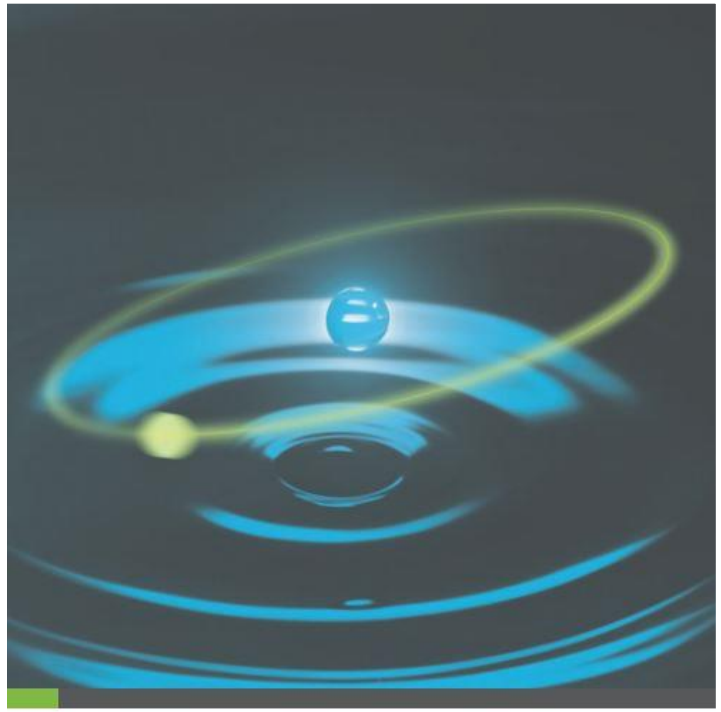
LCOH Component	Component $/Kg H₂	Component Percentage
Capex Component	0.656597	33.64%
Opex Component - Energy Cost	1.020000	52.26%
Opex Component - General Fixed O&M	0.155961	7.99%
Opex Component - Water Cost	0.030000	1.54%
Opex Component - Stack Replacement Cost	0.087245	4.47%
Opex Component - Leased Land Cost	0.001941	0.10%
Opex Component - Decom. & Res. Cost	0.000000	0.00%
		Total Percentage Check
		100.00%
LCOH ($/Kg H_2)	$1.951743	
LCOH (AED/Kg H_2)	7.172656	







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

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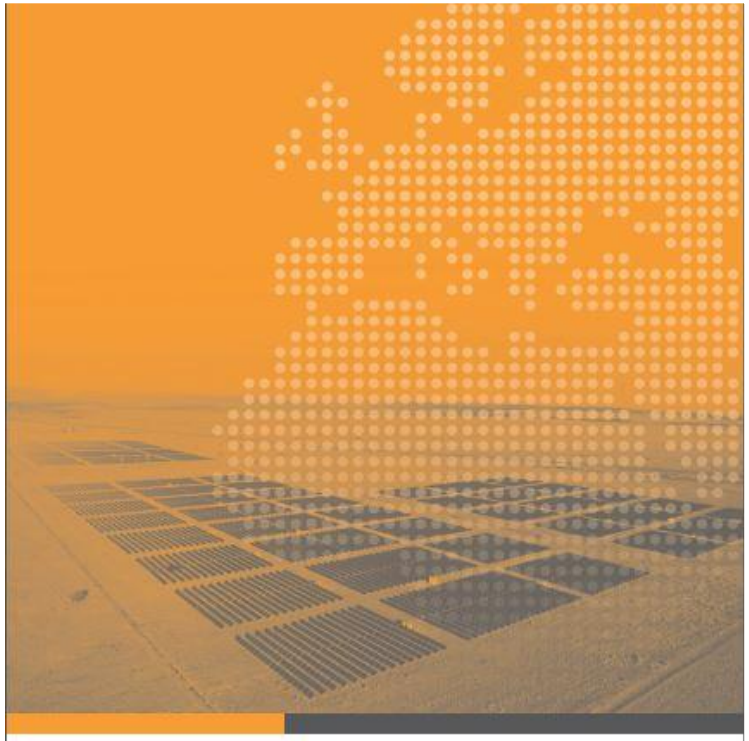
Hydrogen Europe

