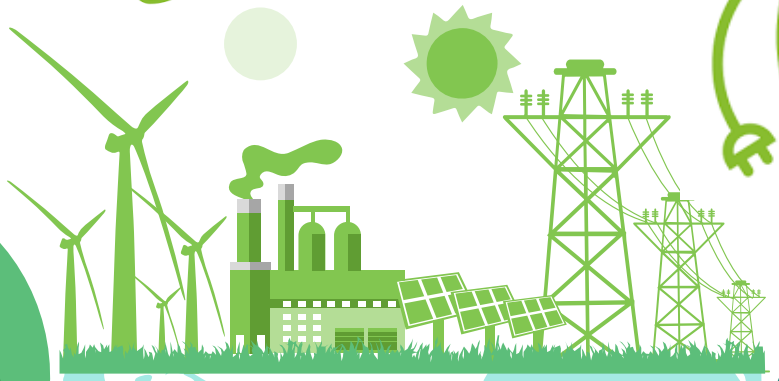







Tunisian Green Hydrogen Society

COP28UAE
Dubai Dec. 3rd, 2023

Green hydrogen
The driver of Tunisia's economy decarbonization and growth

Presented by Chokri Aslouj, Eng. -MSc. -MBA

Agenda

01 Introduction

02 Tunisia’s renewable energy and green hydrogen potentials

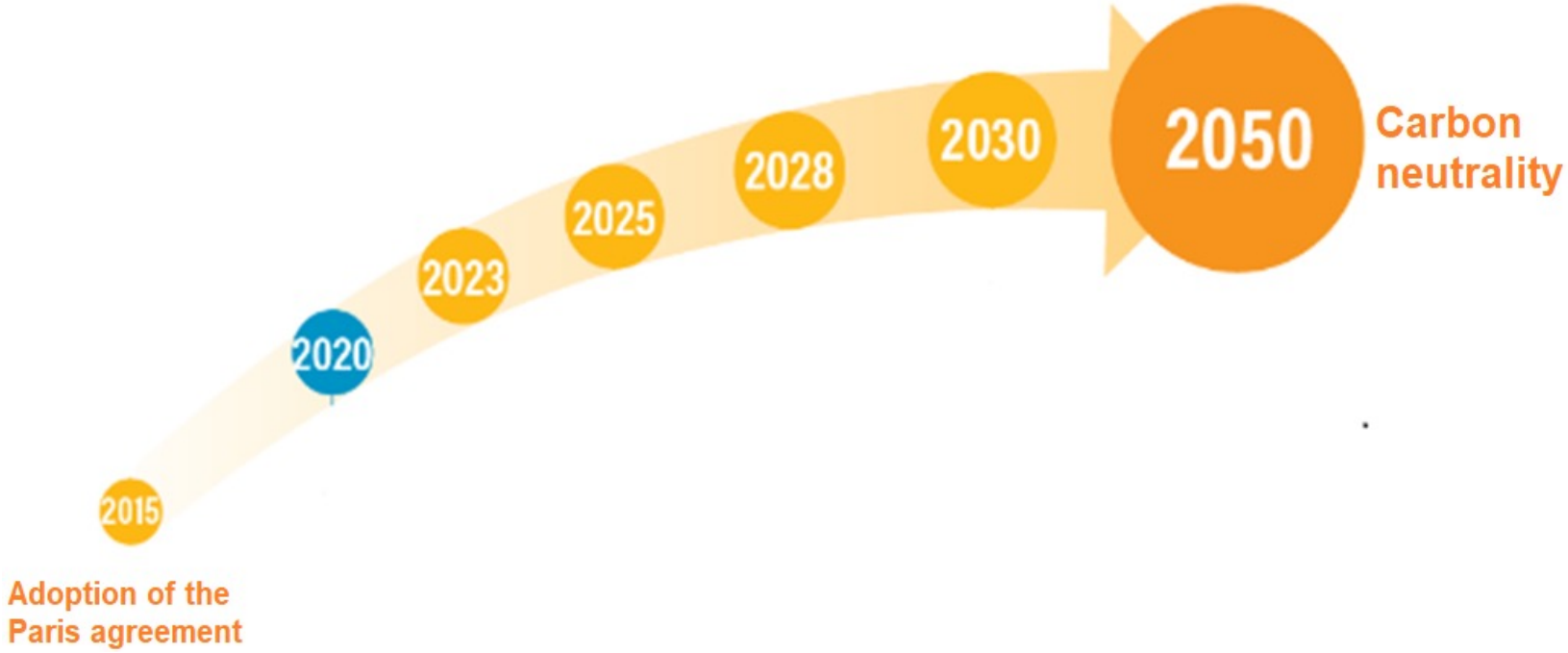
03 The Tunisian green hydrogen strategy

04 Green hydrogen economy benefits for Tunisia

05 A selection of actual green hydrogen projects in Tunisia

01 - Introduction

COP21 Paris agreement - 2015



To achieve carbon neutrality by the year 2050, as stipulated in the Paris agreement, the world economy has to shift away from fossil fuel energy towards renewable sources of energy. This is not going to be possible without a clean energy carrier, which allows to store renewable energy for long periods and transport it over long distances.

Introduction - Green hydrogen

Green hydrogen is the best suited clean energy carrier to attain the carbon neutrality because:

- The worldwide uneven geographical distribution of renewable energy production potentials and demand will make the need to trade RE on a global scale.

Introduction - Green hydrogen

Introduction - Green hydrogen

Green hydrogen is the best suited clean energy carrier to attain the carbon neutrality because:

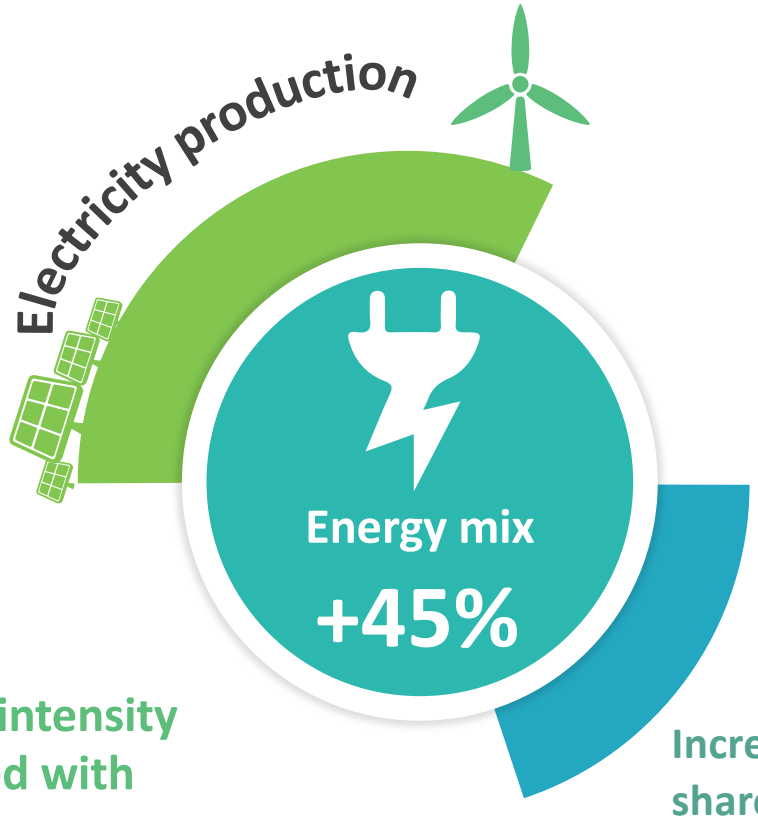
- By increasing the share of intermittent renewable energy in the electricity mix, it becomes more and more challenging to balance the temporal and spatial mismatch between the demand and the supply.

Green hydrogen is the best suited clean energy carrier to attain the carbon neutrality because:

- It will make the decarbonization of the so-called hard to abate sectors possible, which is an indispensable condition to achieve the carbon neutrality by the year 2050.

Introduction - Green hydrogen

Tunisia's energy transition main targets



Carbon footprint reduction

+45%

Reduction of the carbon intensity by 45% in 2030, compared with the reference year 2010 (currently 30Mt CO_2/y)

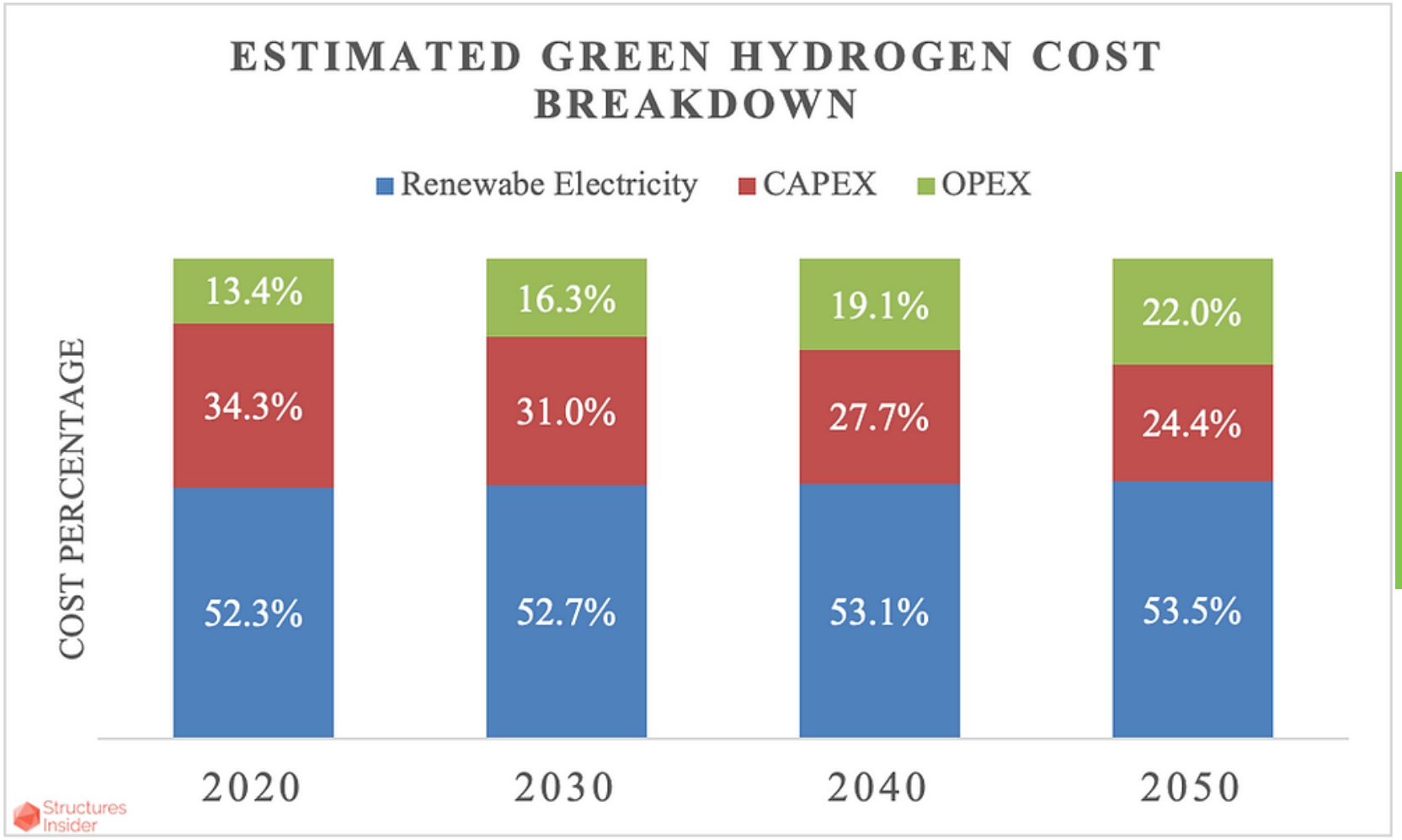
Energy demand reduction

-30%

- 30% reduction in primary energy demand compared to a trend scenario by the year 2030.

