Aged Offshore facilities at the service of Energy Transition

Offshore CO_2 & H_2 Handling & Transportation

Workshop: “Risorse abiotiche marine: attualità e prospettive”

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martedì 15 marzo 2022

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Introduction

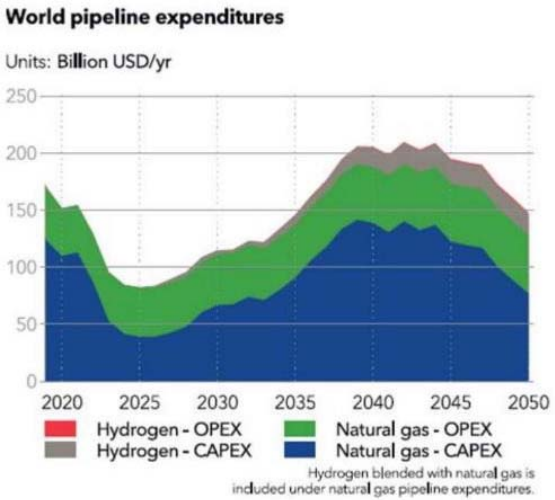
Offshore Assets and Pipelines as enablers of the transition to a decarbonized energy system

- The COVID-19 Pandemic has shed new light to the threat of climate and environmental changes. There is a general call for industry, policy makers, investors to boost the transition to a decarbonized energy system and to pursue the Paris Agreement goal for climate protection.

- The new energy production and distribution scenarios include Renewable Energies, **Hydrogen as energy vector** and the application of **Carbon Capture, Utilization and Storage (CCUS)** technologies.

- Existing **Offshore Assets**, namely Fixed Facilities, **could be repurposed** to accommodate new process plants, e.g. for H_2 Production/Storage/Offloading and for CCS.

- At the same time, an **infrastructure is required to transport anthropogenic 'impure' CO_2 from multiple sources overland** through often densely populated regions to storage sites and **to transfer the produced Hydrogen** to the end users, either pure or blended with natural gas.



Credits: DNV Energy Transition Outlook

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(*) including converted natural gas pipelines

A New Era of Opportunities for Aged Offshore Facilities

ENERGY STORAGE
- Produce and store green H2
- Produce blue H2 / Carbon solid

Energy production
- Electrical substation for windfarm
- Produce electricity from Renewables (Wind, wave, current, ETM, geothermal)

CO_2 CAPTURE

Co_2 Transport & Storage

Artificial reefing

Ship supply/ unloading
- Hub for unloading CO_2 from ship
- Fueling station for boats (H_2/NH_3/LNG)

Aquaculture

Logistic base (for nearby O&G or windfarm)
- Base for wind farm assembly
- Spare parts storage
- Service accomodation
- Ship docking/ maintenance

Waste Management

Educational/ training facility & Scientific laboratory
- For renewables pilots
- For ocean observation

Tourism

Subsea Data Centre
(green powered, seawater cooled)

Green Hydrogen as an Energy Vector

BROWN/BLACK HYDROGEN

Hydrogen extracted from coal using gasification

GREY HYDROGEN

Hydrogen obtained starting from fossil fuels without capturing the produced Green House Gases

