



FPSOs Decarbonization

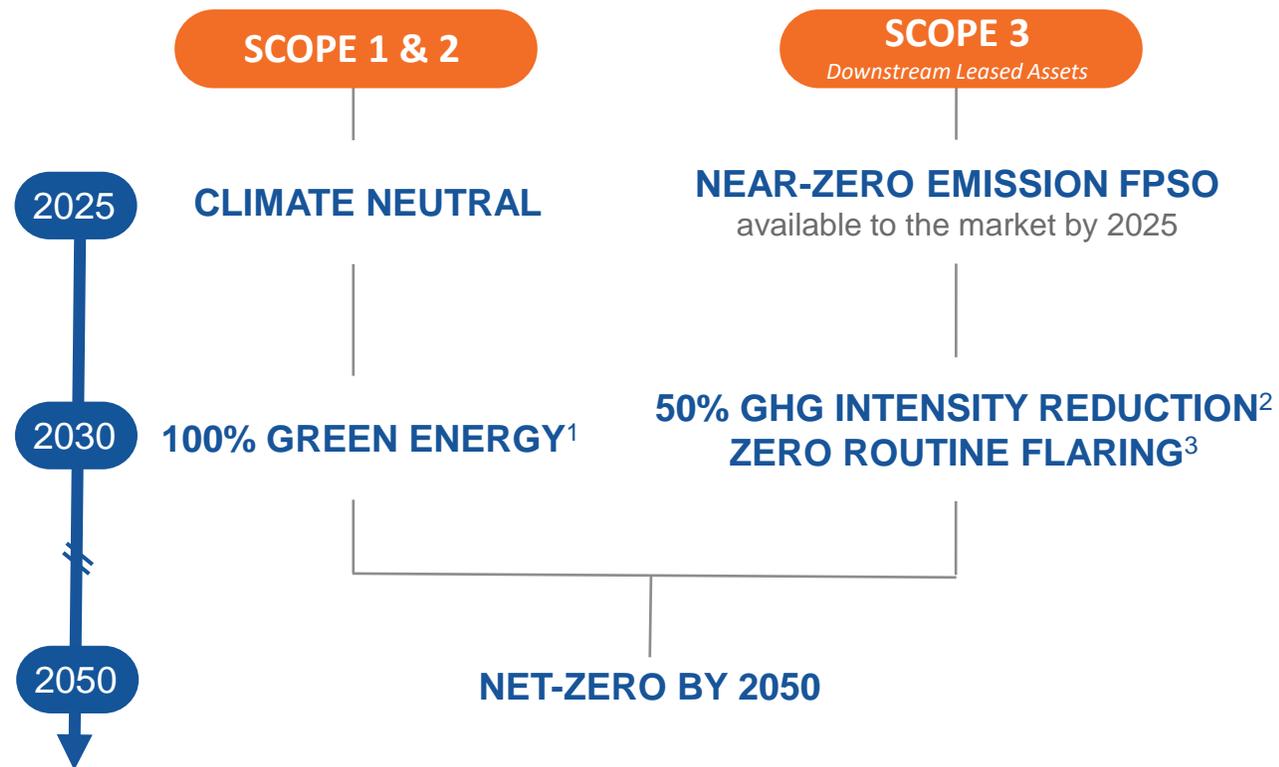
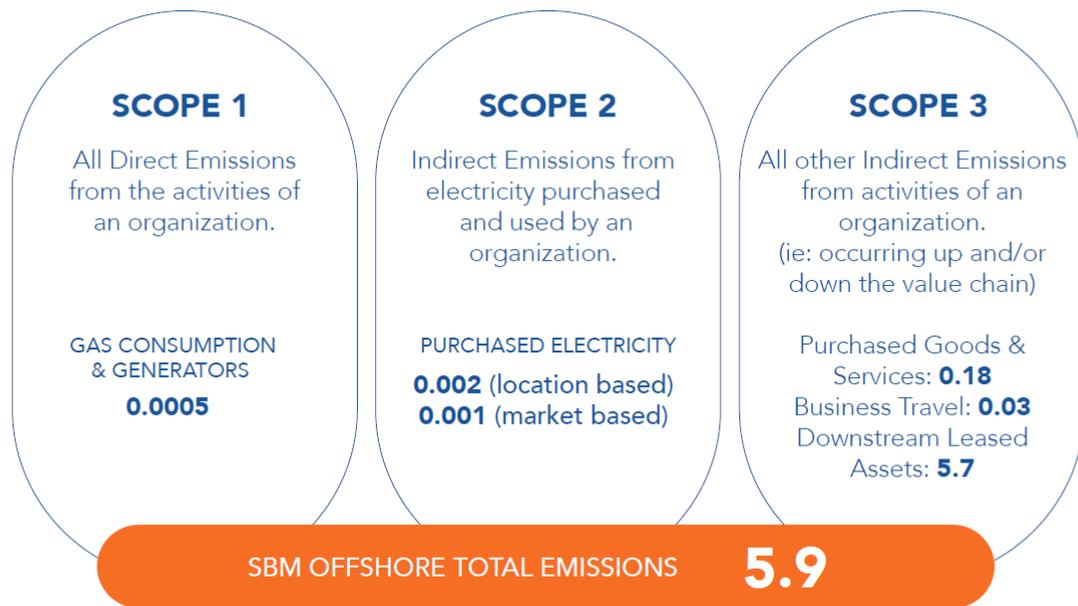
Jacinto Madrid - **SBM Offshore**