- Published **April 2020**, in cooperation with Hydrogen Europe
- **Presented to FransTimmermans**, EVP EU Commission in charge of Green Deal and 14CEOs 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
Dii Desert Energy

- 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**

3 Hydrogen in the MENA region

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):

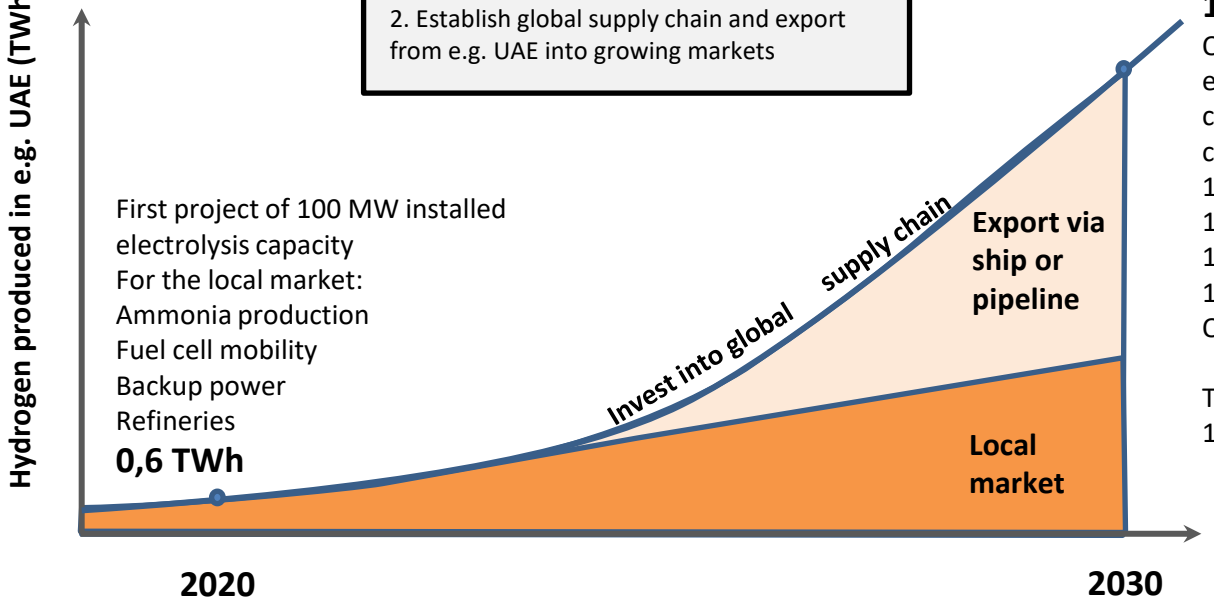
- **Capex:** capital expense for the electrolyzer (including the balance of plant)
- **Opex:** operating expenses for running the electrolyzer. Primarily this is electricity, with some costs for maintenance of the system and water.
- **Lifetime:** to assess the total cost of hydrogen, lifetime must be 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.

Hydrogen: Initiating and Scaling Up
Idea to look at the opportunities for hydrogen at Dubai South

1. Global hydrogen supply chain South

Target

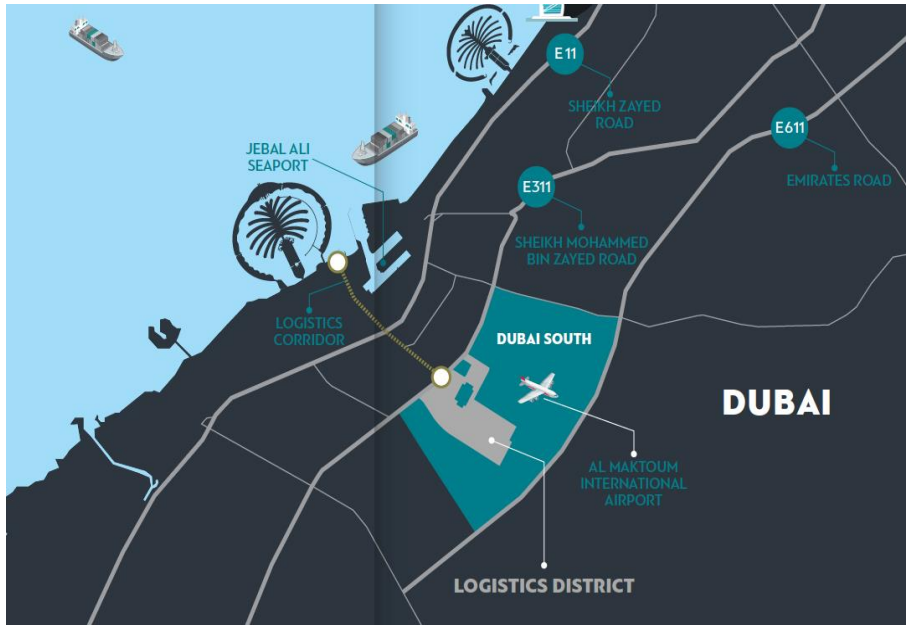
1. Develop local market to reach required scale for global supply chain
2. Establish global supply chain and export from e.g. UAE into growing markets