BLUE HYDROGEN

Grey hydrogen with Carbon Capture Use and Storage

TURQUOISE HYDROGEN

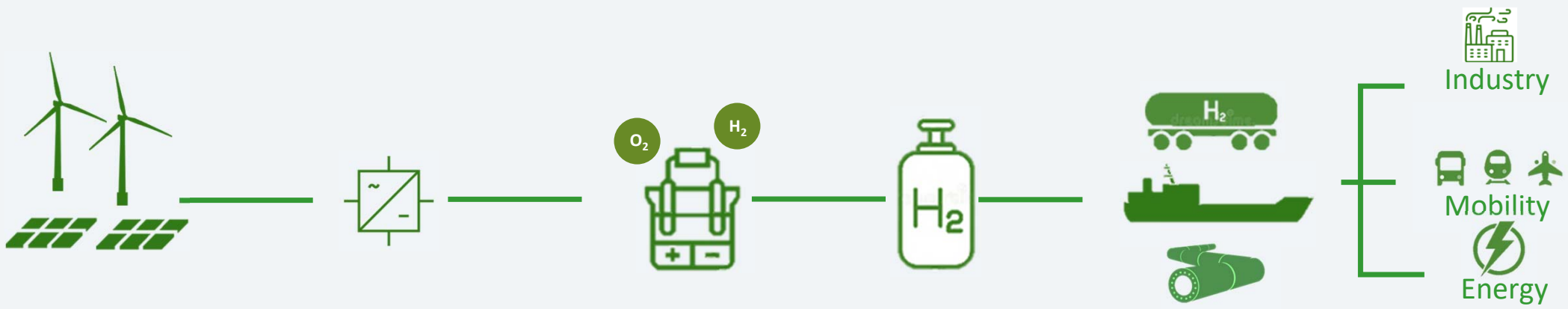
Hydrogen produced by thermal splitting of methane. Carbon is produced

GREEN HYDROGEN

Hydrogen produced by splitting water into hydrogen and oxygen using electricity coming from renewable energy

GREEN HYDROGEN VALUE CHAIN

RENEWABLE ELECTRICITY GENERATION → ELECTRICAL HUB → GREEN H2 PRODUCTION → H2 STORAGE/ CONVERSION → H2 TRANSPORT → H2 APPLICATIONS



Green Hydrogen in the Offshore Environment

Incentives For Green H_2 Deployment In offshore Environment

- ✓ **Increasing size of offshore renewable energy parks** - hydrogen generated from **excess of renewable energy**, exceeding at a time the capacity of the grid
- ✓ More consistent and **higher speed of wind**
- ✓ **No use of land**
- ✓ **Abundancy of sea water**
- ✓ **Repurposing of aged asset**, close to decommissioning
- ✓ Potential **availability of an existing infrastructure** (pipeline) to shore
- ✓ Offshore **Platforms as Refueling Stations** for Ships (less congestion on harbors – push toward new fuels)

Our Concept:

- **20 - 50 MW electrolysis capacity**
- **Medium size facility**

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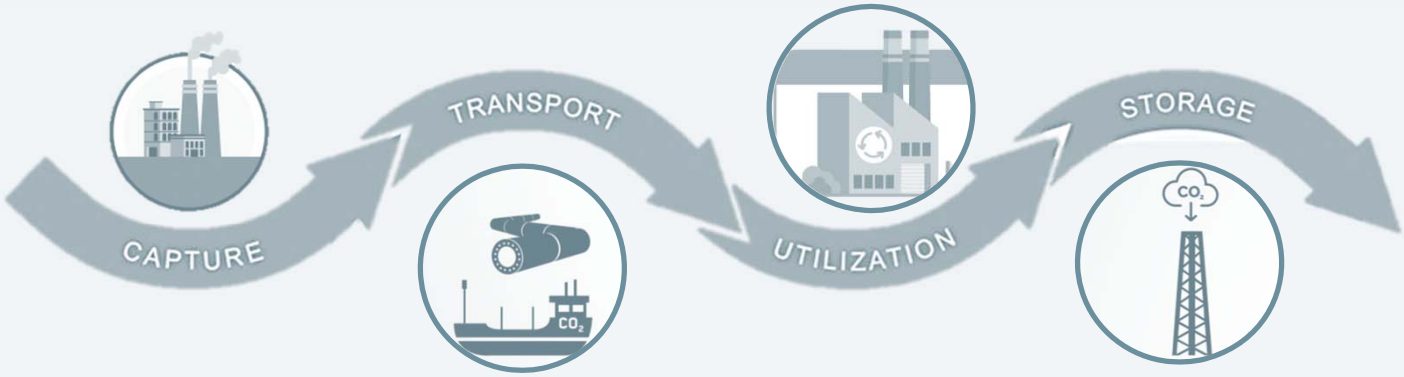
Carbon Capture, Utilization and Storage