1. FPSO Decarbonization: SBM Objectives
2. Carbon Capture Solution
3. NearZero FPSO
4. Key Take Aways

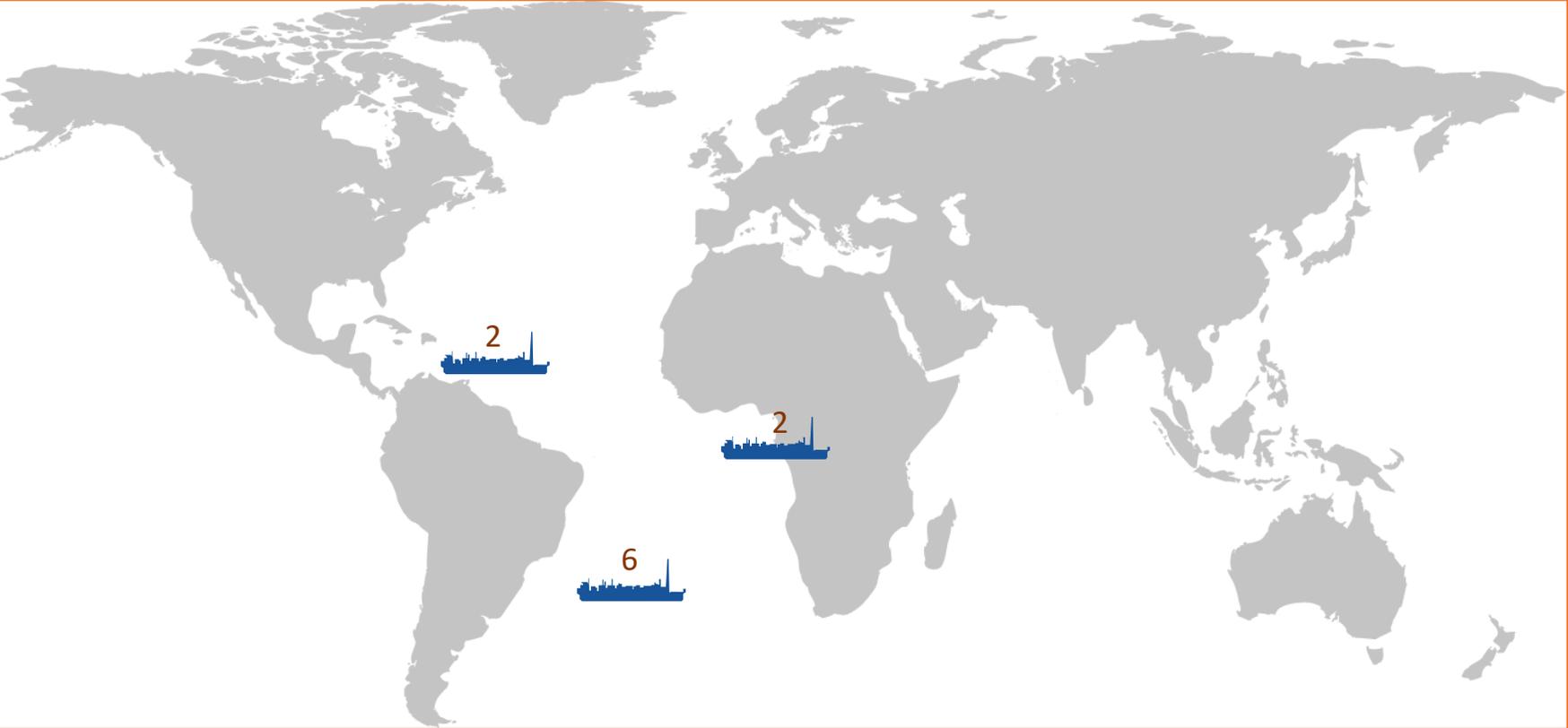
FPSOs Decarbonization: SBM Objectives



SBM Offshore Reported Emissions 2023 based on CO₂e volumes

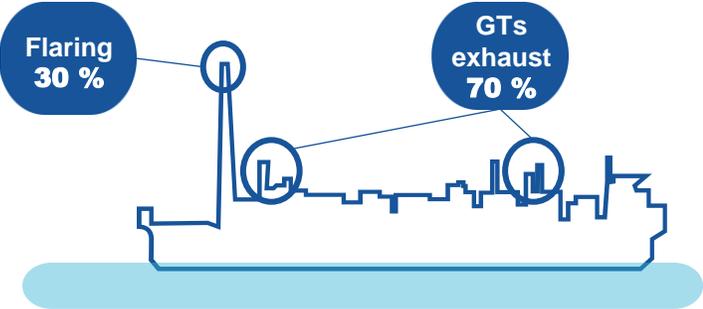


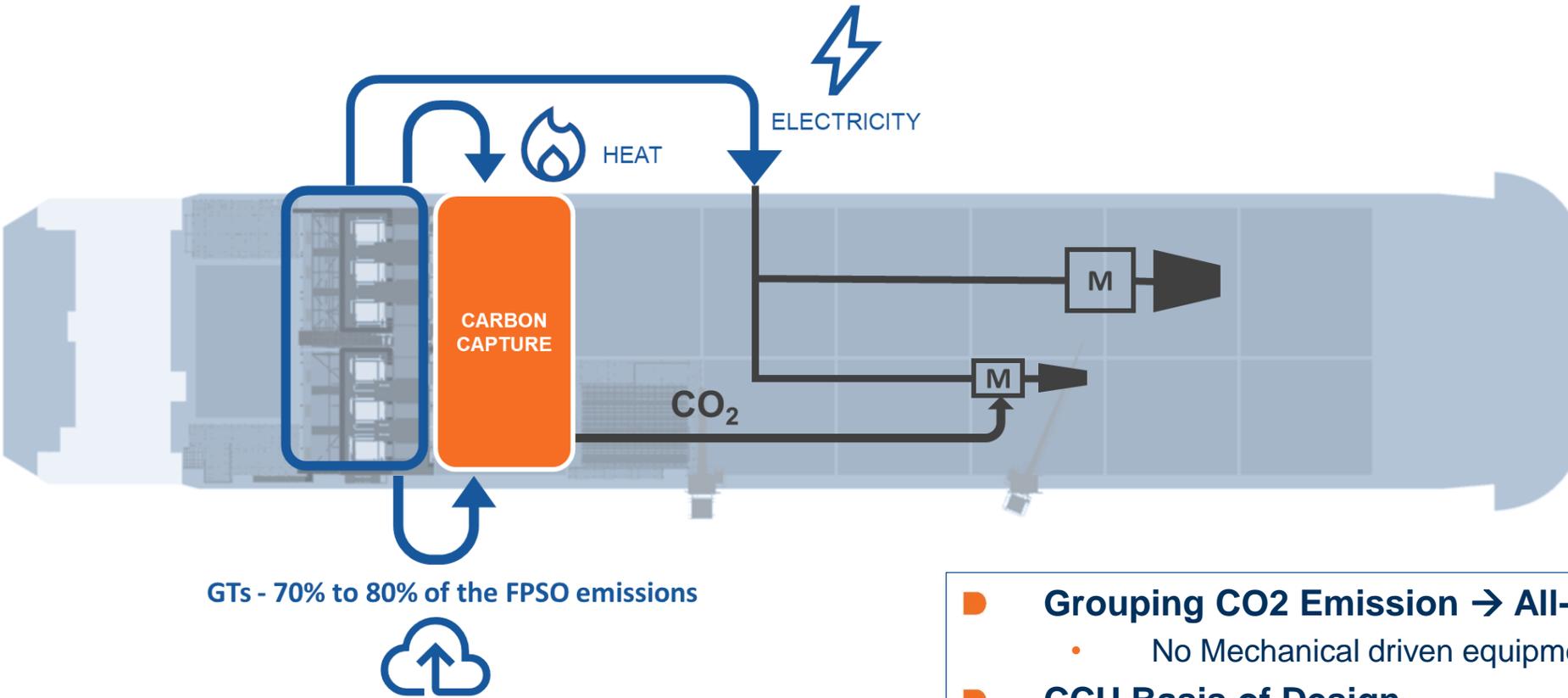
(1) Aiming for 100% sourcing of green energy by 2030 and considering investments in certified projects to offset against any residual GHG emissions from Scope 1 & 2
 (2) Reduce GHG-intensity of Scope 3- Downstream Leased Assets with 50% by 2030, compared to 2016 as a base year
 (3) Routine flaring of gas is flaring during normal oil production operations in the absence of sufficient facilities or amenable geology to re-inject the produced gas, utilize it on-site, or dispatch it to a market. Applies to GHG emissions from Scope-3 downstream leased assets.



