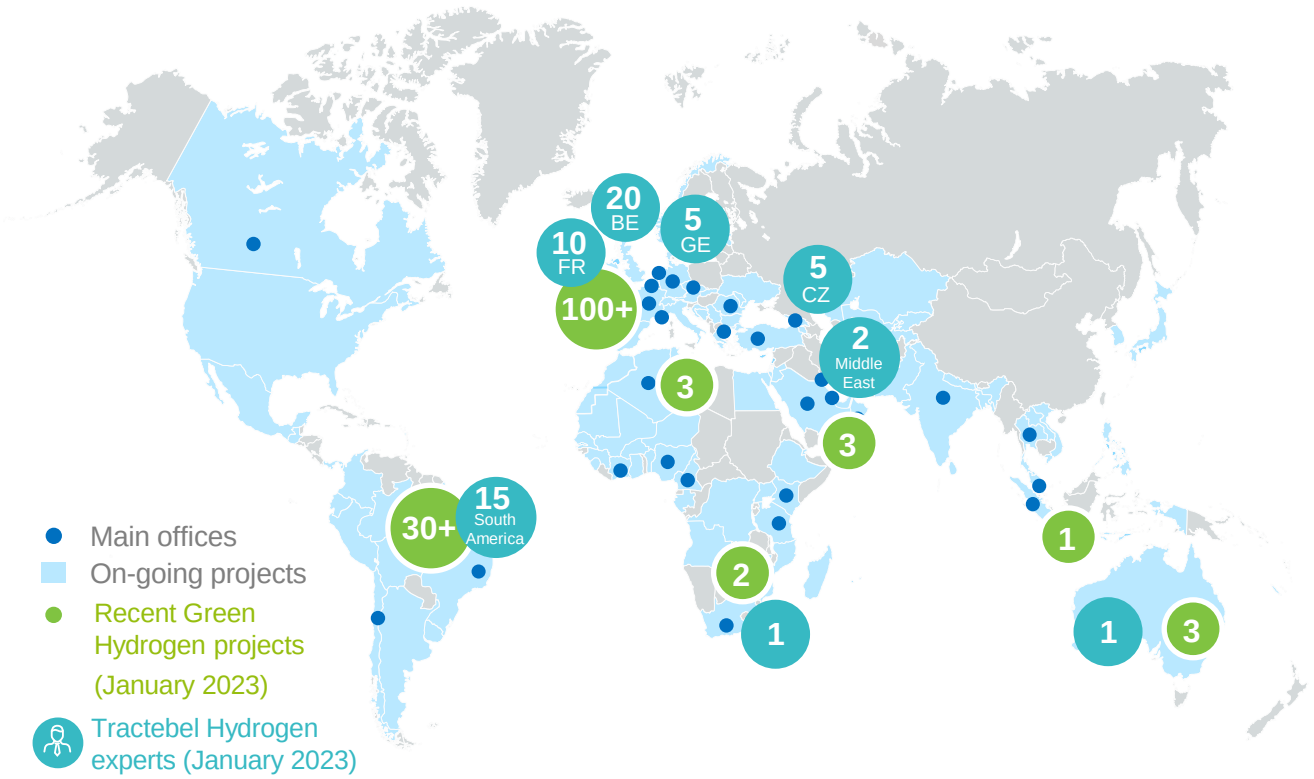
Green H2 für Deutschland – Potentiale aus internationalen Projekten

Windenergietage 09.11.2023

PUBLIC | INTERNAL | RESTRICTED | CONFIDENTIAL

Green H2 @ Tractebel Engineering

Internationality



- Main offices
- On-going projects
- Recent Green Hydrogen projects (January 2023)
- Tractebel Hydrogen experts (January 2023)

605 M€
2022 turnover

5,500
employees

>40
presence in 40 countries

>100
projects in over 100 countries

0.3
High safety standard: frequency rate 0.3

PUBLIC

Hydrogen

Energizing a carbon-neutral future

Tractebel Hydrogen experts

ENGIE Projects

Other Clients

Dolphyn - Producing 320,000 tons of green hydrogen with seawater and offshore wind energy - UNITED KINGDOM

Developing unique offshore infrastructure concept that paves new way for offshore hydrogen production - NORTH SEA

HyNetherlands: developing large scale green hydrogen production THE NETHERLANDS

MH₂-regio: development of a regional H₂-mobility strategy for Frankfurt - GERMANY

ReUze - Pre-feasibility study for ultra low carbon e-fuel from green hydrogen and captured CO_2 - FRANCE

Masshylia: advanced engineering studies for the largest green hydrogen site in FRANCE