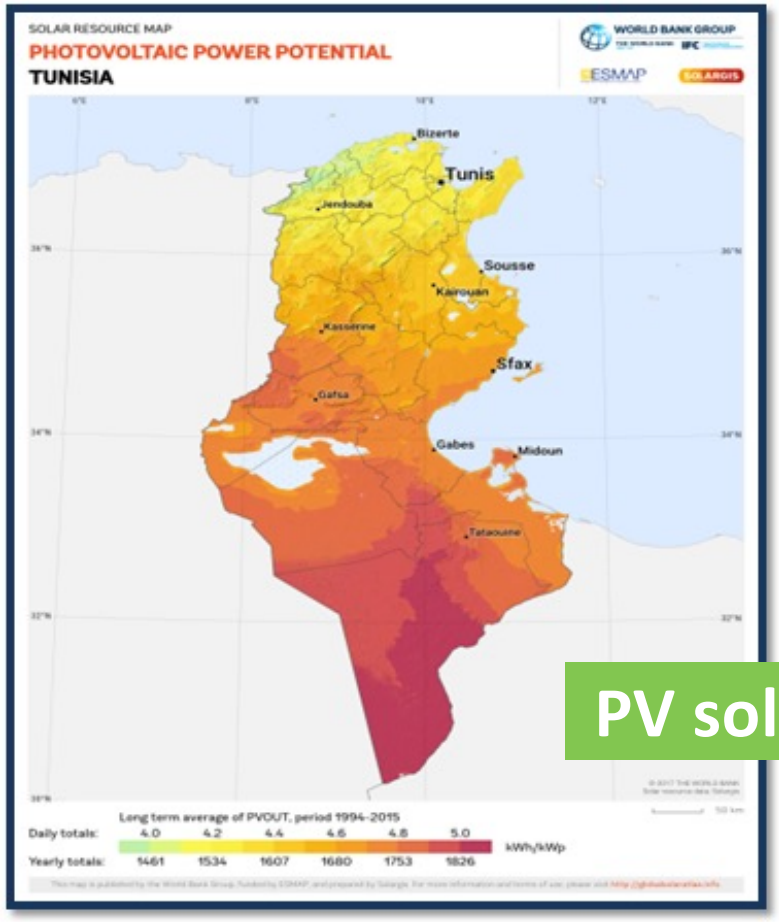
Increase of renewable energies share in the electricity generation mix up to 45%, by the year 2030 (actually 20k GWh/y)

02 – Tunisia’s RE and GH_2 potentials



The electricity is accounting for more than 50% of green hydrogen production cost, which means that only countries with abundant and cheap renewable energy have the potential to become green hydrogen producer.

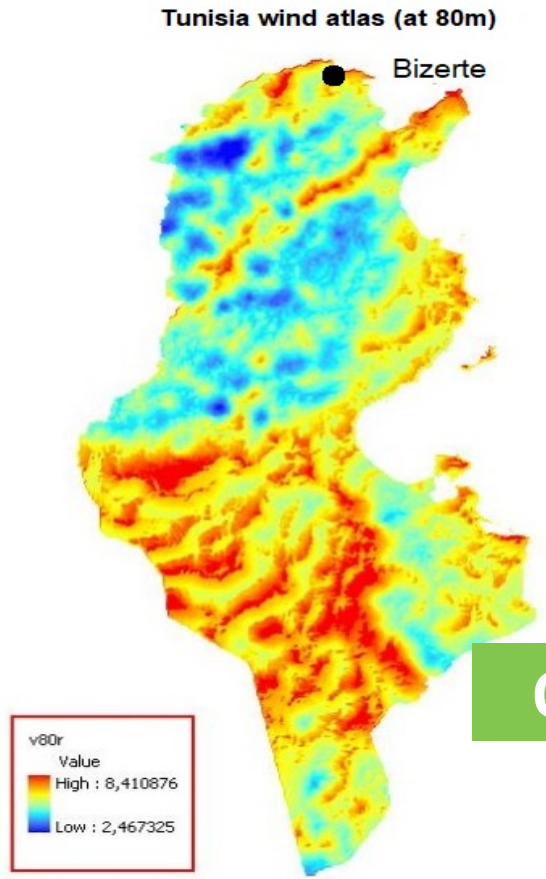
Renewable energy potential



PV solar energy

The exploitable potential of photovoltaic solar energy in Tunisia is estimated at 340-844 GW. The average global horizontal irradiation (GHI) is of the order of 1850 kWh/m² per year, which results in an average production of 1650 kWh/kWp per year (equal to 1650 hours at full power).

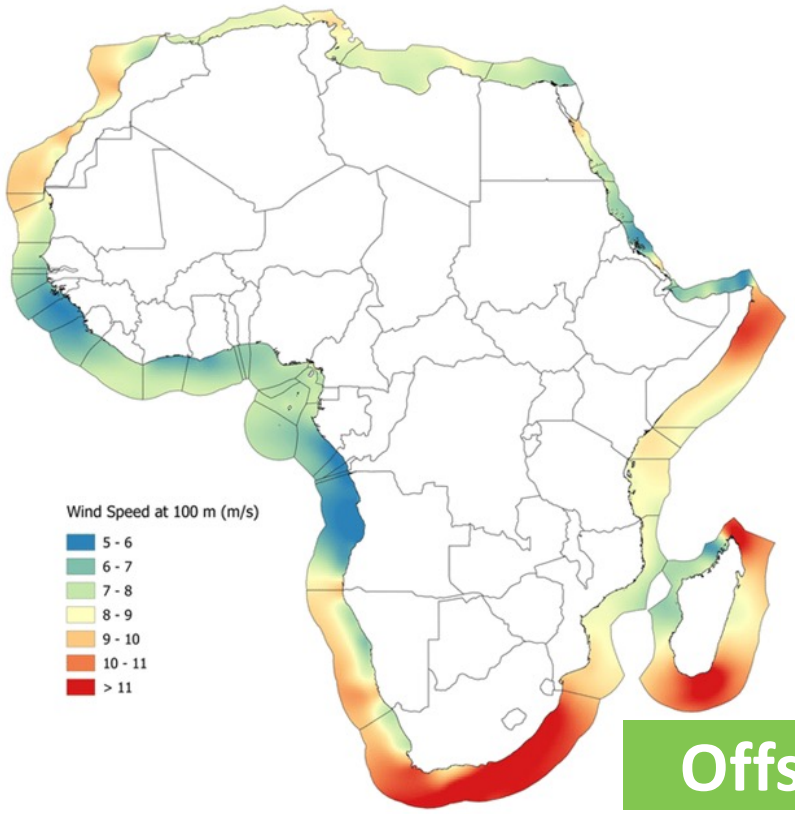
Renewable energy potential



Onshore wind energy

This map depicts Tunisia's wind atlas (at 80m), which identifies the sites with optimal wind conditions for setting up wind farms. The total energy potential for favorable sites in Tunisia is estimated at 10 GW over an exploitable area of 1600 km²

Renewable energy potential

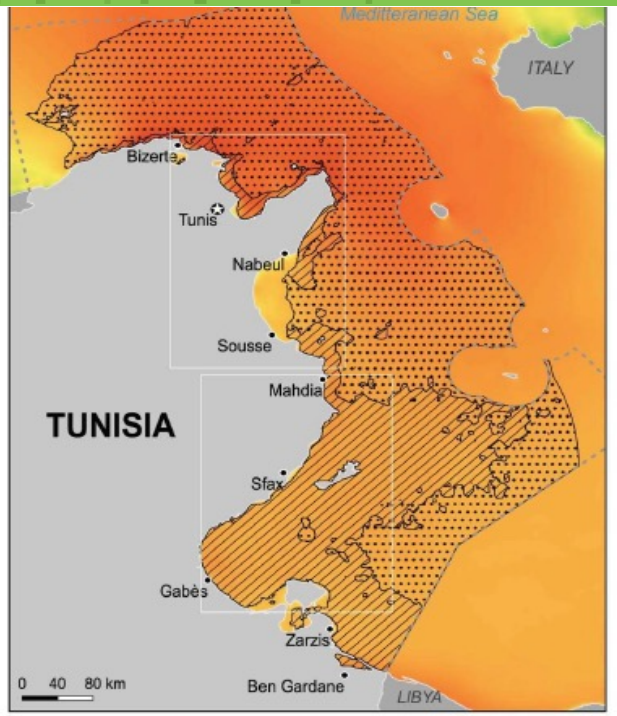


Continental-scale assesment of the african offshore wind potential

The 1700 km long coasts of Tunisia, have the best offshore wind energy resources among all African Mediterranean coastal regions. The total country's potential is estimated at 258GW.

Offshore wind energy

Renewable energy potential

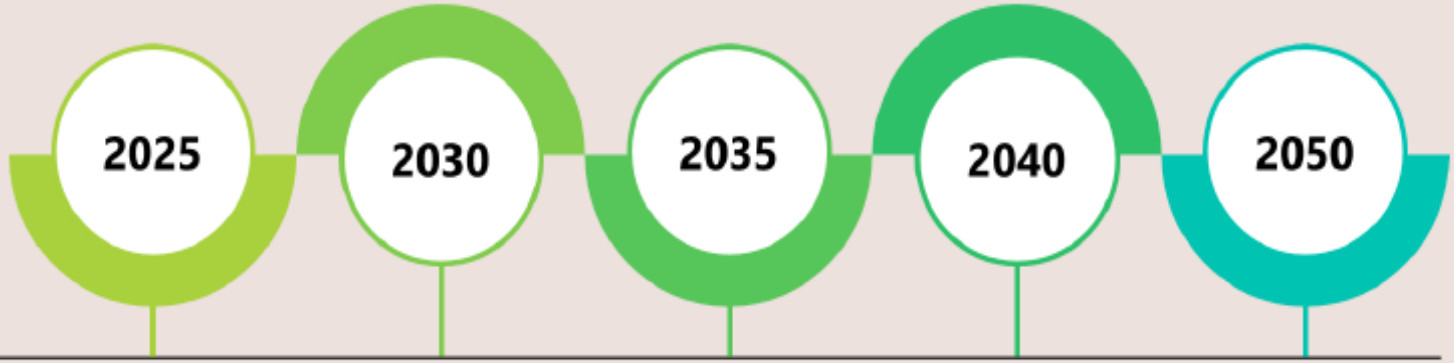


Fixed (water depth < 50m)
Floating (water depth < 1000m)
Exclusive Economic Zone (EEZ)

The continental shelf in the Tunisian territorial waters offer large shallow water areas (<50m) which make them suitable for the cost effective fixed foundation offshore wind turbines