Analysis of 10 FPSOs in operation :

- Name plate capacity from 80 to 230 KBOPD
- GTs total installed power from 70 to 190 MW (including sparing)
- FPSO with startup history ranging over the last 15 years
- Data from the last 5 years

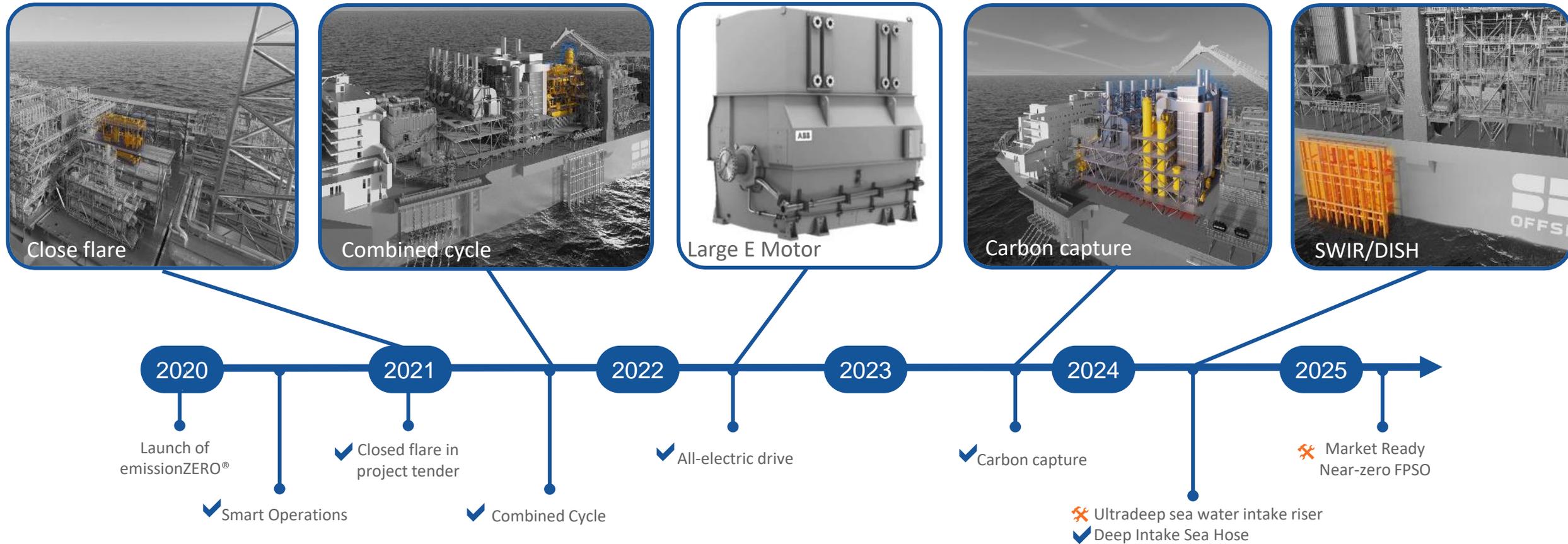




GTs - 70% to 80% of the FPSO emissions

- **Grouping CO2 Emission → All-Electrical FPSO**
 - No Mechanical driven equipment. GTs only for Power Generation
- **CCU Basis of Design**
 - GTs Flue Gas collected and sent to CCU:
 - 250 Deg C downstream of Waste Heat Recovery Unit
 - Atmospheric Pressure
 - CO2: Approx. 3 to 3.5%v/v
 - Capture Capacity: **Up to 1700 TPD CO2**

Roadmap to Near Zero FPSO



Identifying the best technical compromise with:

- The highest level of **technology readiness**