Zero Emission Valley: conceptualizing and constructing 20 hydrogen refueling stations in FRANCE

1GW Green H₂ Conceptual Design and Techno-Economic Assessment Sines - PORTUGAL

20 Belgium

4 Germany

10 France

2 Czech Republic

2 Middle East

Scoping study on the potential for Power-to-X (Green Hydrogen) ALGERIA

Pre-feasibility study for 1GW green ammonia - NORTH AFRICA

Business development activities in India & APAC

H₂ - Offshore platform: feasibility study for hydrogen production incl. conversion to ammonia - VIETNAM

Development of a green hydrogen study - BRAZIL

HyEx: Pre-feasibility study for green ammonia production CHILE

10 Latin America

Forklift mobility with first green hydrogen in CHILE (EPC)

2 South Africa

Technical due diligence for 1GW green ammonia for export - MIDDLE EAST

Design and EPCM for mining transport decarbonization Mogalakwena - SOUTH AFRICA

Taking green hydrogen into Yara's factory - Owner's Engineer AUSTRALIA

H₂ exporting/importing facilities: feasibility study to assess transport technologies and conversion of LNG terminal facilities - AUSTRALIA

A renewable hydrogen solution provider

Master Plan

Renewable Generation

Transmission & Distribution

Power to H2

Compression & Storage

Transport

H_2 Mobility

H_2 Power & Heat

H_2 Industry

H_2 Chemicals

CH_4 (green methane)
NH_3 (green ammonia)
CH_3OH (green methanol)

Building integrated solutions
Covering the whole value chain
Supporting you at each step of your project

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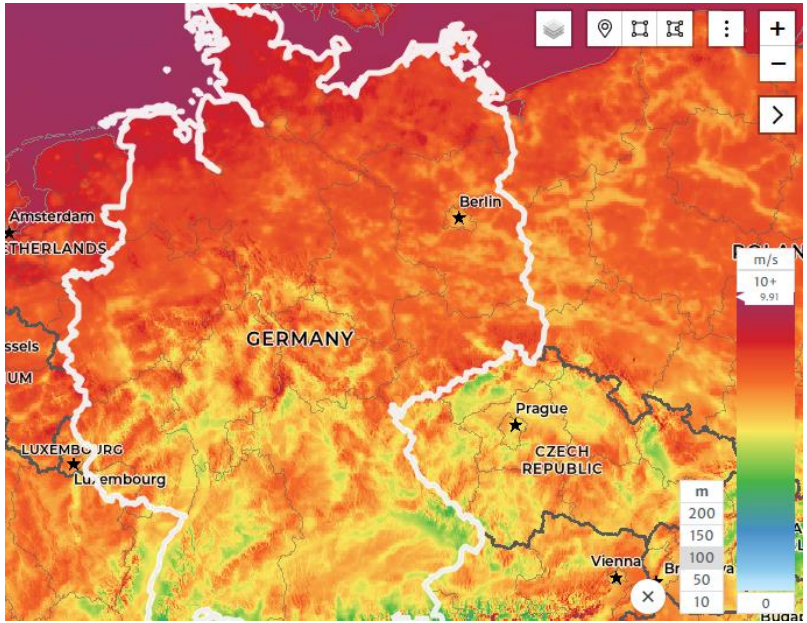
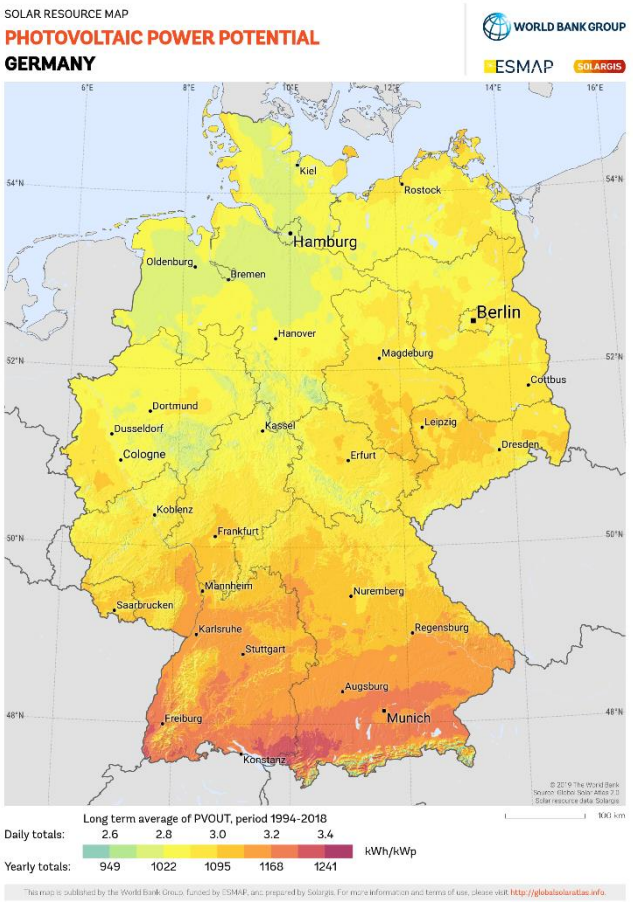
Green H2
Where from?