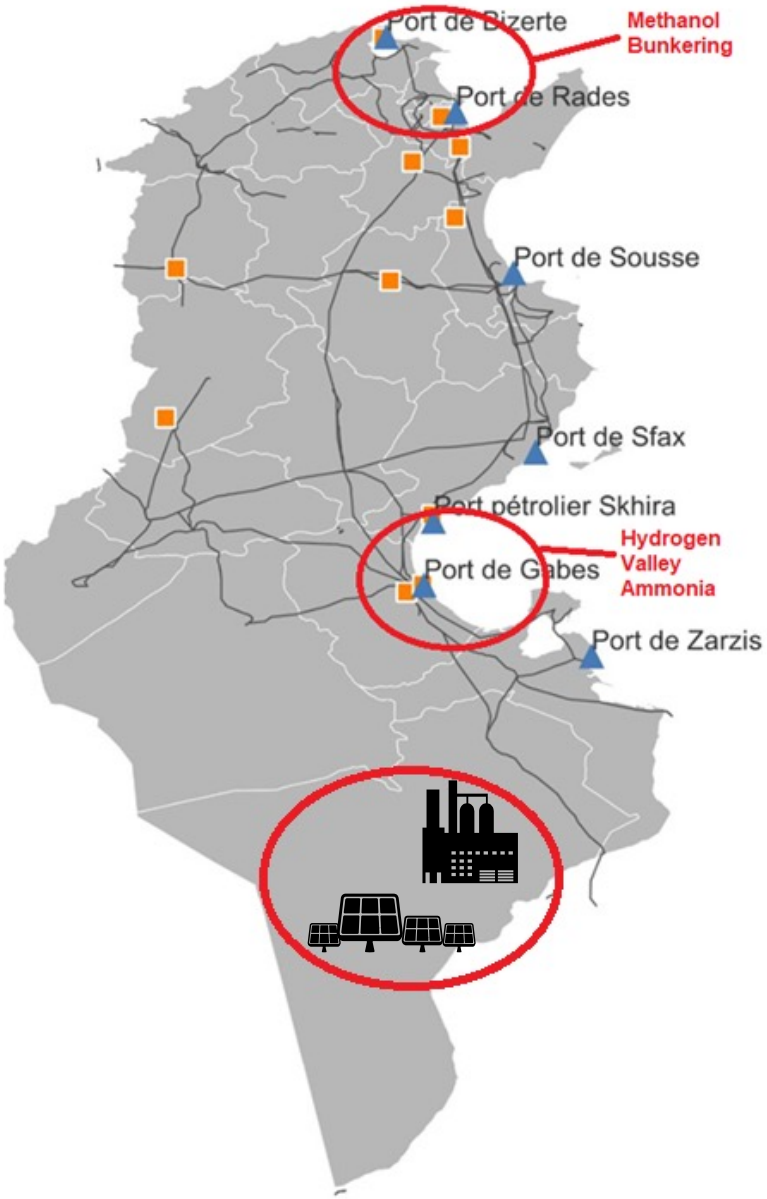
Offshore wind energy

03 – Tunisian national green hydrogen strategy



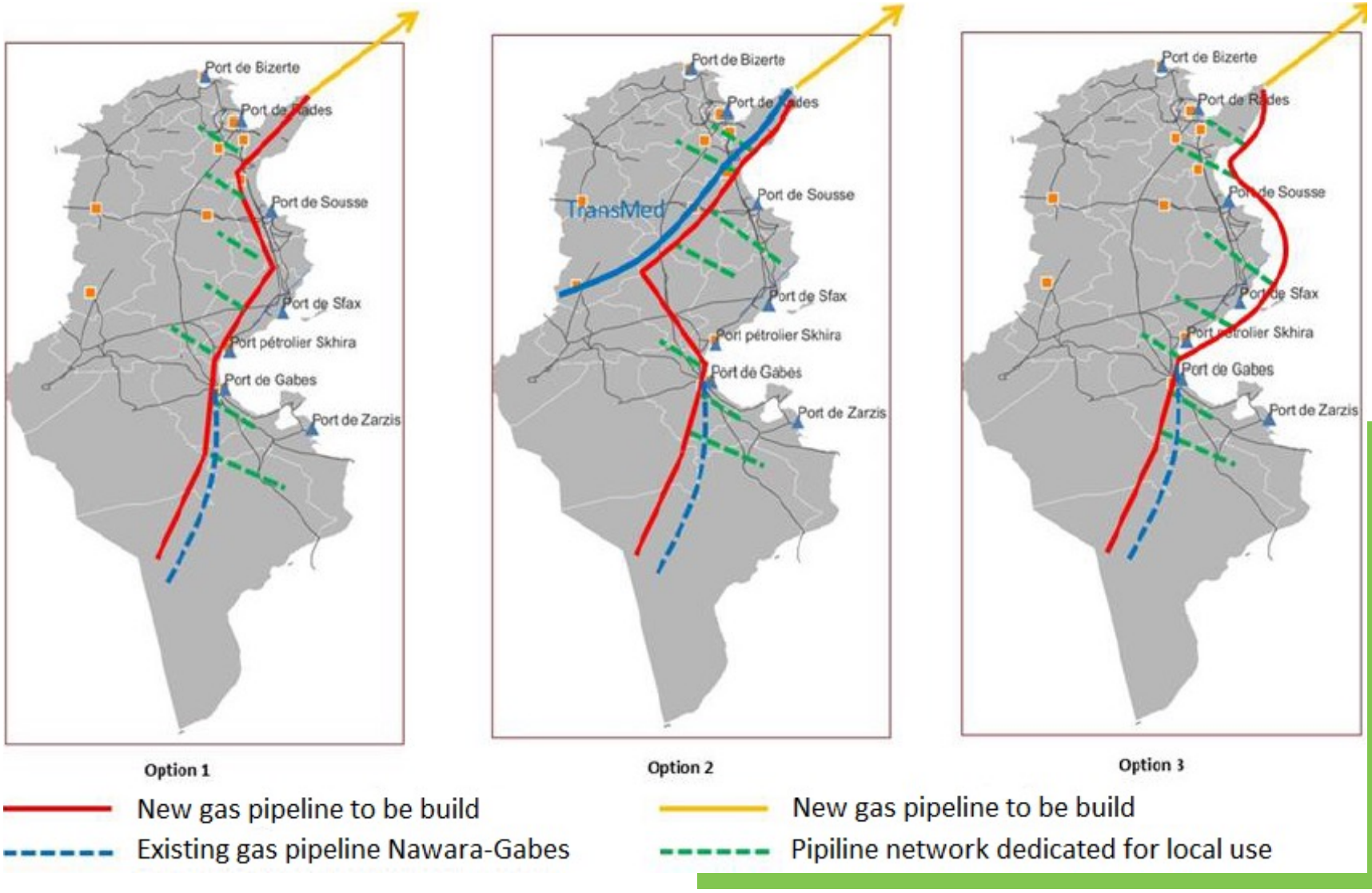
	2025	2030	2035	2040	2050
GH2 production (in Kt)	-	~320	~1 100	~2 100	~8 300 (6 000 export H_2V par pipes)
Electrolyser capacity (GW)	-	3,85	12,9	23,3	86,8
RE capacity (GW)	-	~5	16,4	28,4	~100
Jobs (n)	-	19 000	64 000	116 000	434 000
Avoided emissions (kt CO_2 eq.)	-	217	1 400	4 800	19 000

Tunisian green hydrogen roadmap

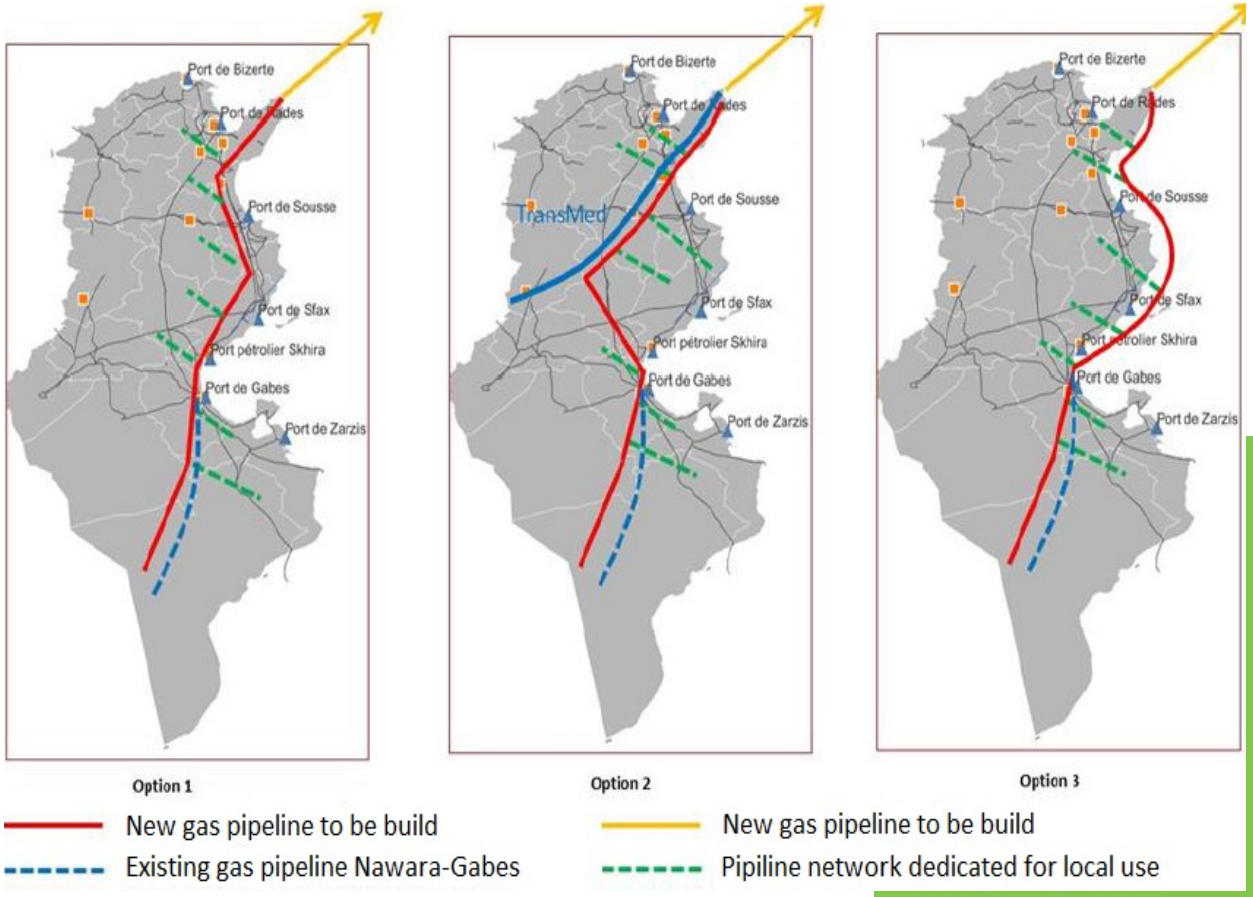


Identification of three hydrogen valleys in special economic zones (SEZ) where supply and demand are concentrated in order to accelerate the economic development of the sector.

GH_2 National strategy

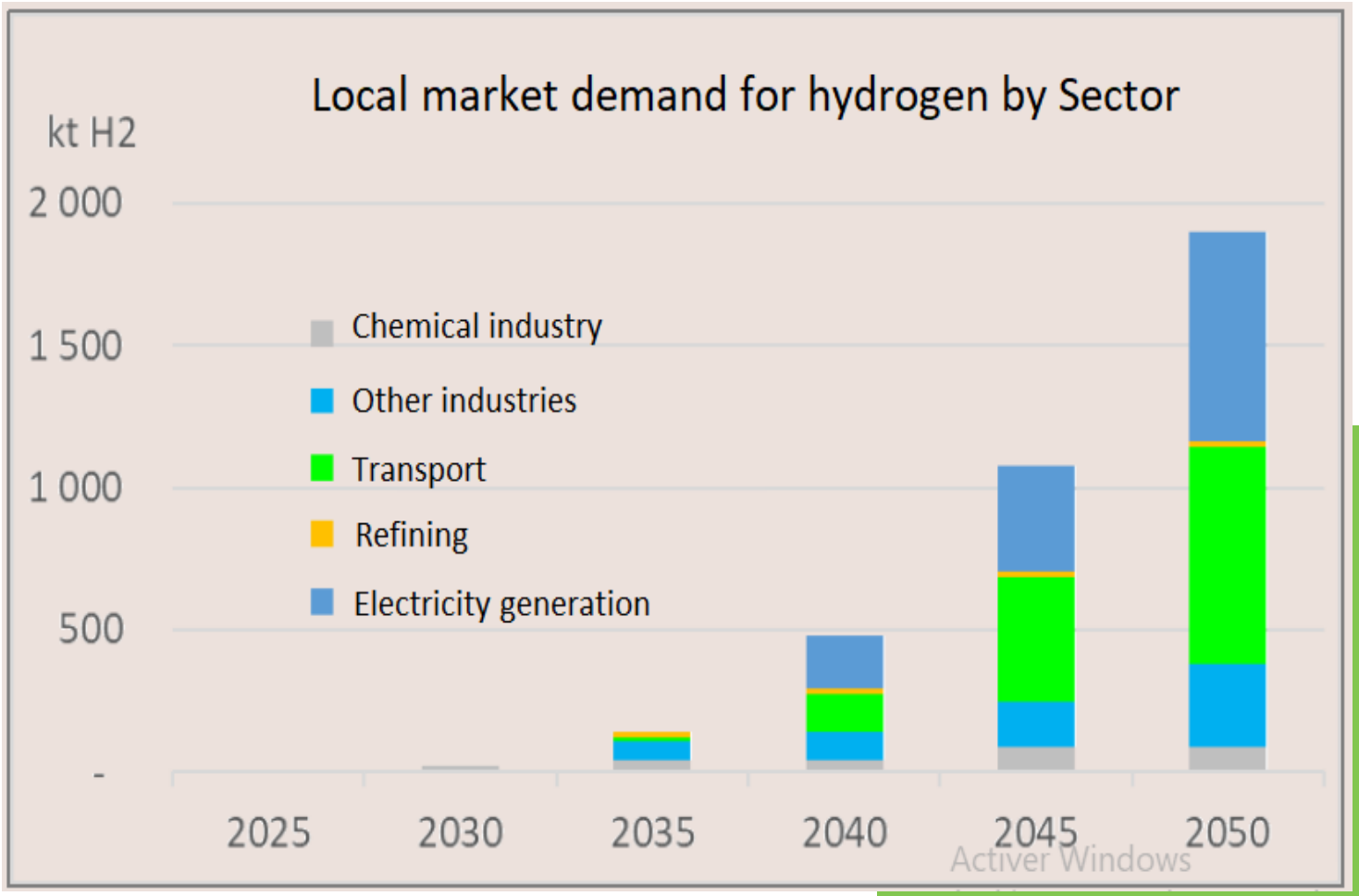


GH_2 National strategy



A new dedicated gas pipeline would be necessary to ensure the collection of GH_2, produced in the south and its transport to the north of Tunisia before being exported to the EU via a submarine pipeline, which will connect the Tunisian and the European hydrogen backbone.