CAPTURE	TRANSPORT	STORAGE	REUSE

• Pre-Combustion
• **Post-Combustion**
• Oxy-Combustion
• **Direct Air Capture (DAC)**
	• Pipelines (new or existing)
	• Ships
		• Depleted O&G reservoirs
		• Deep saline aquifers
		• Coal seams
			• **Direct:**
			  • EOR
			  • Food&beverages
			• **Conversion:**
			  • Chemical conversion
			  • Mineralization
			  • Biological conversion

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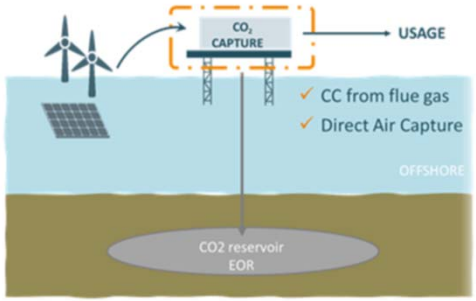
Carbon Capture and Storage in the Offshore Environment

Incentives for CO_2 Plants Deployment in Offshore Environment

- ✓ **Increasing size of offshore renewable energy parks** – plant powered by **excess of renewable energy**, exceeding at a time the capacity of the grid
- ✓ **No use of land**
- ✓ **Repurposing of aged asset**, close to decommissioning
- ✓ **Proximity to depleted reservoirs** for underground storage
- ✓ Potential availability of an existing infrastructure (pipeline) for reinjection/export



SAIPEM CONCEPT OF OFFSHORE FACILITY HOSTING A DAC PLANT:

- **(30 x 25)m**
- **1500 ton/year of CO2 captured directly from the air**

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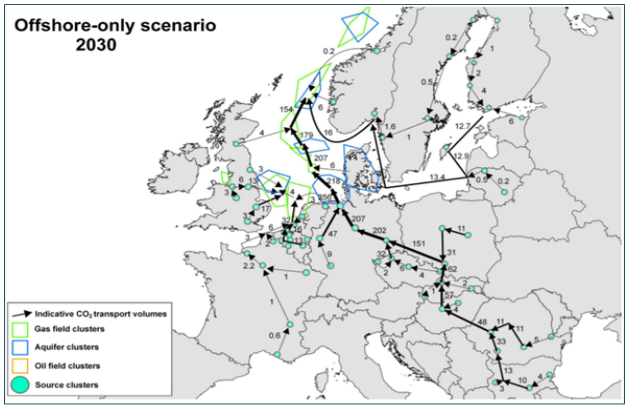
Towards the Circularity of Existing Offshore Pipelines

- O&G Infrastructure **Dismantling** is an **expensive** solution for existing offshore pipelines.
- The new Vision is to **Extend Life and Re-Use.**
- **European Oil and Gas Transport Associations** study the feasibility of repurposing the existing pipeline infrastructure towards transport of:
  - **H_2, H_2/Natural Gas (NG) blends**
  - **captured CO_2**
- **East Mediterranean regions and North Africa** are considering their current and future infrastructure for both repurposing and readiness for H_2 and H_2/NG transport scenarios towards Europe.
- CO_2 captured from existing industrial clusters as well as from new **Blue Hydrogen Production sites** can re-use existing sealines connecting ports to offshore storage site.