Wind and solar potential
Germany

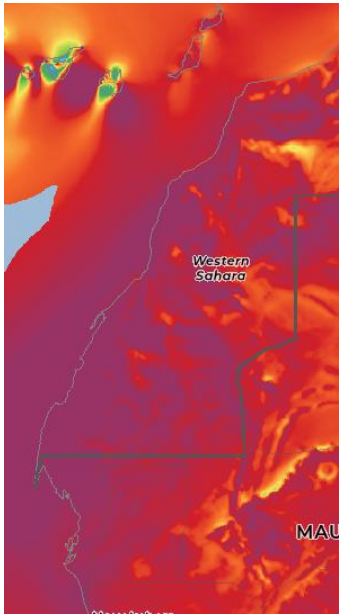


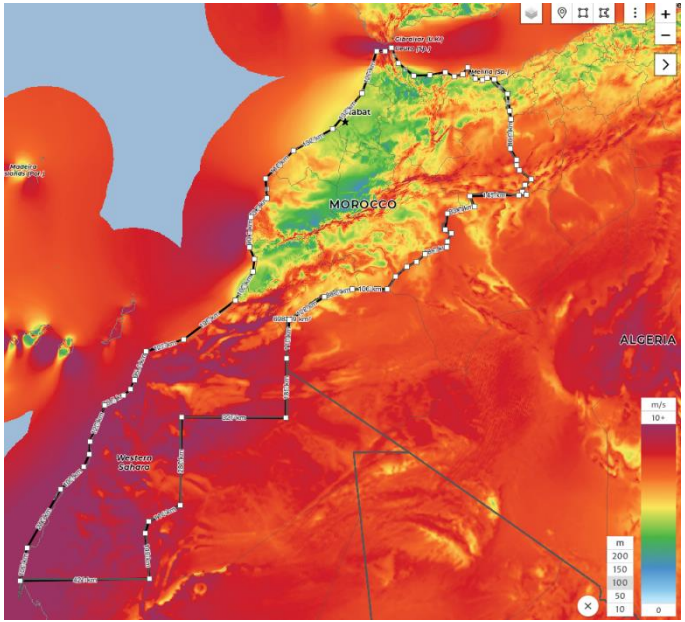
Wind 2000-3000 h/a full load
PV < 1000 h/a full load