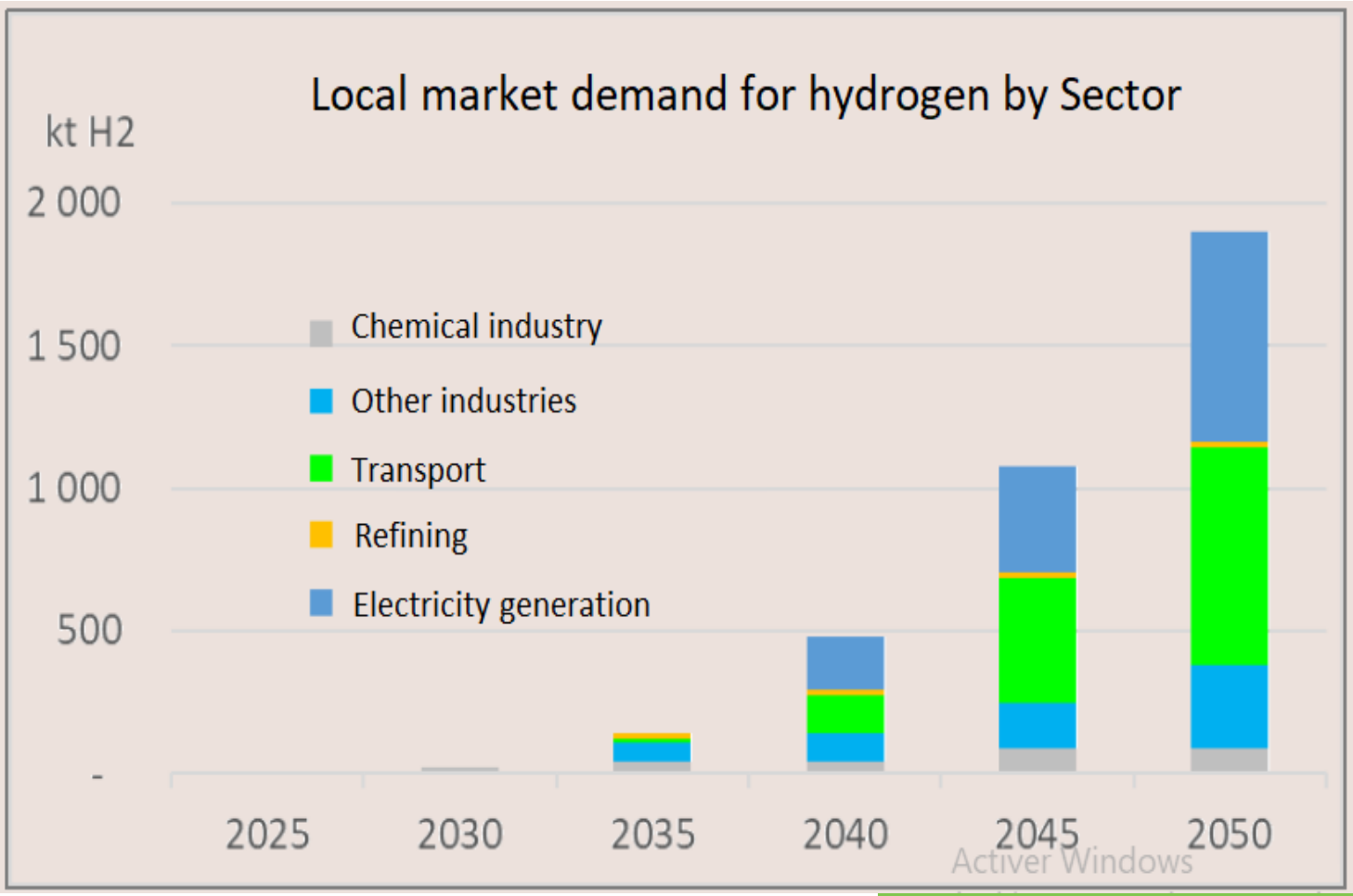
A local distribution pipeline network will be built gradually to ensure the power supply of the local market beginning with the big industrial consumers



The local use of green hydrogen and its derivates is considered as enabler and accelerator for:

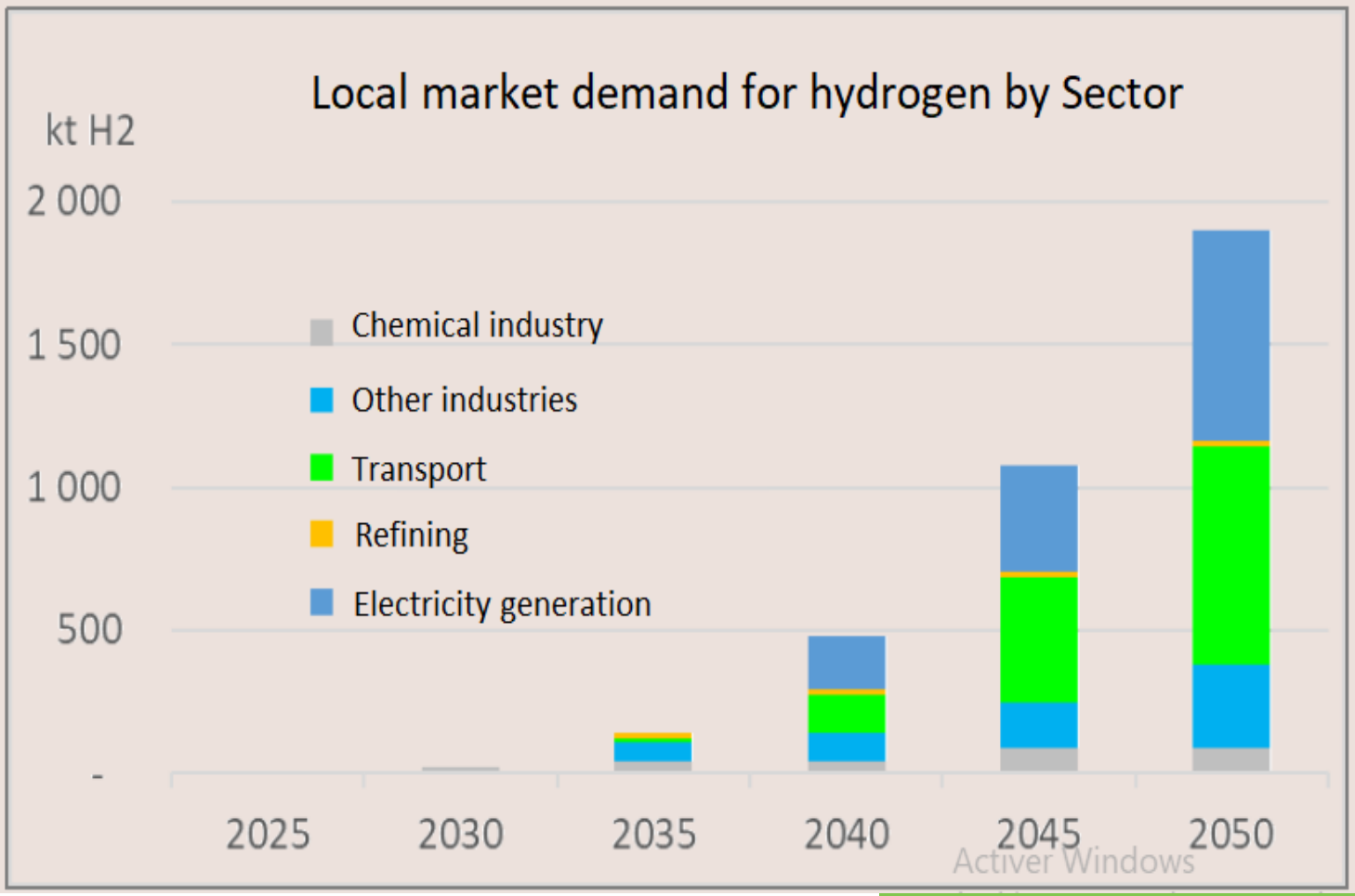
-the Tunisian energy transition towards carbon neutrality ,
-the modernization of the local industry and
- the development of the national economy.

GH_2 National strategy



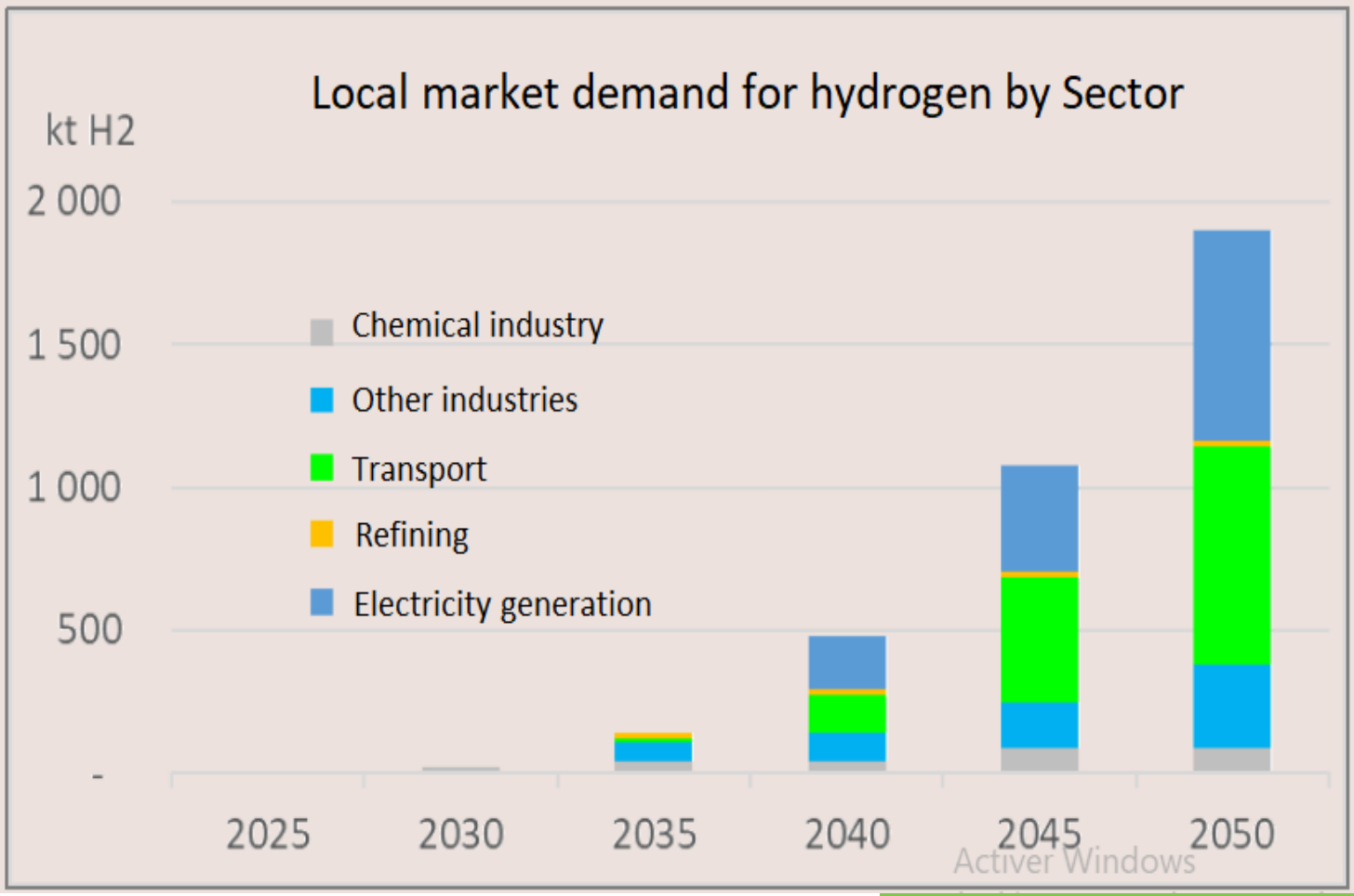
The main prospects for the development of GH2 for the local market are as follow:

1 - The production of green ammonia for the Tunisian fertilizer industry. Tunisia could avoid ammonia imports, currently ranging from 250 – 400 Kt/a, and even become an exporting country by developing a green ammonia industry



The main prospects for the development of GH2 for the local market are as follow:

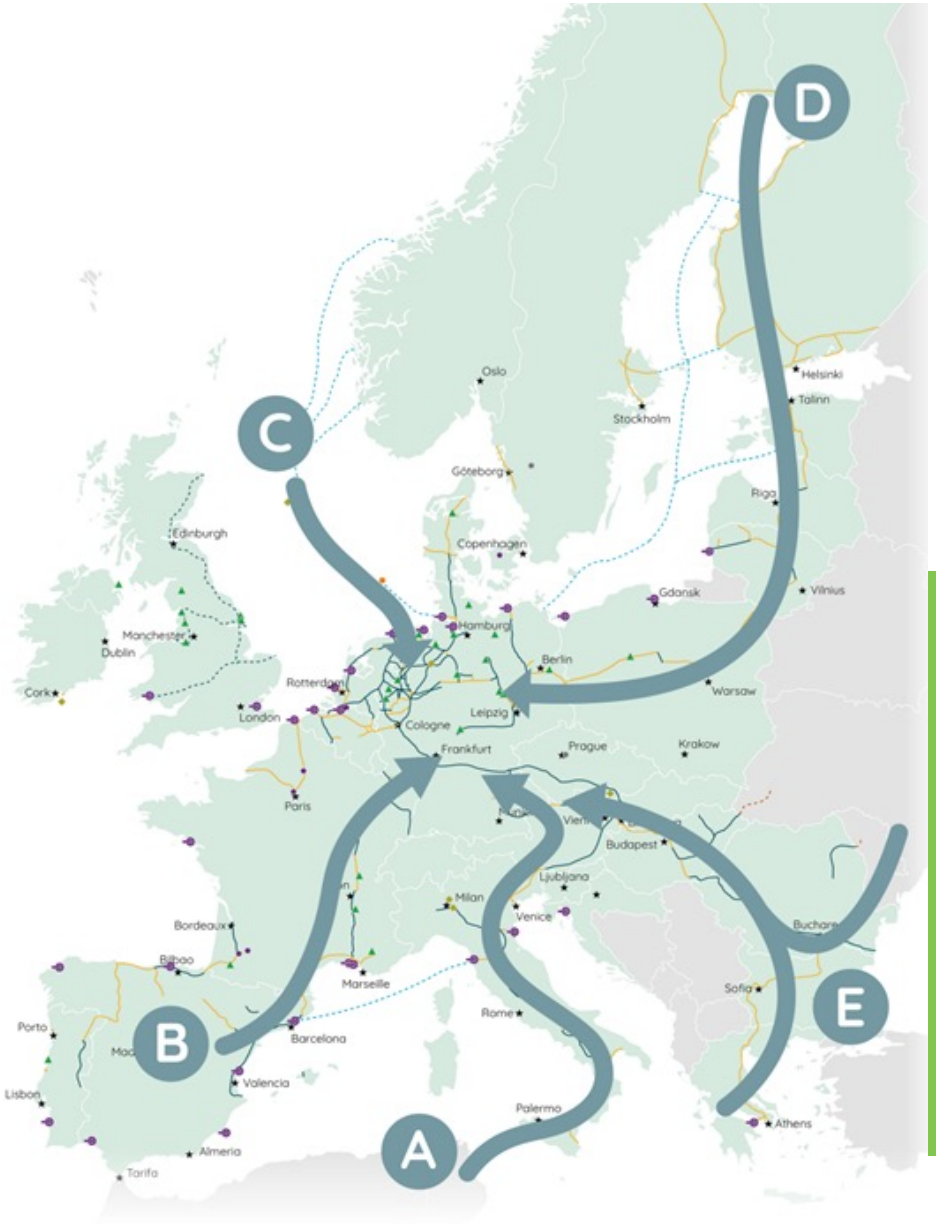
2 – The production of sustainable fuels for heavy terrestrial and maritime transport and for the aviation industry (Sustainable Aviation fuels – SAF)



The main prospects for the development of GH2 for the local market are as follow:

3 - Electricity generation, most of the natural gas turbines of the national utility company – STEG are hydrogen ready. GH2 could therefore replace partially the 4000 Ktep consumed currently to produce electricity

GH_2 National strategy



In addition to the local use, the export of green hydrogen and its derivates is also considered as a main driver for the Tunisian economic and industrial development. Europe's imports will rise up to 10Mt in 2030 and 40 Mt in 2050. In the European green hydrogen strategy, Tunisia is considered as a main supplier for the EU, via the corridor A.

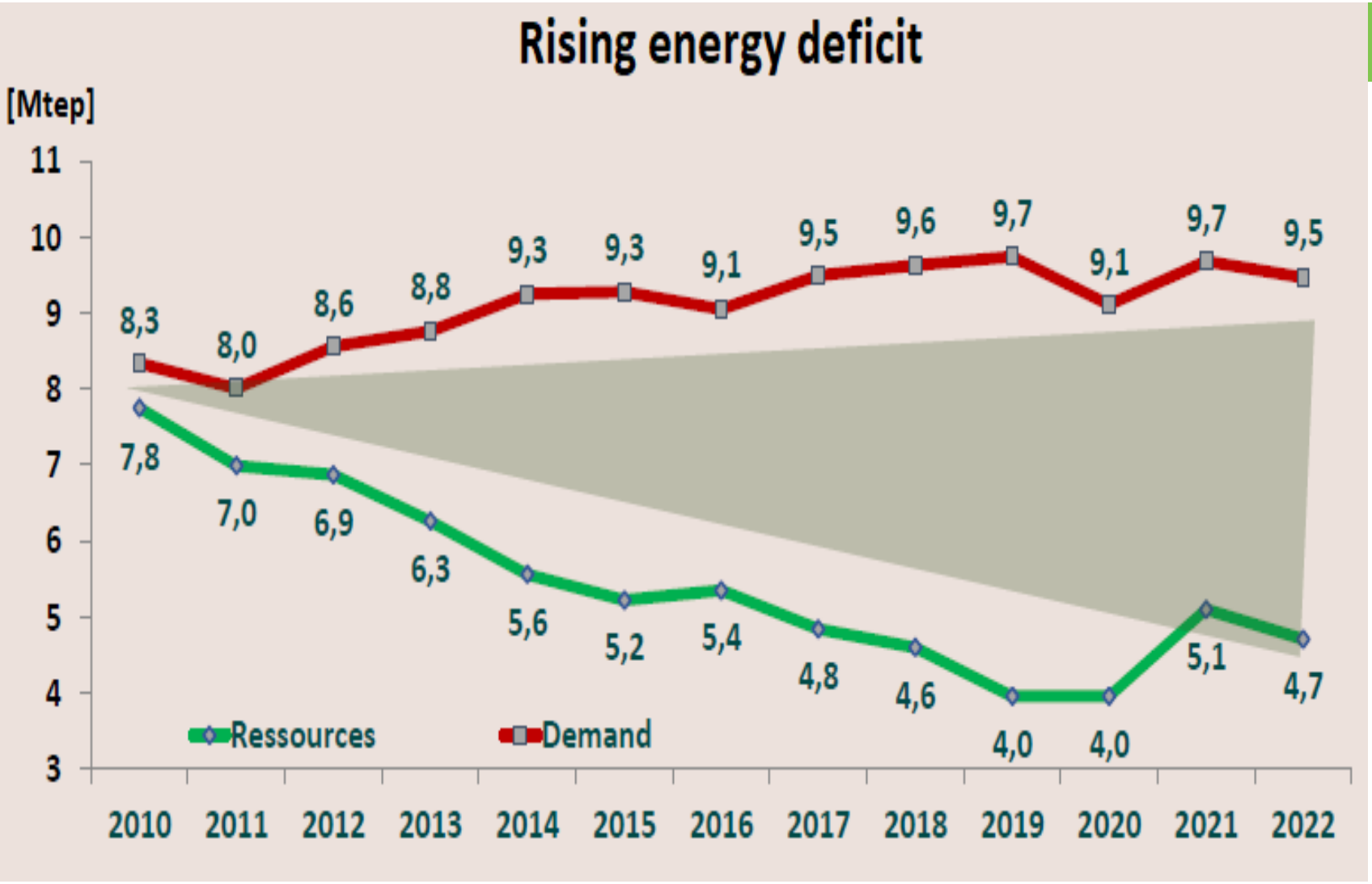
04 – Green hydrogen economy benefits for Tunisia

TUNISIA'S GREEN HYDROGEN POTENTIAL

8 -10 Million tons production capacity

6 – 8 Million tons for export

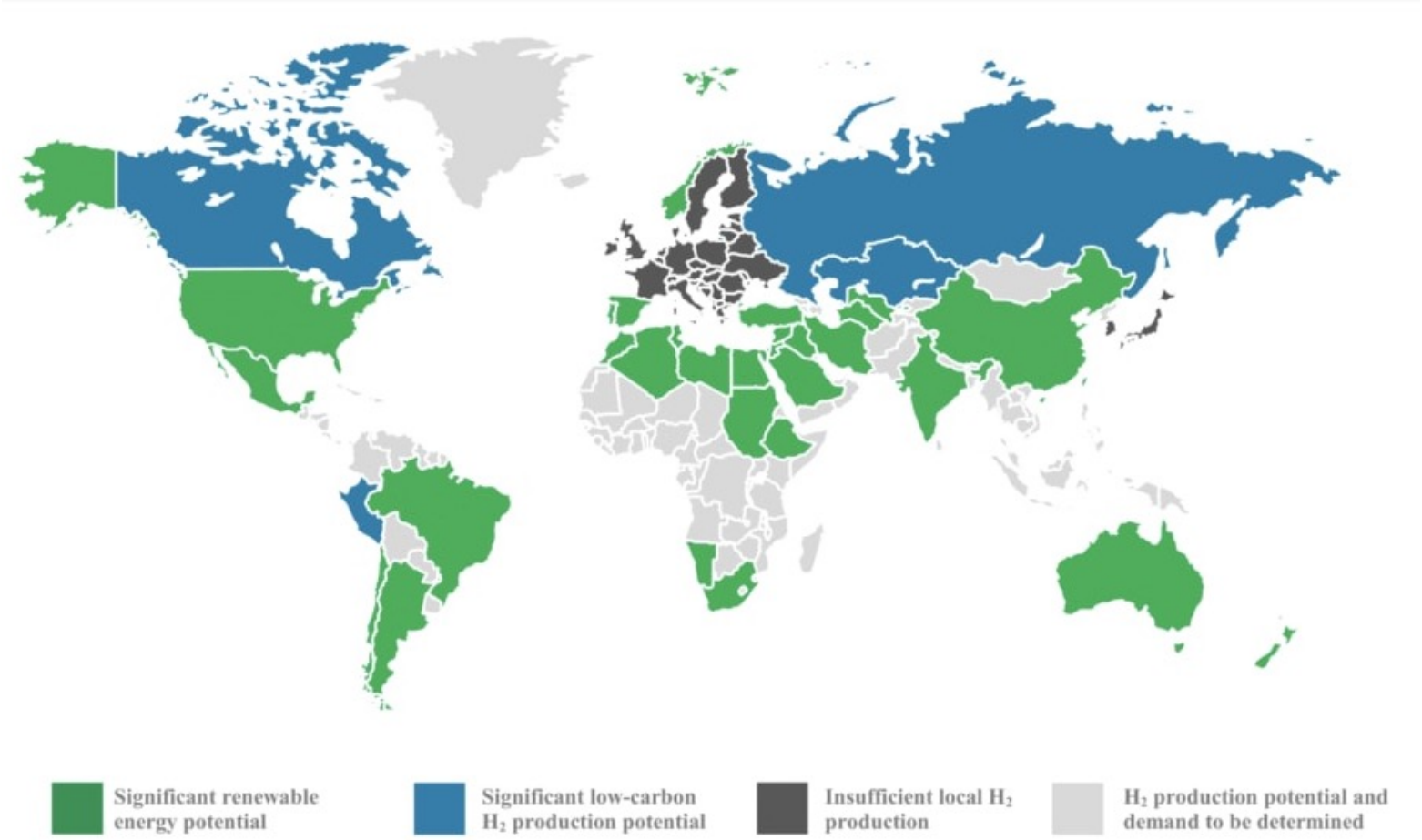
2- 4 Million tons for local use



The massive use of RE and GH2 could tackle effectively the rising energy deficit

Energy balance

During the last decade the energy deficit has risen to the tenfold. Therefore, Tunisia is compelled to resort massively to imports in order to cover almost half of its energy needs, a situation which undermines markedly its energy security. In Tunisia, energy subsidies represent 58% of development expenditure, 13% of the state budget or 3.7% of GDP.