100 TWh
Or 15 GW installed electrolysis capacity + transport chain
1% Ammonia Market
1% Methanol market
1% Fuel market
1% Gas market
Of the global markets

This corresponds to 10 bn€ market

2. Hydrogen Master Plan Dubai



NEOM (KSA) has strong interest in green hydrogen

- New city, the size of Belgium (26,000km^2)
- 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 in July 2020 signed an Agreement for USD 5bn Solar based Green Hydrogen for producing 1.2m tons of green ammonia per year

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,..

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

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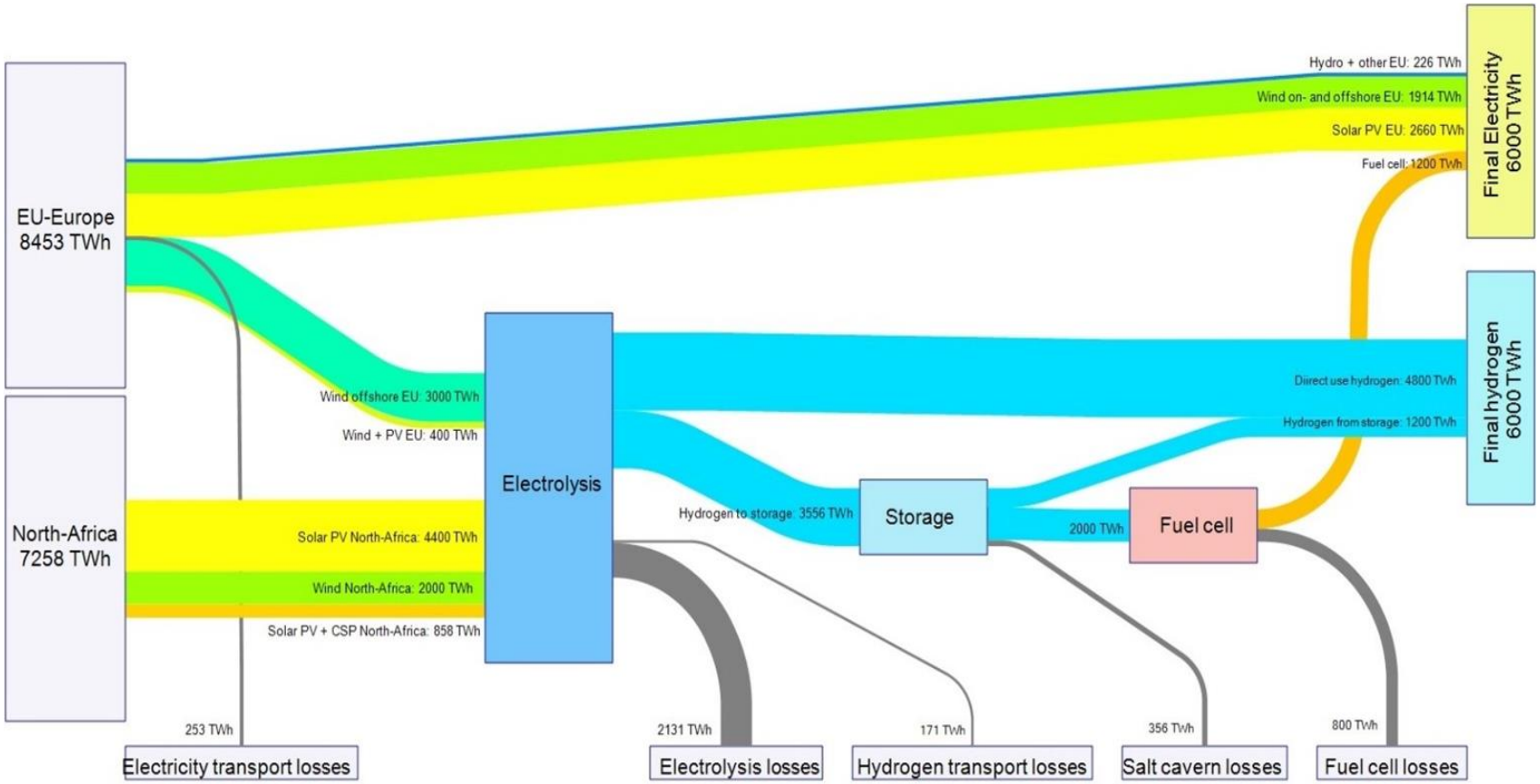
EU Hydrogen Strategy