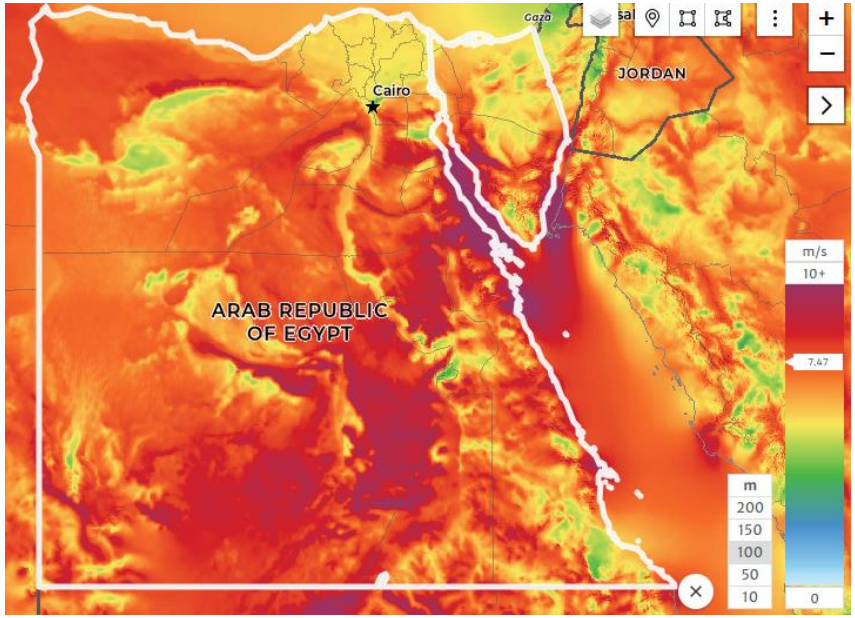
Wind potential
South Morocco

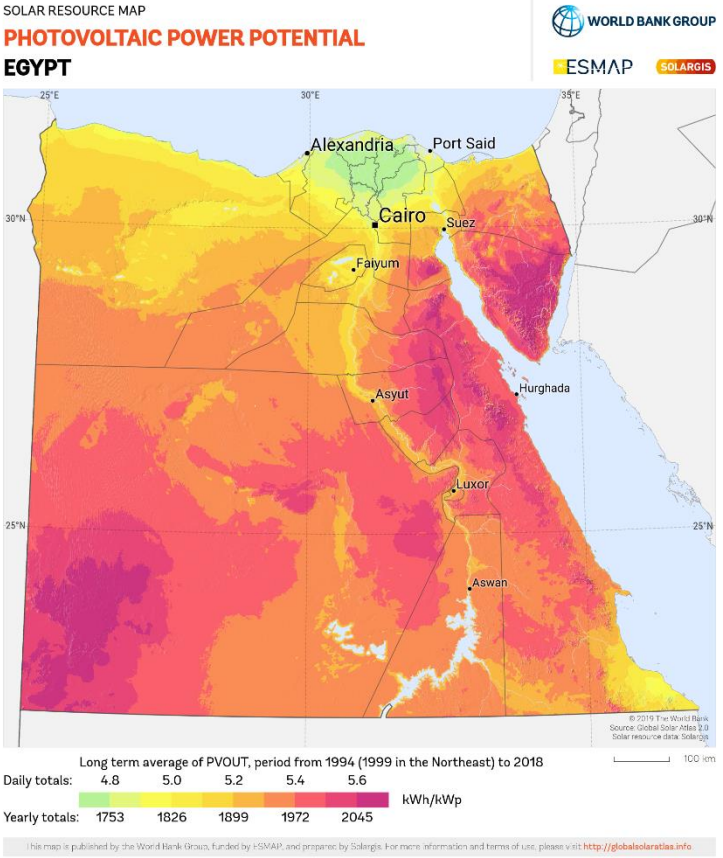
- Wind speeds average 10-12 m/s, k >3
- > 5000 h/a full load
- Abundant land availability, 50% of national terrain, 2% of population
- 400 kV grid connection saturated
- New 3 GW line to South Morocco under IPP tendering.
- Big port in Dakhla under construction





Wind and solar potential
Egypt





Wind 4000-5000 h/a full load
PV 2800 h/a full load with tracking

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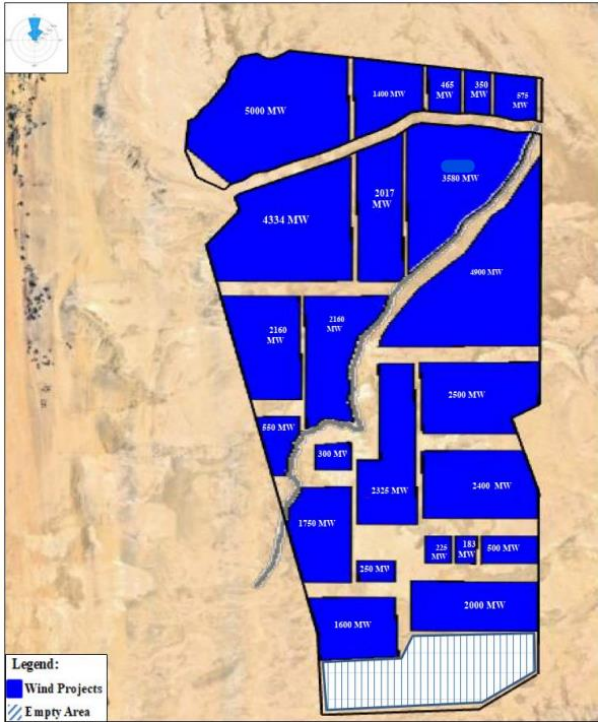
Land Availability
Egypt

- The Egyptian Government reserved areas for several 10 GW of RE production
- Grid connection masterplan under development.
- Export of GH2 via Seaports



Egypt Transmission

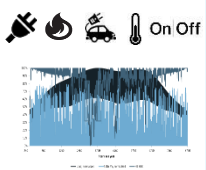
- The existing 500 KV network needs to be reinforced to transmit RE to green industries
- > 500 km distance between RE generation and Port
- The HTSO analyses the possibility to increase the voltage of the transmission network to 750 kV or even 1000 kV.