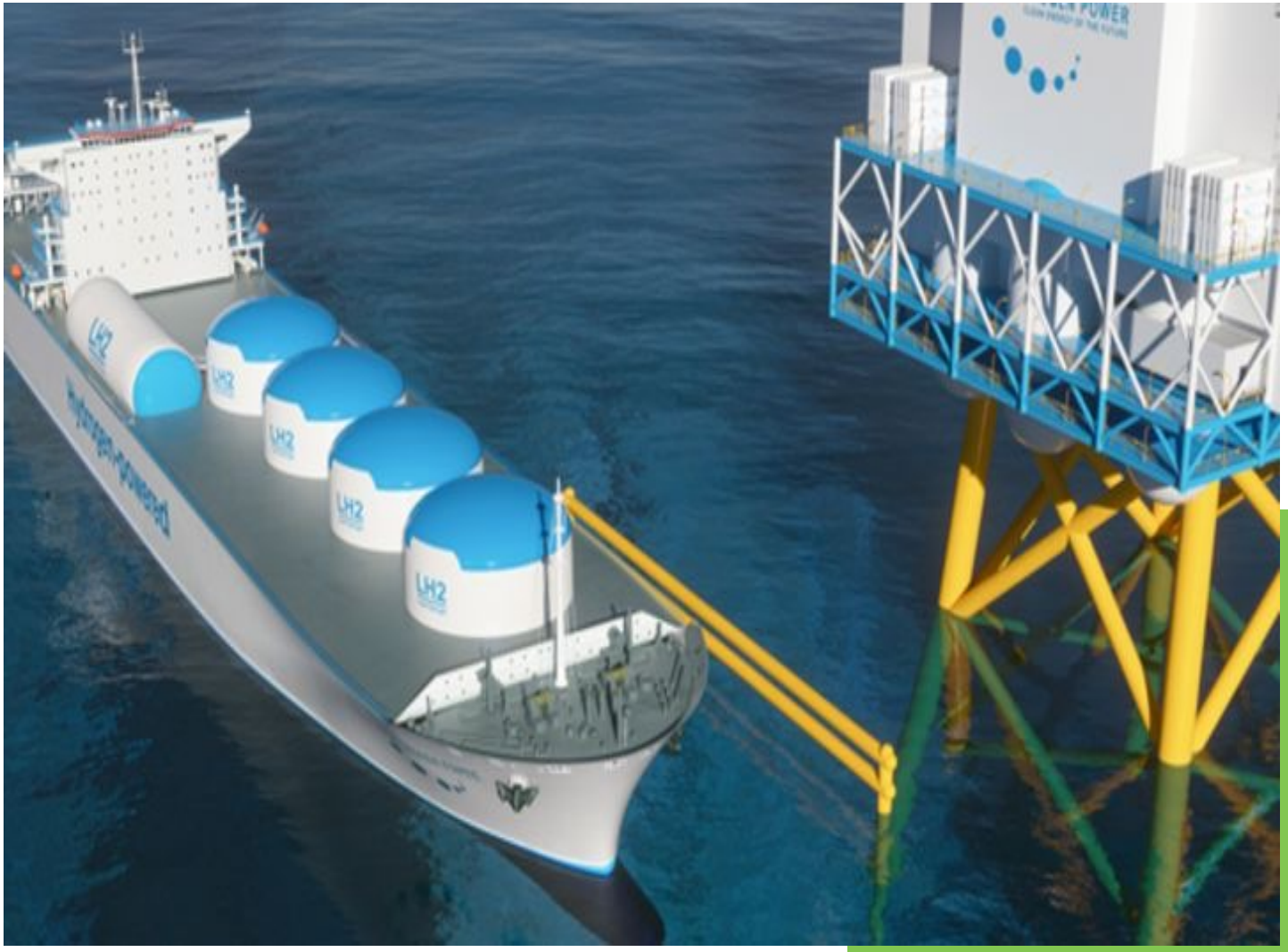


Location advantage

Proximity to EU

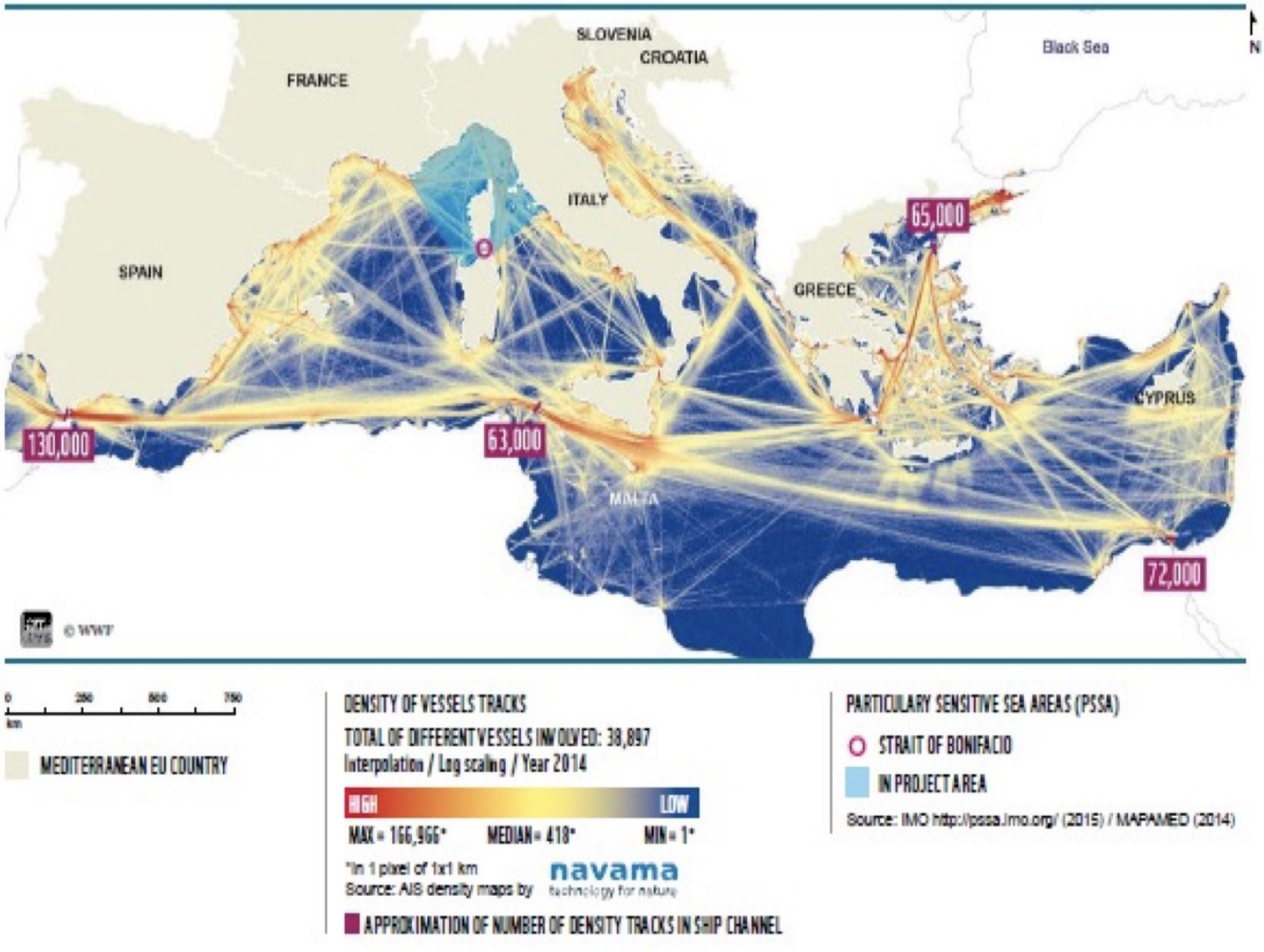
The proximity to Europe, which is one of the most mature and demanding markets for green hydrogen and derivates worldwide, allows Tunisia to export via pipelines. This mode of transport remains unbeaten from the point of cost, sustainability and reliability and therefore constitutes a significant competitive advantage for Tunisia to become a major green hydrogen producer and supplier for EU.

The benefits of green hydrogen



The financial manna coming from the export of green hydrogen and its derivates is considered as a main driver for economic and industrial development since it will provide Tunisia with the ressources to overcome its budgetary difficulties, to decarbonize its economy, to modernize its industry, etc.

The export of green hydrogen and derivates could be made by LH2 or LOHC tankers



The Mediterranean Sea is one of the busiest waterways in the world accounting for more than 20% of the world's water-borne trade. More than 150,000 ships pass through the Straits of Gibraltar and the Suez canal carrying over 900 million tons of cargo.

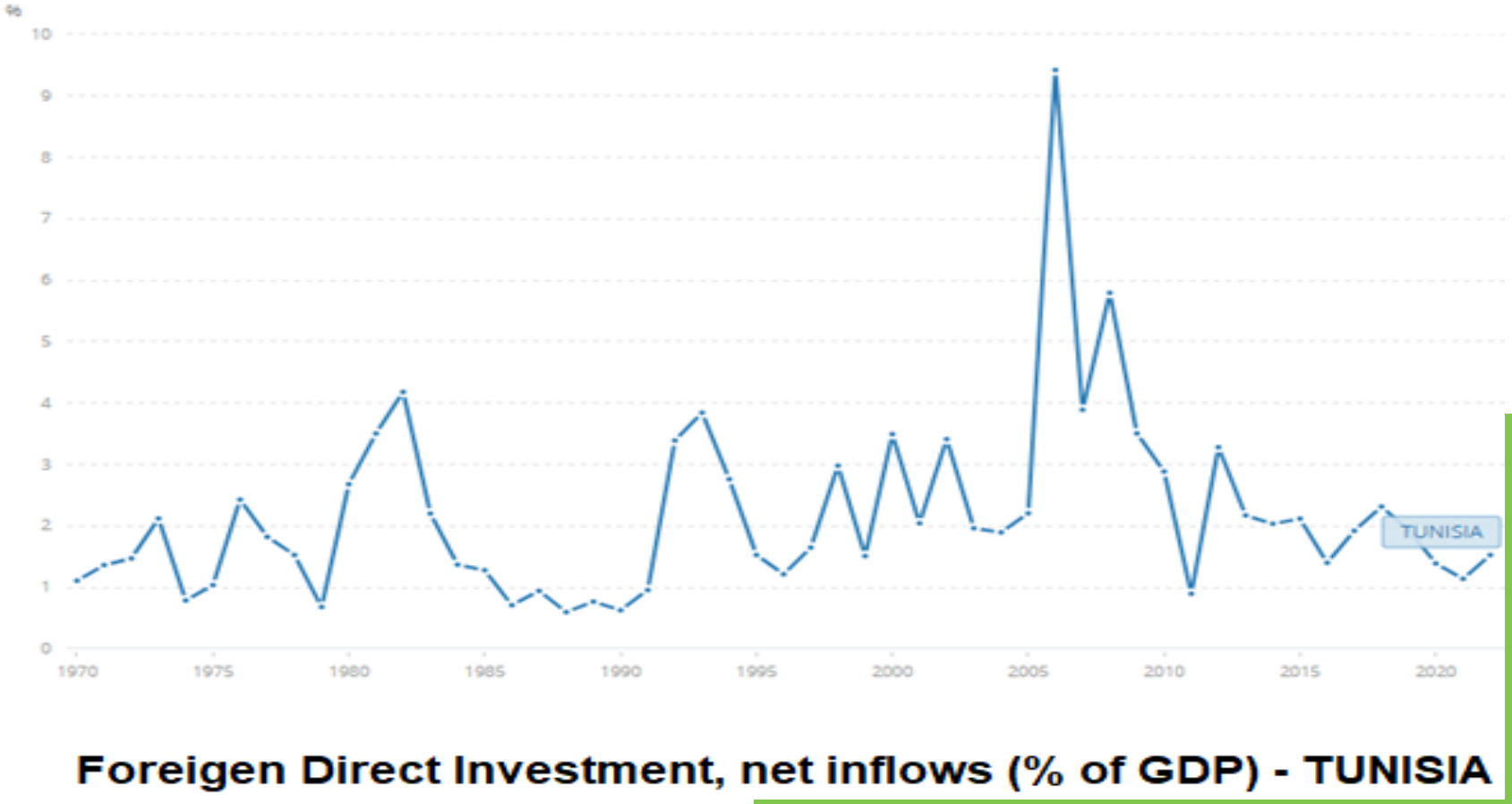
One of the major sea routes in the Mediterranean "Sicily strait" passes by the doorsteps of the Tunisian city of Bizerte, which makes this location very interesting to setup a global green hydrogen bunkering station.