CO2Europipe — Towards a transport infrastructure for large-scale CCS in Europe

European Hydrogen Backbone initiative 2021

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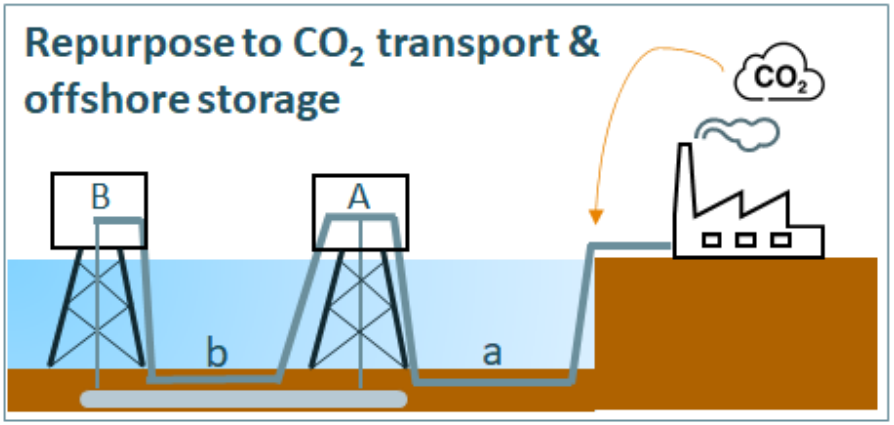
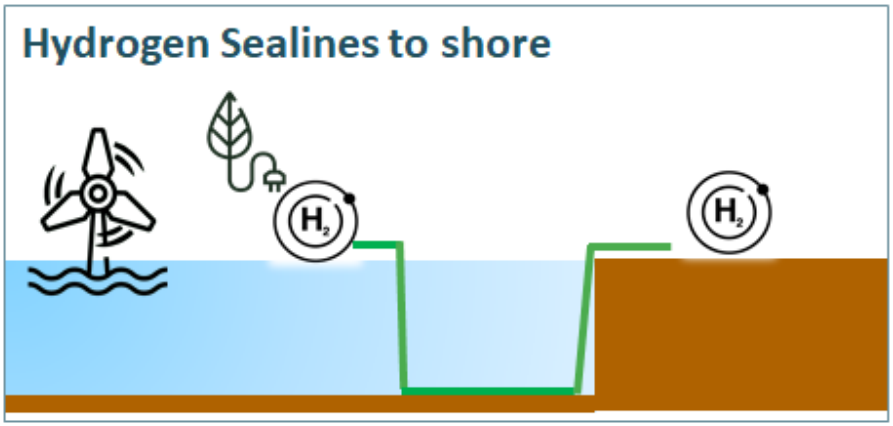
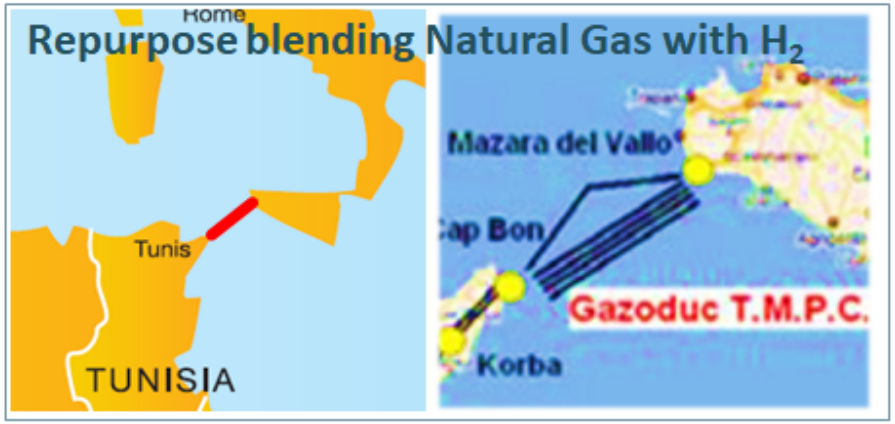
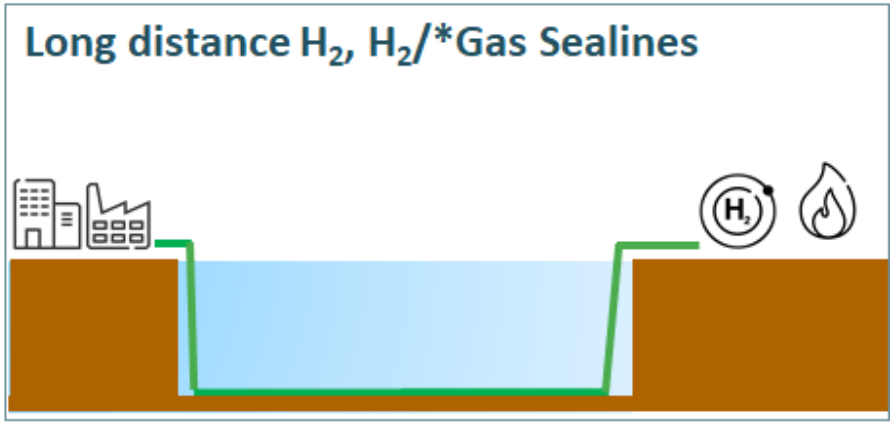
Offshore Pipelines from Repurposing to Newly Built for New Energies