Prosumer

Techno-economic assessment for multi-fluid complex energy applications

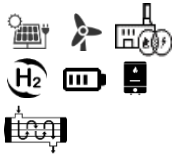
IN-HOUSE TOOL & APPROVED METHODOLOGY

STEP 1 NEEDS



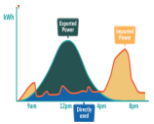
Energy needs
- Electricity
- Heat/Cool
- Steam

STEP 2 AVAILABLE OPTIONS



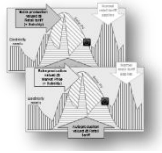
- Investment Costs
- Operational Costs
- Potential synergies
- RES Availability

STEP 3 OPERATION



- Availability
- Flexibility
- Time shifting
- Buffering

STEP 4 CONTEXT



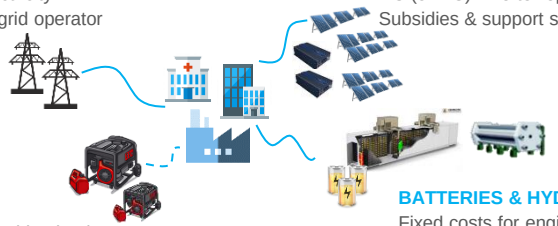
- Supply Contracts
- Regulatory Context
- Metering Rules
- Feed-in Tariffs

Prosumer

ONE SINGLE SITE APPROACH

ACCESS TO THE GRID
Buy/Sell Electricity
Services to grid operator
Or off-grid

PVs, WIND & INVERTERS
DC (or AC) Inverter optimisation
Subsidies & support schemes



GENSETS
Optimal combination between gensets sizes, Efficiency curves, Start-up costs

BATTERIES & HYDROGEN
Fixed costs for engineering, cooling system, electronics, hardware, container.
Grid stability module

INCLUDING NEIGHBORHOOD SYNERGIES

OUTCOMES

- Optimal size, RES share, LCOEs, Heat cost
- Investments needed (on or off site)
- ROI, Payback, NPV,…
- Savings on energy bill
- Avoided CO_2 emissions
- Operating regimes

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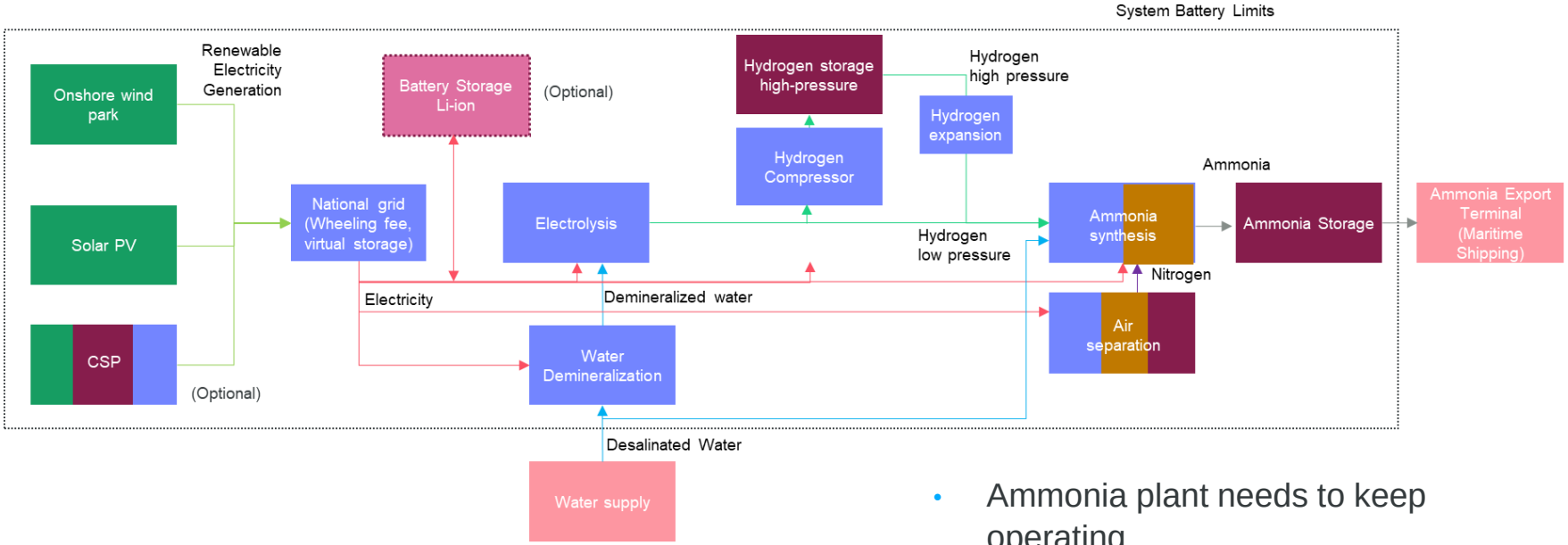
Power-to-Ammonia – Model Setup