The benefits of green hydrogen

The benefits of green hydrogen

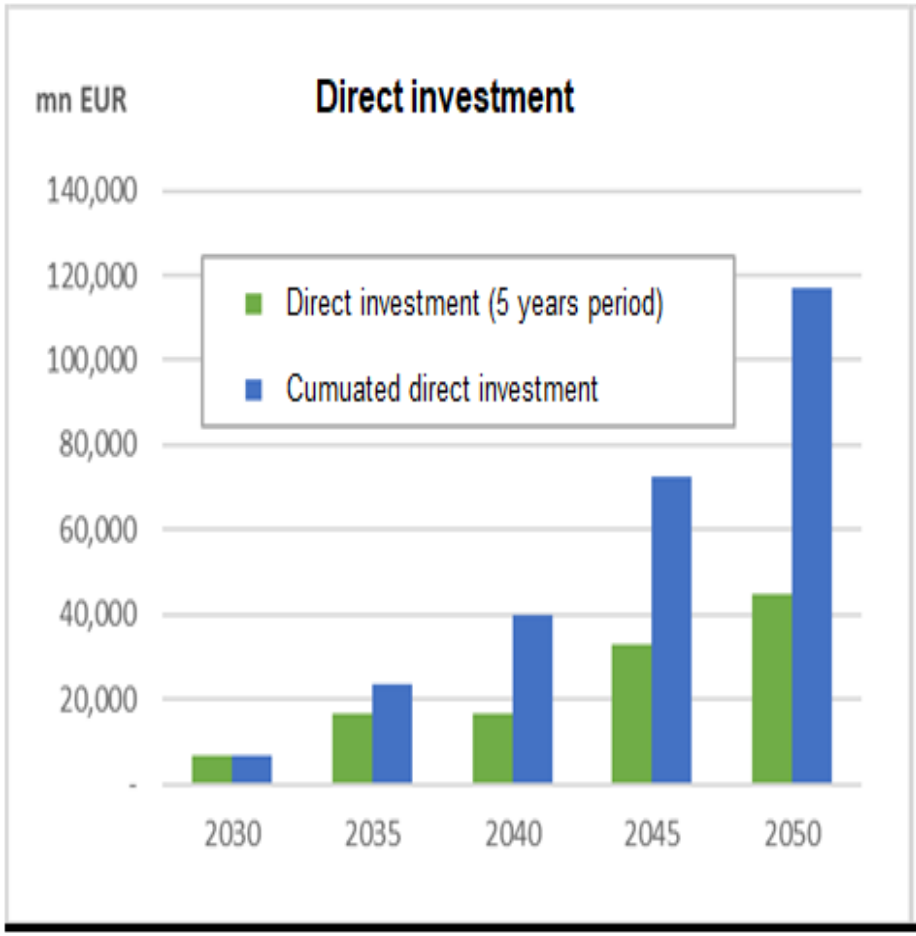
Setting up a bunkering station in the north of Tunisia would mean exporting green hydrogen at no transport costs.

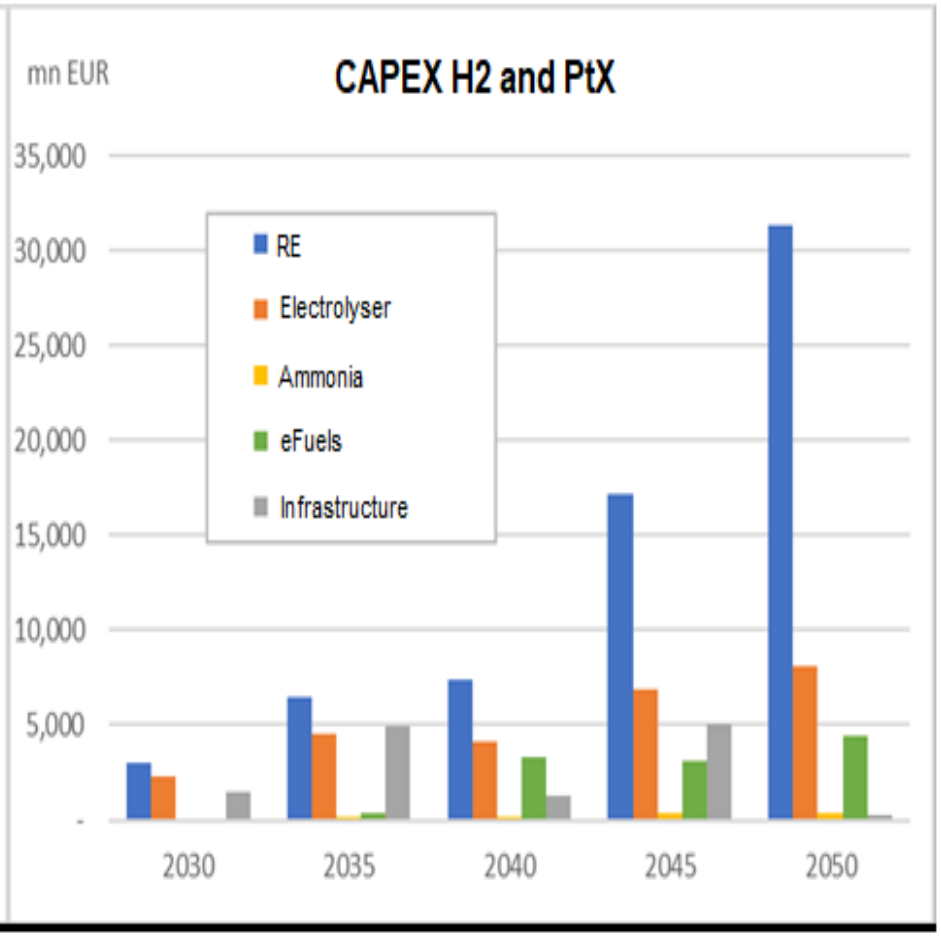
The benefits of green hydrogen



Foreigen Direct Investment, net inflows (% of GDP) - TUNISIA

The political and social instability in recent years, Foreign Direct Investment in Tunisia's economy have declined markedly. The investment in the new green hydrogen economy will boost foreign investment (15b€/MtH2)





The benefits of green hydrogen

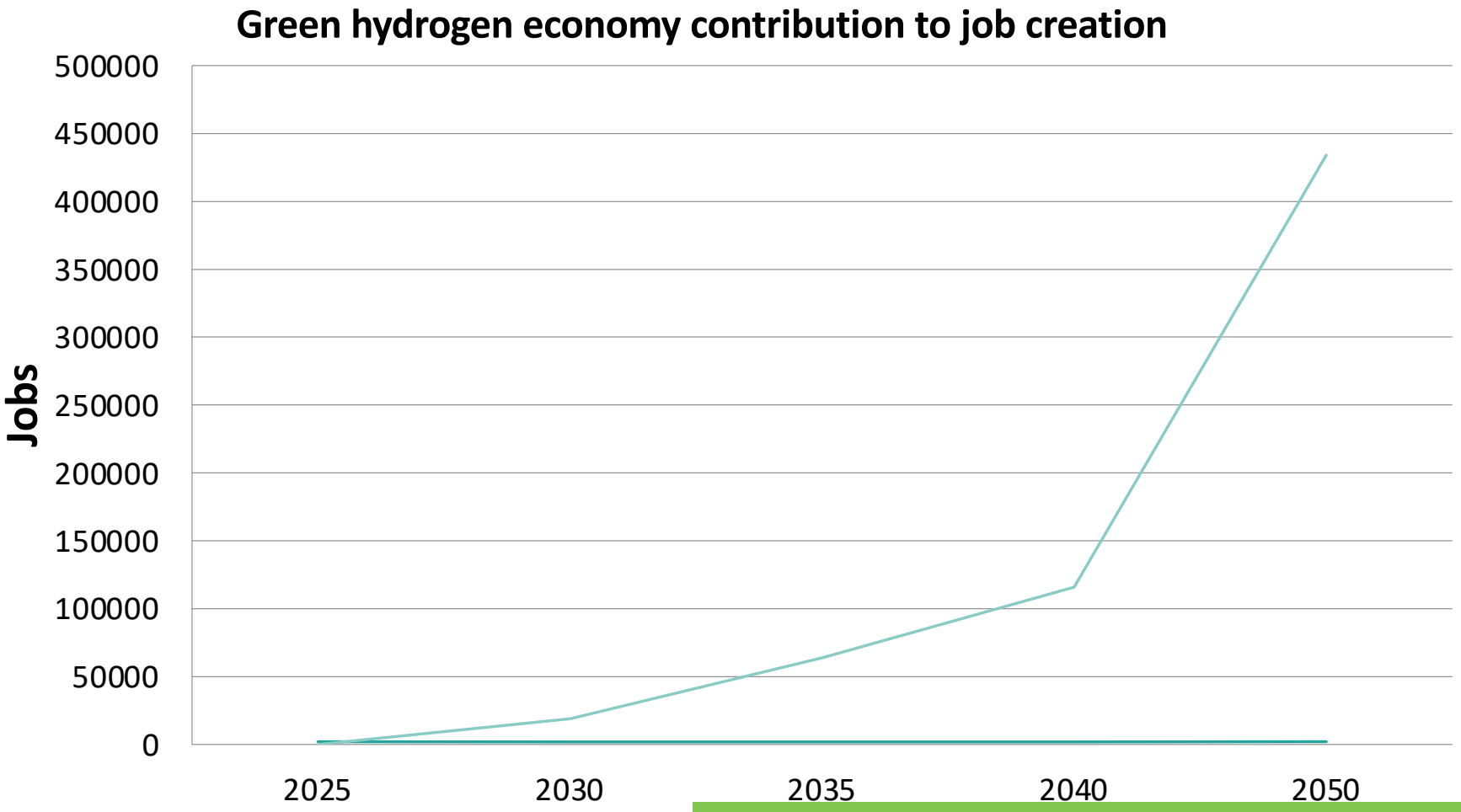
The development of the green hydrogen sector will contribute to attract much needed foreign capital to revitalize the Tunisian economy since most of the projects will be financed by Foreign Direct Investments. They are presented here in terms of cumulative total until 2050.