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.”

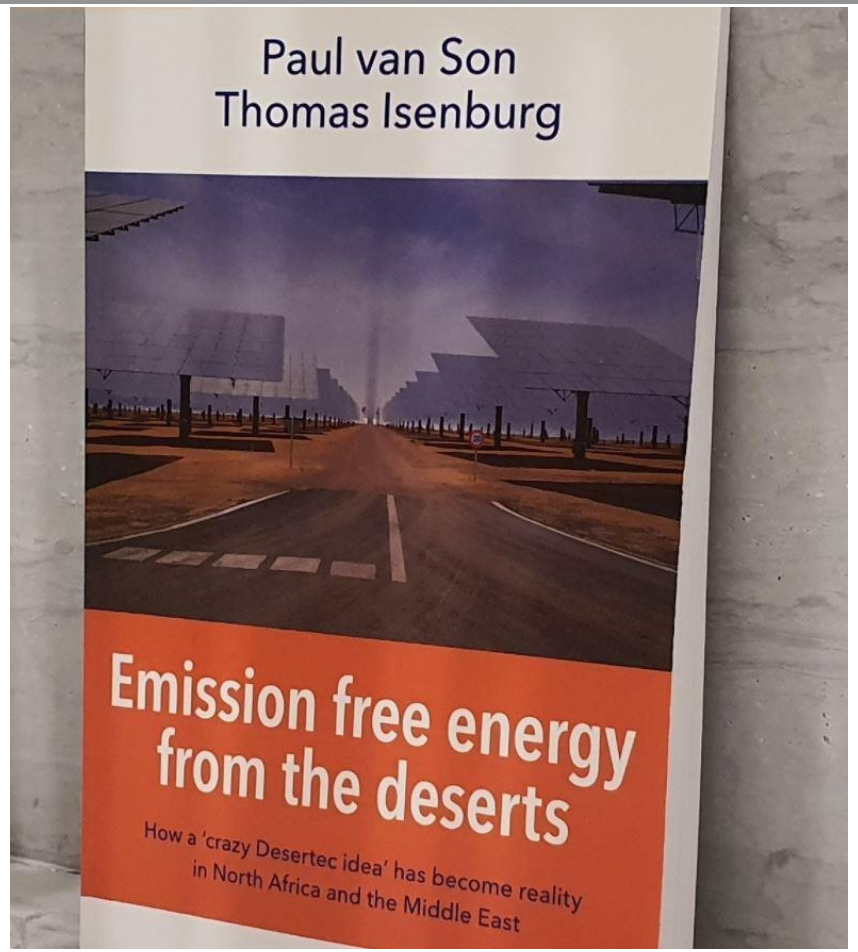
Frans Timmermans, designated Executive Vice President of the European Commission, responsible for the ‘European Green Deal’.

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.

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 expeort of green electrons and molecules
- **Update and translation into French to 'zoom' into the perspective of 'green electrons and molecules' in Maghreb (2020)**



Thank You!

Contact Us

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