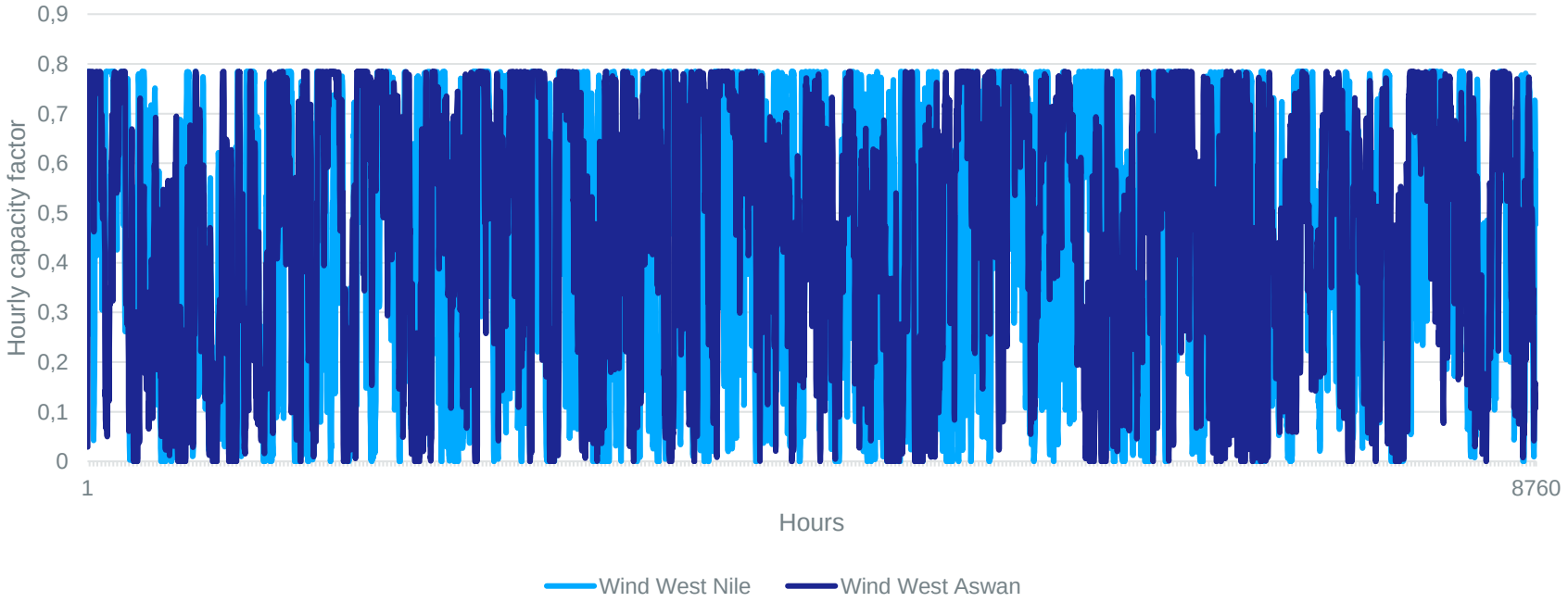


Legend:

Renewable Generator	Converter	Generator	Storage	Market
Define generation profiles	Multiple Input/ Output vectors	Unit size + Partial load performance	Temporal shift of energy vectors	Buy / Sell vectors