JOB CREATION ECONOMIC GROWTH

The benefits of green hydrogen

In Tunisia 1% of economic growth can create 10 – 40 k jobs

The benefits of green hydrogen

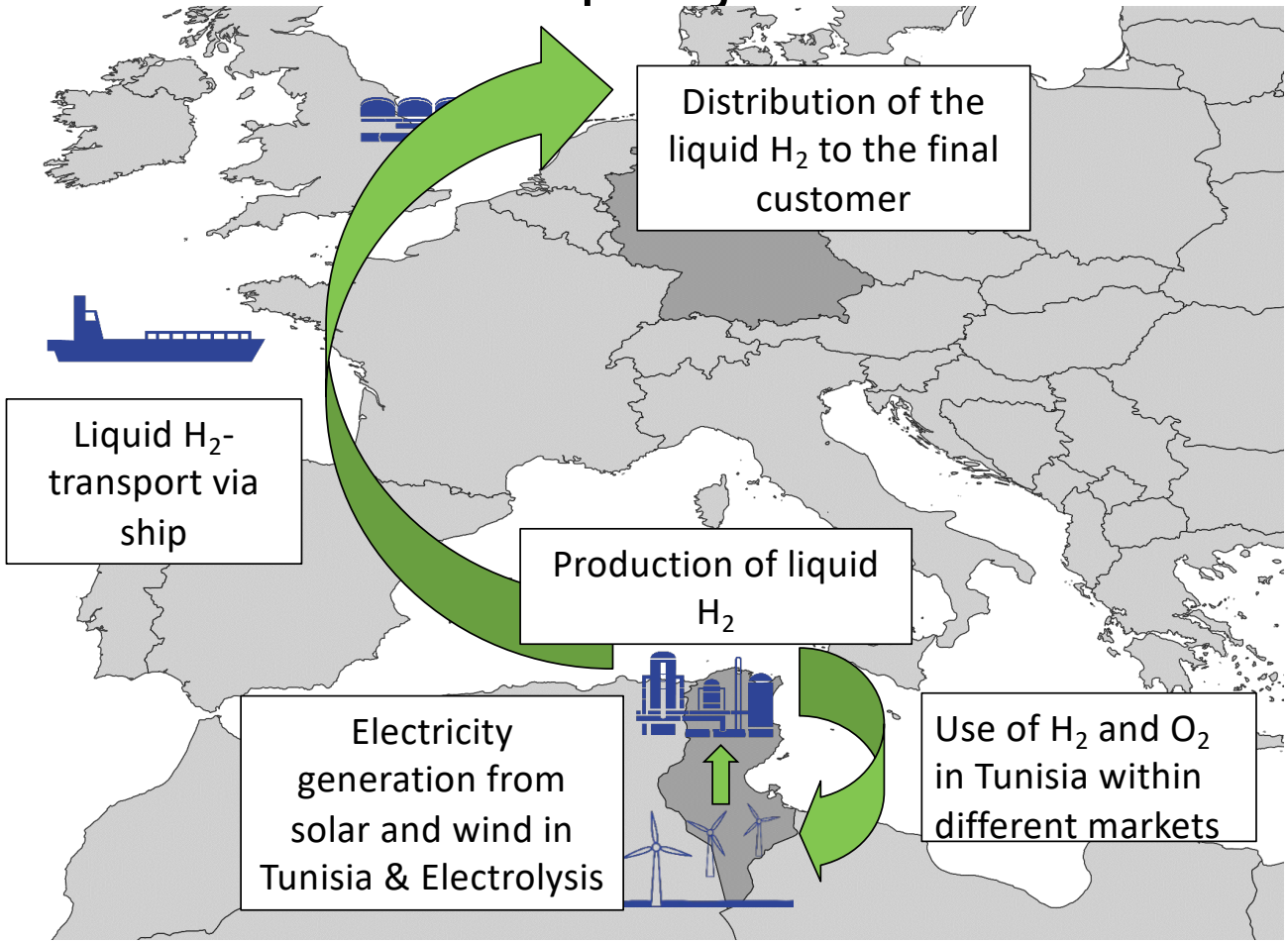


According to the national green hydrogen strategy, up to 450K jobs will be created

05 – Selection of actual green hydrogen projects

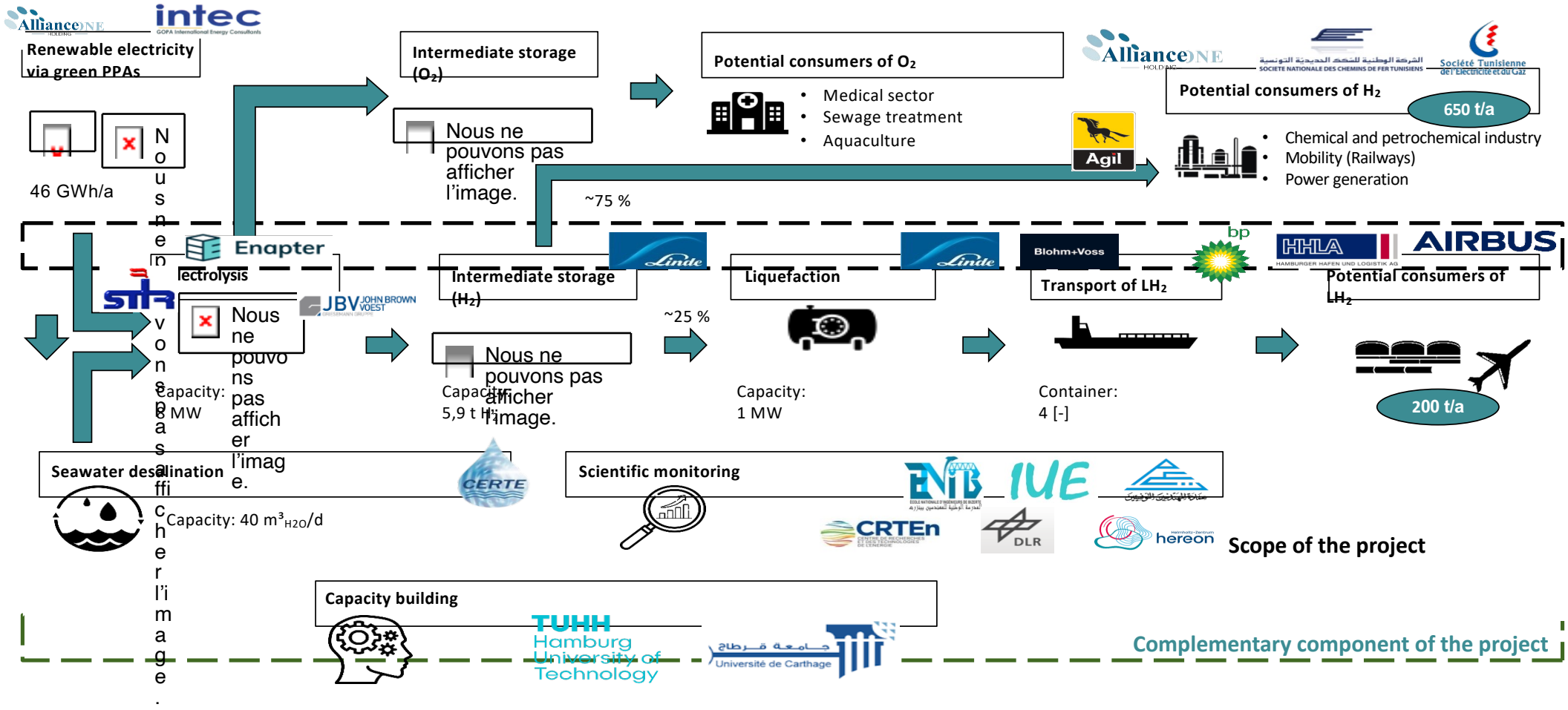
Pilot project Bizerte - Hamburg

Key components of the project



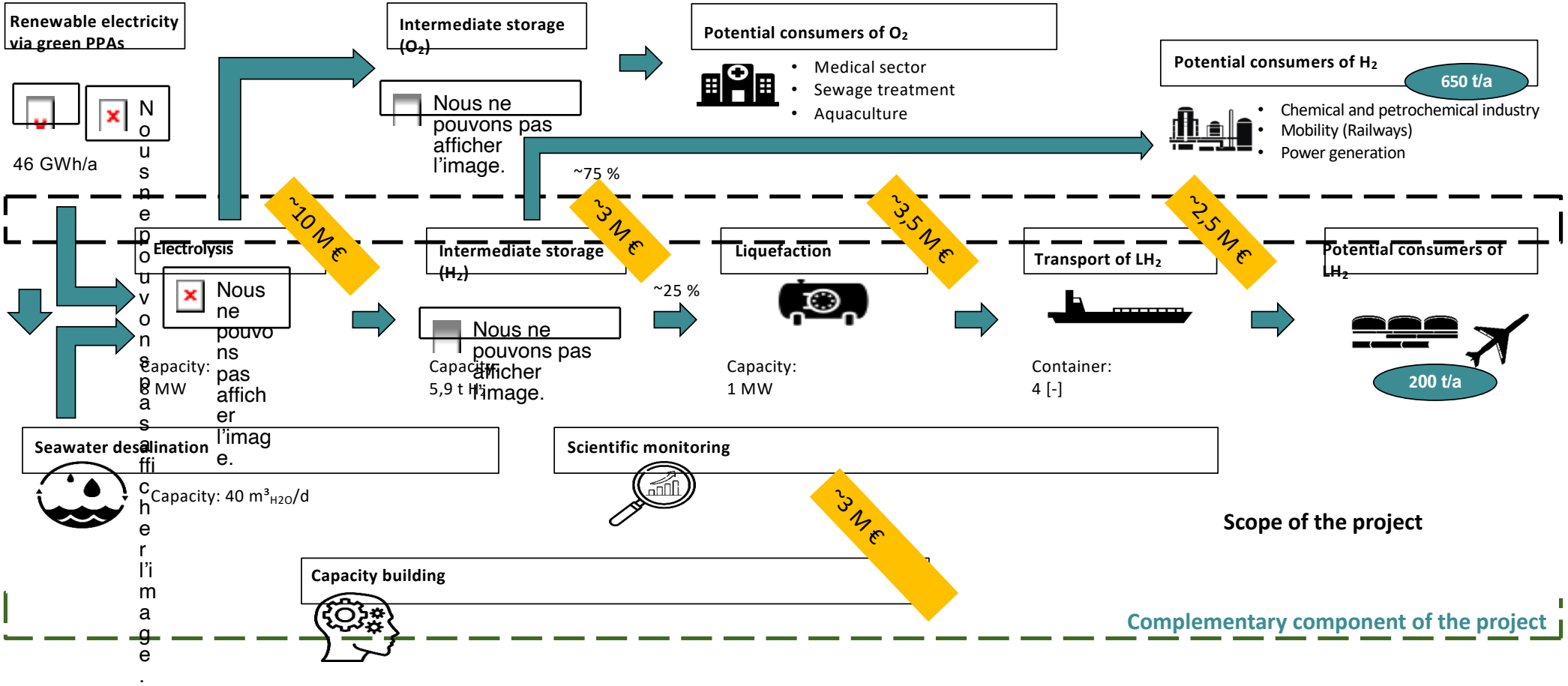
Capacity Building & Scientific Monitoring

Project concept – General overview



Project concept – Estimation of investment cos

If KfW provides funding, a total of 22 million euros will be available for the construction and operation of the plant, with a further 3 million euros for capacity building.



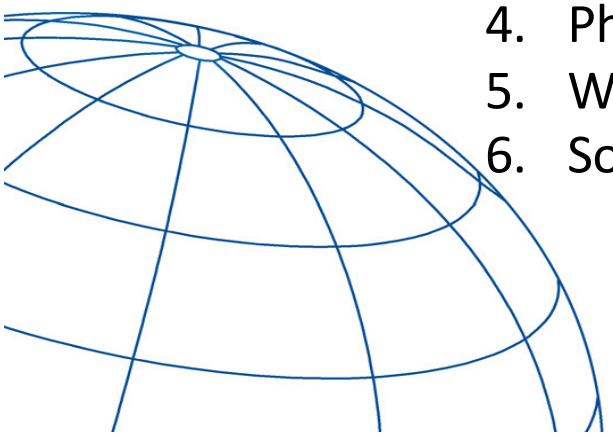
TESCO
Consulting for Sustainable Development Engineering

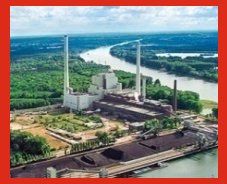
TÜVRheinland CERTIFIED
Management System
ISO 9001:2015
ISO 14001:2015
Valid until: 2023-05-04
www.tuv.com
ID 9000005913

INTEGRATED GREEN PROJECT

(Investment 10 billion $ / Jobs up to 17000)

1. Phosphate Extraction and Enrichment Industrial Complex Sra Ouerten including green ammonia production (Production 6 million tons /year Phosphate and derivates)
2. Cement Fabrik – Béja (1 million ton of Clinker or 1.2 million tons of cement/year); *'Dry Process'*, a green technology)
3. Multipurpose ECOPORT Sabra marine terminal – Bizerte
4. Photovoltaic power plant (600MWp)
5. Water disalination 110 million m^3 / year
6. Solar Street-lights International






H2


AMMONIA

Tunisian Green Hydrogen Society

Thank You for your kind attention

chokri.aslouj@gmail.com