- The **lowest** cost impact on term of **\$/ton** of CO2
- The **highest % of reduction**

Adapted to match field specific production profile and lifetime emissions

Carbon Capture - SBM Offshore Solution



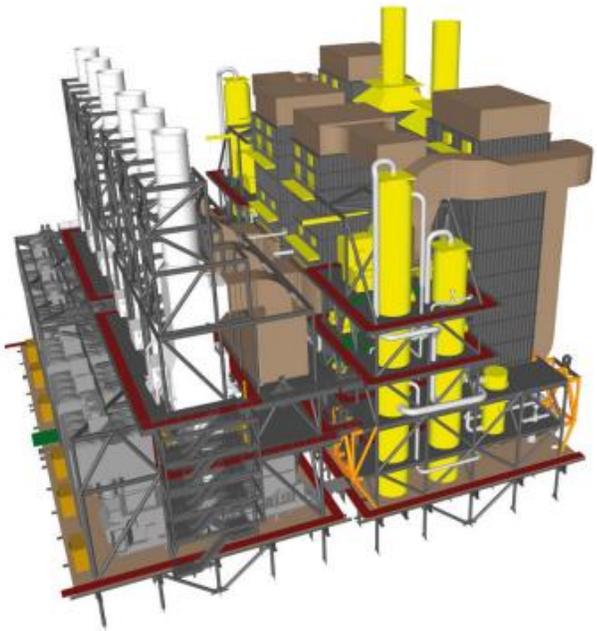
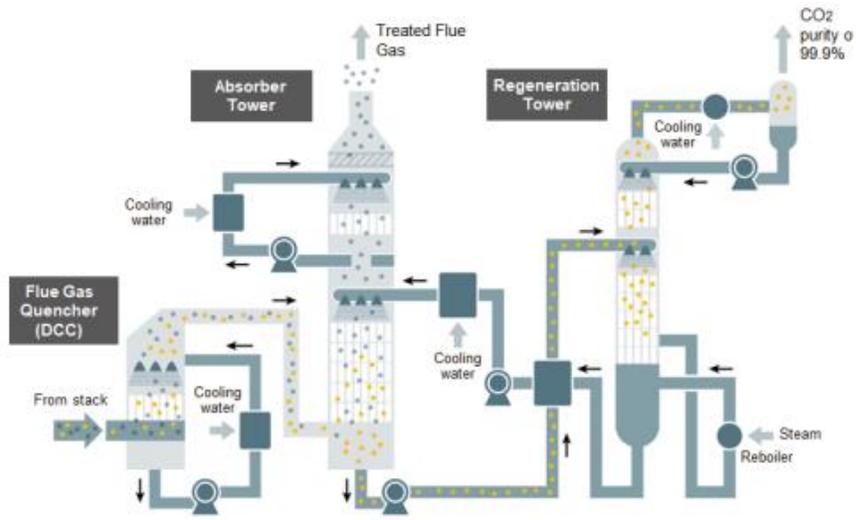
MHI
PROCESS LICENSOR SCOPE
& OWNERSHIP



JOINT DEVELOPMENT



SBM OFFSHORE
FPSO EPC SCOPE
& OWNERSHIP



- High number of cumulated years of operations
- 17 Units in operation
- 240 GTS to cover all aspects of marinization
- Wide range of offshore modules EPC experience

- Multiple onshore units in operation and in construction with carbon capture from Natural gas combustion.
- Onshore Amine plants track records with higher capacity than current BOD.