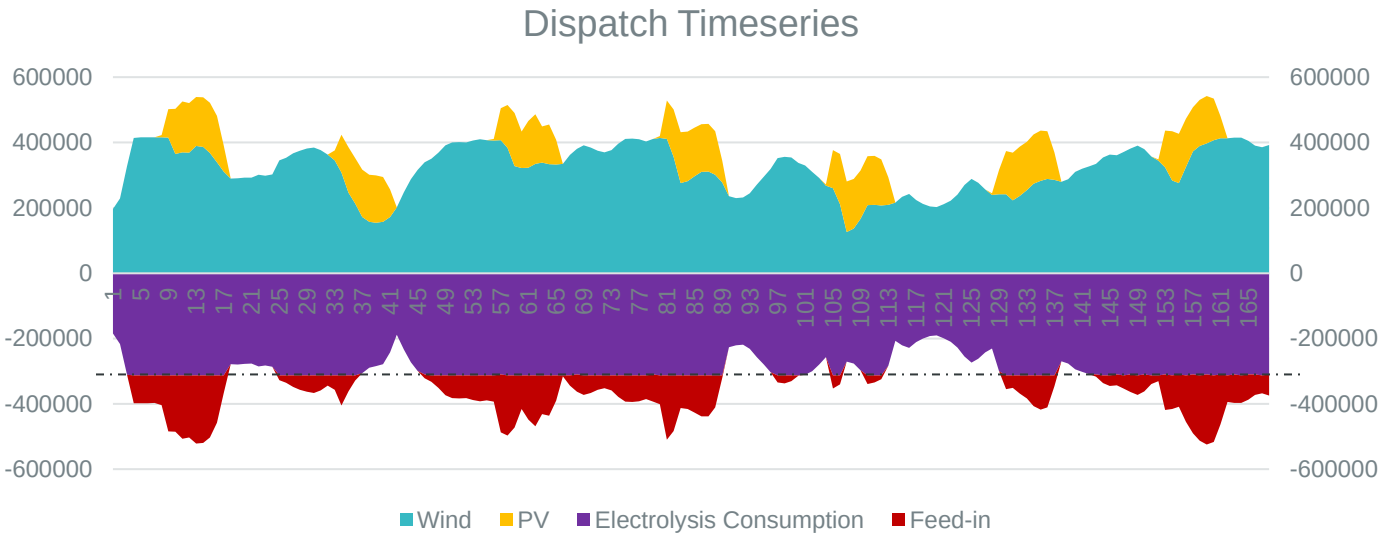
- Ammonia plant needs to keep operating
- H2 storage + Battery covers low wind hours.

Comparison of Wind profiles: West Aswan vs. West Nile



- Even for similar profiles, a combination can improve the downstream capacity factor!
- Only 400 h/a with wind speeds below 6 m/s at night time

Prosumer Results – Dispatch* – example week



- Feed-in happens at 67% of the time, but represents only ~15% of produced energy

*Excel file containing the full 8760-hour Dispatch of the optimized year will be provided as Annex

Conclusions

- Egypt and Morocco offer a very high RE resource potential
- The desert is big enough, abundant space for RE generation
- Egypt and Morocco own port capacities for the transport of green molecules to Europe
- Grid transmission remains a challenge in both countries.
- Green H2 projects require a complex multi disciplinary engineering process

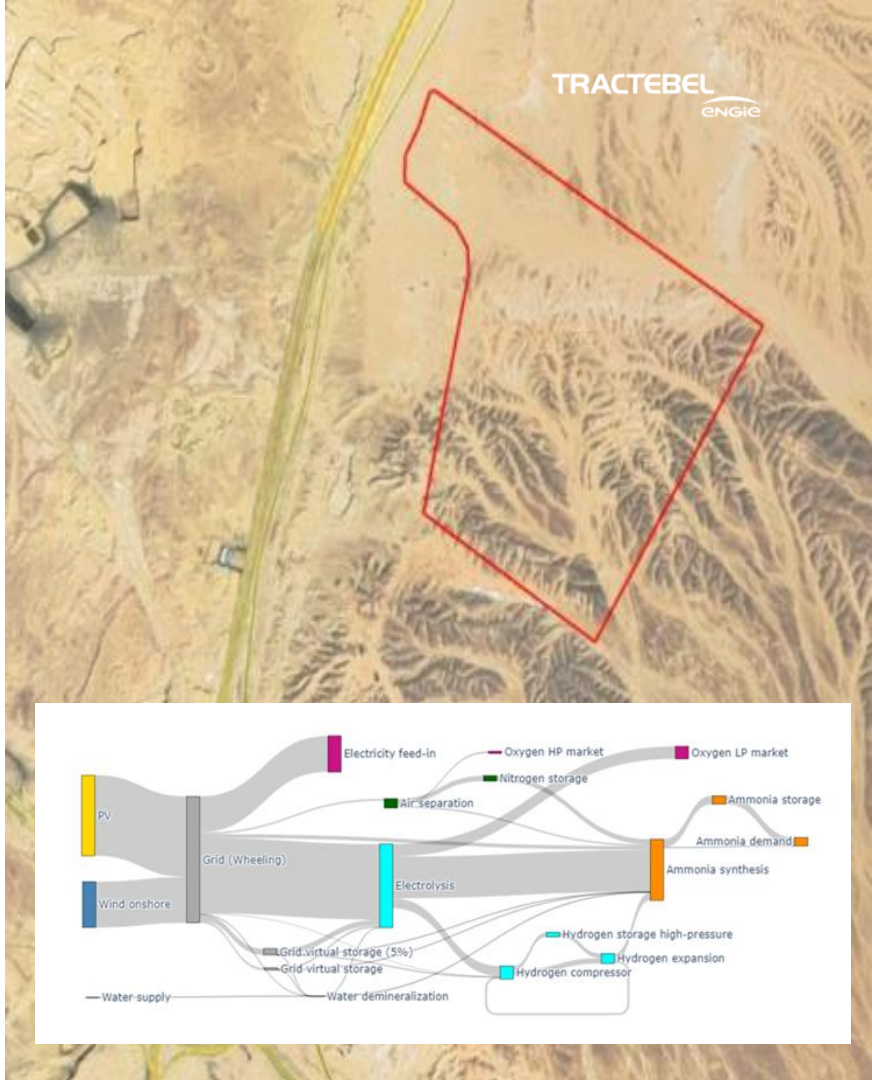
Green H2 Projects in Egypt and Morocco can start construction within around 3 years once offtake is agreed.