The Value of Engineering Effort to Re-Use Offshore Pipelines for H_2 or CO_2

- Reusing an existing infrastructure will ease the transition to the new energy scenarios. At the same time, repurposing for different fluids an infrastructure designed for Hydrocarbons, poses challenges and technological needs.

H_2, H_2/NG Pipelines

- Advance knowledge on **hydrogen effects on "vintage" materials and welds**
- Promote and support **standardization** to ensure a **fit for purpose** and safe offshore pipeline re-qualification
- Re-design for **operating flexibility following H_2 production from renewables energy sources**
- Re-qualify including a **methodology in structural integrity** analysis for H_2 or H_2/NG transport

CO_2 Pipelines

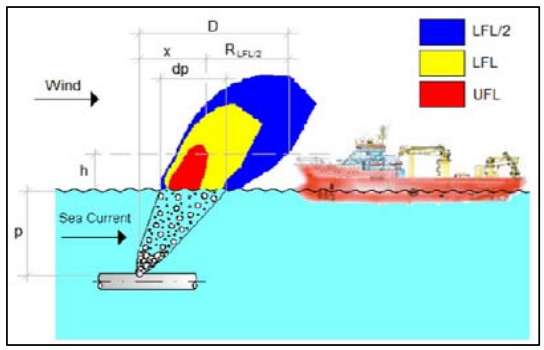
- Re-design for delivering a wide range of CO_2 streams + impurities
- Re-qualify for different **CO_2** transport phases (gas, liquid, supercritical, multiphase) to occur at different stages of the new operating life
- Repurpose to withstand **CO_2 pipelines depressurization** conditions and **hydrates/solid formation**

Focus on H_2 and CO_2 Offshore Pipelines Safety

Safety Engineering

- The major hazards associated to subsea pipeline systems are related to the consequences of accidental loss of containment events. An accidental subsea release can affect:

the buoyance stability of passing ships

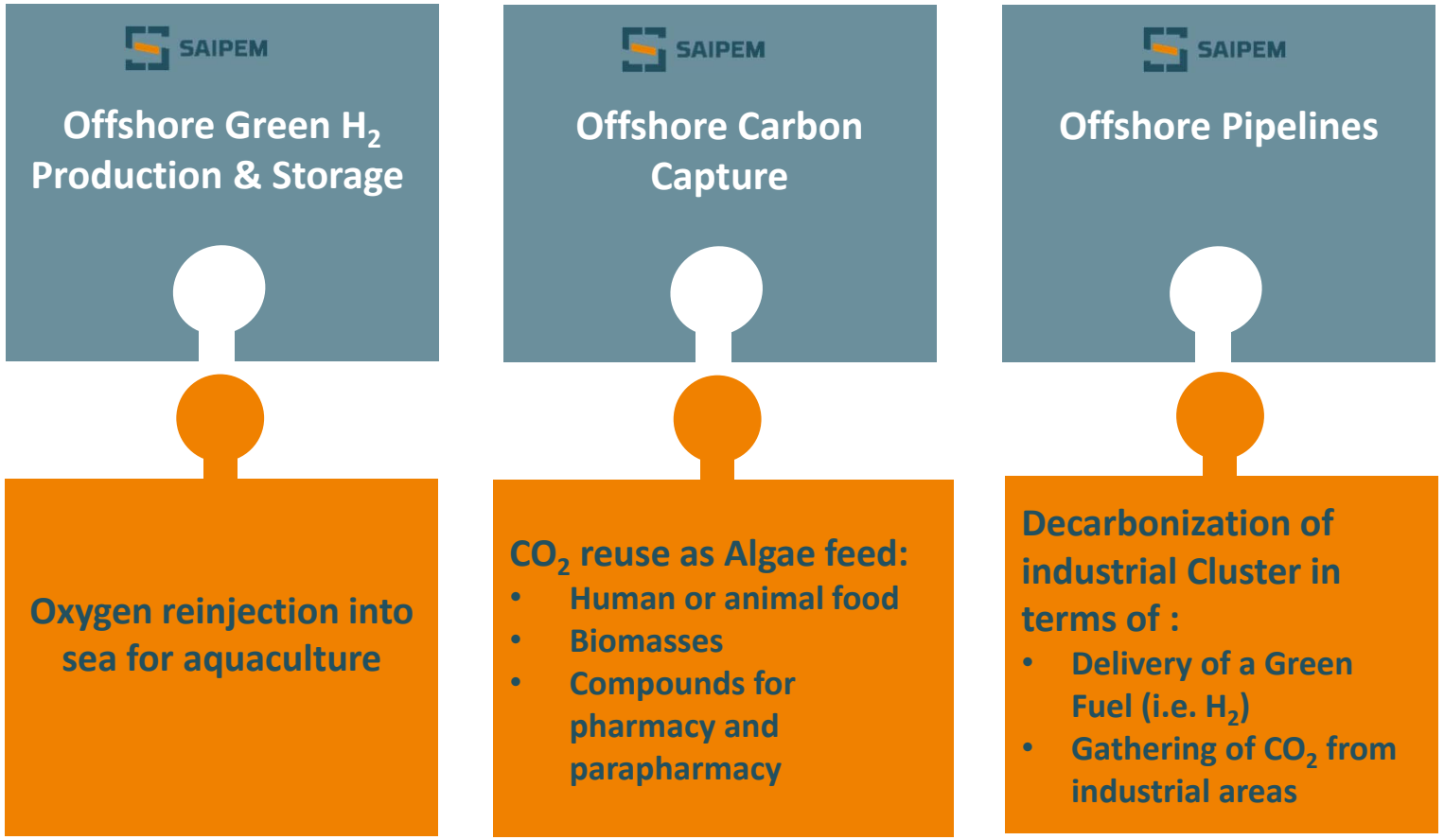


it can evolve into toxic or flammable clouds above sea level

it can impact subsea and atmospheric environment

- In order to reduce the risks deriving to CO_2 or H_2NG transport systems as low as reasonably practicable levels, a formal risk assessment process needs to be carried out from the early stage of the design
- There are Gaps to be filled in all areas of the risk assessment process