- Capacity of 1720 TPD
- Amine based process based on MHI onshore proven technology
- Possibility to build in current yards

- Multiple FPSOs in operation and in construction for the Brazilian pre-salts
- CO2 concentration from 20 to 60%
- Max flow CO2 from 4000 to 5500 TPD

Design and Engineering

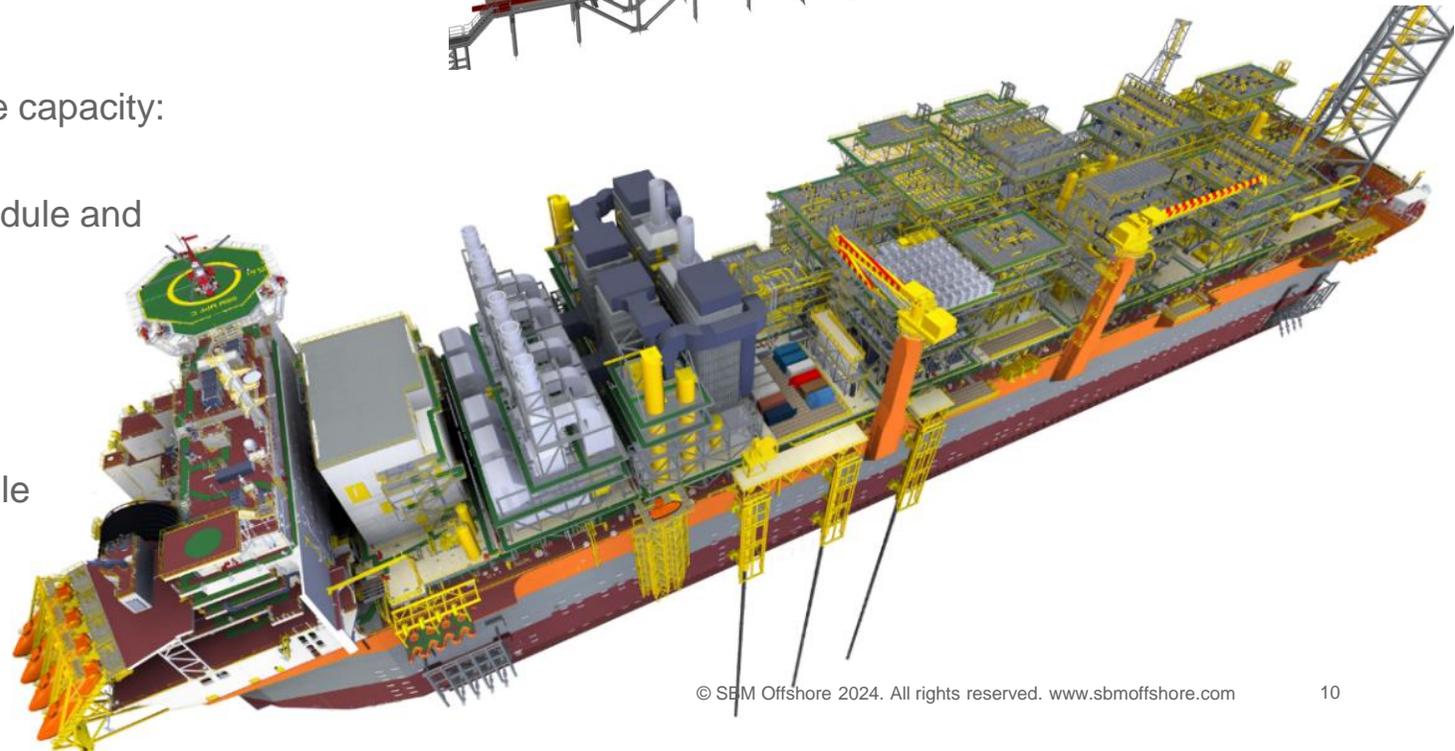
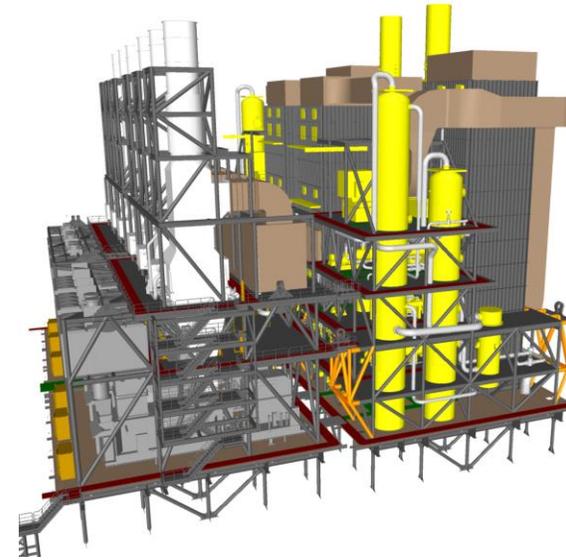
- Modules designed to fit in Standard Fast4Ward module
- Layout based on significant module EPC track records
- Marinization studies performed and endorsed by third-party: Designed adapted for offshore
- SBM Standard (GTS) applied
- Address challenges in exhaust gas conditioning (i.e.: NOx) and resulting CO2 treatment for disposal