Referenz
Green H2 Projekte

4GW Hydrogen

Tractebel successfully supported the Client to submit a Feasibility Study in 4 weeks and to sign FWA with the Egyptian authorities for the project implementation in the frame of COP27. The Feasibility Study was further elaborated for final submission.

CLIENT	**Masdar - Hassan Allam - Infinity Power**
LOCATION	Egypt
CAPACITY	• 2 x 200 MW pilot projects (for ammonia/e-methanol production) • 4 GW targeted total capacity
PERIOD	2022 - 2023
SERVICES PROVIDED	**Feasibility Study** • Concept screening and basic design of PV, Wind, electrolysis, NH_3/CH_3OH plants & storage • Optimization of the value chain nodes and the power supply configuration • TIC and development cost estimation & financial analysis • Development of the project execution plan



Green LOHC

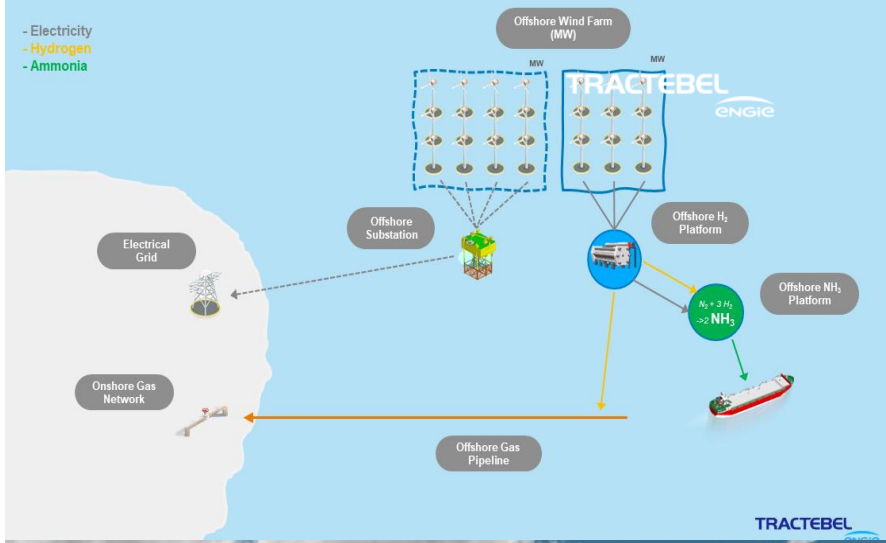
Integrated value chain from renewable energy to LOHC.

CLIENT	**Confidential**
LOCATION	Tunisia
CAPACITY	200MW
PERIOD	2022 - ongoing
SERVICES PROVIDED	**Technical Due diligence PV and Wind** **Pre-Feasibility Study (Prosumer Sizing)** **Feasibility Study**

- System design
- Utilities & power balance
- Risk register, development of Safety Concept
- Plot plan
- Project Schedule
- CAPEX/OPEX estimation

Offshore production platform for green H_2 and NH_3

LOCATION	Offshore (worldwide)
PERIOD	2021
CAPACITY	100 - 400 MW (modular)
SERVICES PROVIDED	**Concept study** • Conceptual design of electrolysis plant of size 100 – 400 MW and ammonia synthesis unit (300t/d), balance-of-plant and platform structure (topsides) • Definition of the system configuration for main and utility units • Layout planning • CAPEX/ OPEX estimation • LCOH calculation • Economic & Financial model



Let’s get in touch!

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