Opportunities of match-making



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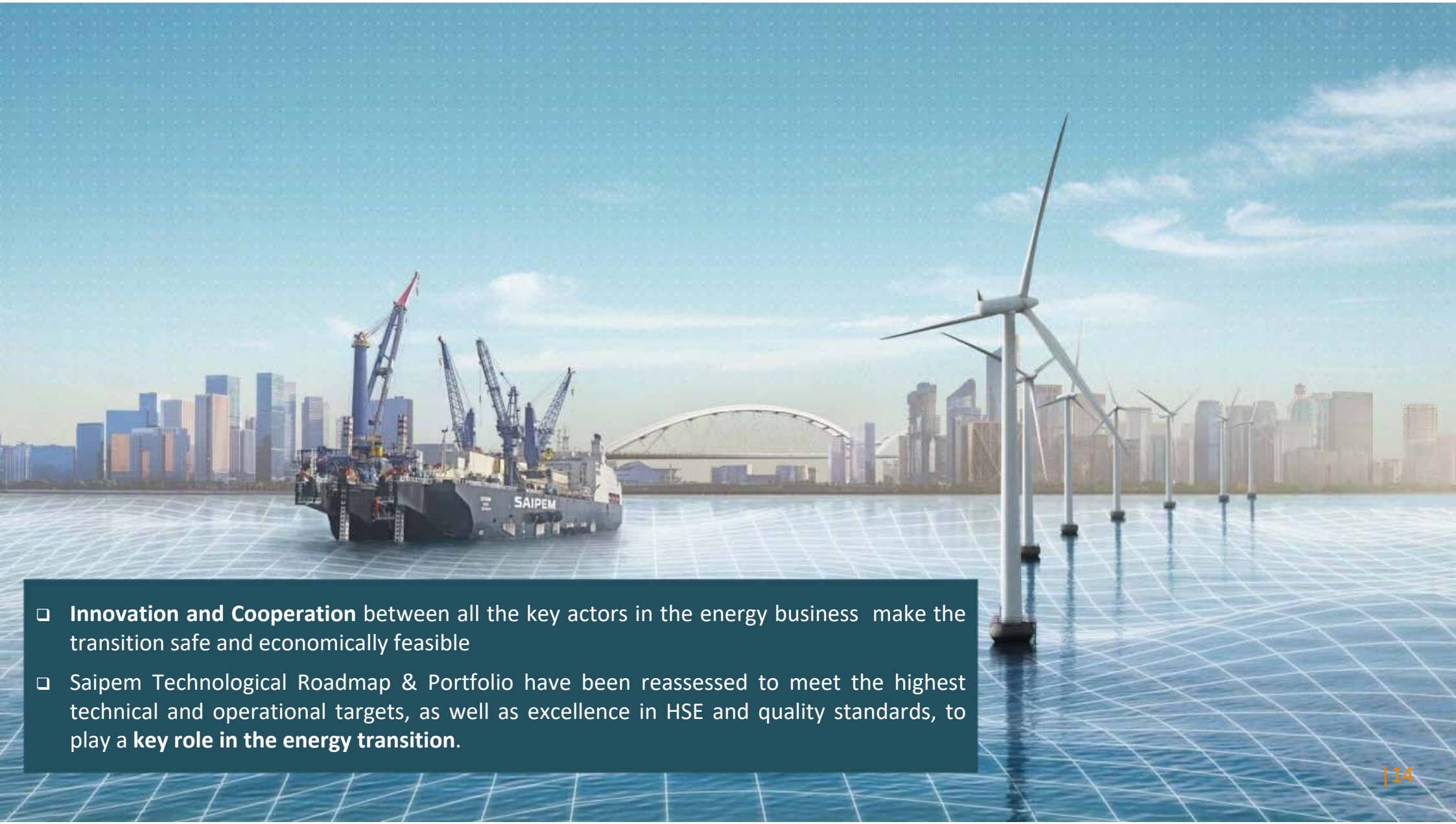

- **Innovation and Cooperation** between all the key actors in the energy business make the transition safe and economically feasible
- Saipem Technological Roadmap & Portfolio have been reassessed to meet the highest technical and operational targets, as well as excellence in HSE and quality standards, to play a **key role in the energy transition**.

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