Construction constraints

- Module weight and height must remain within crane capacity:
- Less than 4000t, Less than 45m height
- Access for maintenance must be granted in the module and for surrounding modules.

Execution analysis

- Compatible with SBM execution model and schedule
- Possibility of commissioning of the system

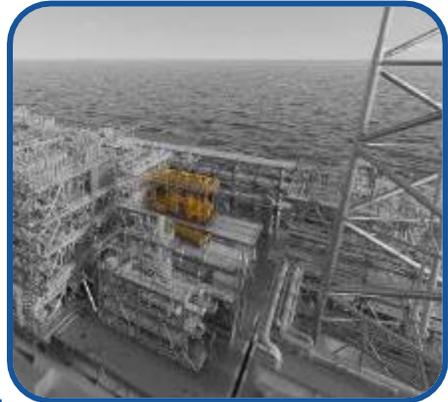


Near Zero FPSO



What is NearZero FPSO?

Closed Flare



Combined cycle



SWIR/DISH



Carbon capture



Large GT / Large eMotor

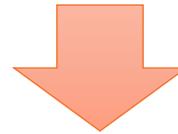


MPF



Fast4Ward®
Better Performance,
Delivered Faster

Measure	Case							
	L1	L2	L3	L4	M1	M2	M3	M4
All Electric	X	X	X	X	X	X	X	X
Cargo Blanket / Flare Gas Recovery	X	X	X	X	X	X	X	X
Combined Cycle	X		X	X	X	X		
Carbon Capture		X	X	X	X	X	X	X
Heat Integration				X	X	X	X	
250 m (DISH)					X		X	X



- Implementation of low carbon solution on existing units allowing to identify the **best technical compromise** considering:
 - Highest level of technology **readiness**
 - **Lowest \$/ton** of CO2
 - **Highest %** of emission reduction
 - Compatible with MPF and F4W Standardization program

The most suitable solution is **field specific**

Key Takeaways



- **Wide range of low carbon emission solutions available**, most of them already existing or being implemented in FPSOs.
- **Carbon Capture** solution is adapted for offshore and will significantly reduce CO2 emissions (up to 70%).
- **Contaminants (cost-efficient NOx), CAPEX and CO2 disposal** still the main **challenges** for Carbon Capture implementation.
- **NearZero FPSO** allows a **technically and cost-efficient solution** significantly **reducing GHG emission** while maintaining low execution risk.
- Equivalent **NearZero FPSO is unique** as depends on field specifics. **Early studies** and closed **collaboration** with Client is suggested to find the most adapted solution in terms of emission reduction and CAPEX.



TRUE.
BLUE.
TRANSITION.