DELIVERING INNOVATIVE & SUSTAINABLE SOLUTIONS

ADVANCING TECHNOLOGICAL RESPONSE AND THE CREATION OF INNOVATIVE SOLUTIONS, FROM CONCEPTUALISATION TO COMMERCIALISATION, TO SUPPORT GLOBAL DECARBONISATION GOALS
In July 2020, Sembcorp Marine and GE’s Grid Solutions were selected by German utilities company RWE Renewables as the preferred suppliers for the high voltage direct current (HVDC) electrical transmission system for the 1.4 gigawatt Sofia Offshore Wind Farm. This further strengthens our strategic diversification into greener solutions.
Our contribution towards decarbonisation is realised through our sustainable products and solutions aligned to our five areas of innovation focus. For each focus area, we actively manage the risks, explore opportunities and engage in research and development, with strategic collaborations, to deepen our core engineering capabilities. Our pipeline of sustainable products and solutions also comply with some of the world’s strictest safety, quality and engineering regulations. This ensures that our solutions achieve zero harm to people and the environment.

“Decarbonisation is a multi-faceted issue requiring different perspectives and collaborations. Sembcorp Marine is proud to support Singapore’s push for decarbonisation and we look forward to contributing our experiences from developing low-carbon engineering products and solutions for the global markets, and from our ongoing efforts to tap solar power in our yard operations.”

- Mr Wong Weng Sun, President & CEO of Sembcorp Marine
OUR WORK IN 2020

Largest membrane type LNG bunker vessel in Asia
The 12,000 cubic metre GTT Mark III Flex membrane tanks are the largest ever built in Singapore and the rest of Asia. This state-of-the-art design allows for safe transfer of LNG during bunkering operations as well as reducing loss of cryogenic LNG through evaporation. This vessel also boasts an optimised vessel hull form using computational fluid dynamics (CFD) as shown on the left, and energy-efficient designs that effectively reduce carbon emissions during operation.

Floating offshore wind turbine solution for moderate to harsh environment based on the SWACH design
As the offshore wind market is moving into deeper and harsher environments with larger turbines, our subsidiary, Sevan SSP, developed a cost-efficient floating foundation for offshore wind turbines. Based on our proprietary Sevan SWACH (Small Waterplane Area Cylindrical Hull) design, the cylindrical floating foundation solution is scalable to house the largest wind turbines and offers excellent motion characteristics in harsh conditions.

Work Boat World Best of 2020 Awards “Best Medium Ro-Pax” design – Hjellestad
Hjellestad, an aluminium hybrid plug-in double-ended ferry LMG-16-DEH, designed by our wholly-owned subsidiary, LMG Marin, won the Best Medium Ro-Pax Award at the Work Boat World awards. This ferry, which accommodates 16 cars and 80 passengers, is powered by a biodiesel and electrical propulsion system. The lithium-ion batteries onboard are charged by onshore hydroelectric power, reducing the emissions of vessel operation to zero.

Strength through collaboration – Bringing ideas to life
In February 2020, Sembcorp Marine inked a Master Research Collaborative Agreement (MRCA) with Singapore’s Agency of Science, Technology and Research (A*STAR) to set up Joint Lab@TBY to pursue innovation in Digital Design and Advanced Manufacturing. This collaboration aims to pave the way for shorter time-to-market solutions by boosting our engineering capabilities, production capacity and efficiency. Joint Lab@TBY will capitalise on ongoing construction projects which will provide a real-world environment for research.
Sembcorp Marine is committed to providing innovative and sustainable engineering solutions for the global offshore, marine and energy industries. In keeping with the global shift towards a cleaner and greener energy mix, we developed a suite of solutions across the entire offshore wind value chain.

### Sembcorp Marine Offshore Wind Innovation & Solutions

#### Sofia HVDC Substation
- Offshore Fixed Platform

#### PC1200 | 1600 | 2000 WTIV
- Wind Turbine Installation Vessel

### OUR OFFSHORE WIND VALUE CHAIN

- **Marine & Geophysical Survey**
  - Hydrographic Vessels, Offshore Survey Vessels

- **Fixed & Floating Foundations**
  - Jackets, Monopiles, Spar, TLPs, Semi-submersibles

- **Substations & Platforms**
  - Offshore Substations, Renewable Hub
ASEAN Explorer
Cable Laying Vessel

FLINSTONE
Offshore Rock Placement Vessel

LMG 400 Offshore Service Operation Vessel (SOV)
Support Vessels, Wind Turbine Service Vessels

Wind Farm Installation Vessels
Semi-submersible Crane Vessels, Lift-boats, Heavy-lift Vessels

Subsea Cabling Vessels
Trenching Vessels, Cable Laying Vessels

Seabed Assets Protection Vessels
Rock Dumpers

Operations & Maintenance
Offshore Support Vessels, Wind Turbine Service Vessels
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TOWARDS A LOW CARBON FUTURE THROUGH COLLABORATIONS

Gas Collaboration
Successfully completed Joint Development Projects (JDP) on LNG with American Bureau of Shipping (ABS) and A*STAR’s Institute of High Performance Computing (IHPC) comprising Risk Analysis for LNG Bunkering Leakage & Explosion and LNG Boil-off Rate Determination & Management. The image (left) is the result obtained from a CFD simulation showing a gas cloud (cyan color) resulting from an LNG leak during bunkering operation for two designs of bunkering station: with enclosure (first from left) and without (second from left).

Large Scale Maritime Fuel Cell Systems
A collaboration between Corvus, Toyota, Equinor, Norled, Wilhelmsen, LMG Marin, the NCE Maritime CleanTech cluster and University of South-Eastern Norway (USN) to develop and produce modularised and cost-effective Proton Exchange Membrane (PEM) fuel cell systems for the international marine market.

Carbon Capture Project - Stella Maris
A collaboration by Altera Infrastructure, TGE, Moss Maritime and Sevan SSP (a wholly-owned subsidiary of Sembcorp Marine) to explore and develop a commercially competitive solution for large scale maritime transport, offshore discharge, floating storage and injection of CO₂ for permanent storage in subsea reservoirs.
ENSURING A SUSTAINABLE FUTURE THROUGH COMPLIANCE

Marine and offshore assets are capital intensive and often operate under harsh environment. To ensure the safety of the crew, the environment and the asset, we design, build and deliver our products and solutions according to stringent international standards. These regulatory and statutory requirements include among others Norwegian’s NORSOK standard, UK HSE requirements, Norwegian Maritime Authority Regulations as well as the Code for Construction and Equipment of Mobile Offshore Drilling Units (MODU).

The responsibility to ensure these regulations are met lies with a dedicated team of regulatory compliance and technical safety engineers who are involved in every stage of the project. Using tools such as standard operating procedures, flowcharts, checklists and experience transfer from past projects, our engineers continuously innovate their work processes to execute projects seamlessly. As new regulations addressing different aspects of Health, Safety and Environment are introduced periodically, our team undergoes regular competency development courses to be kept up-to-date and relevant.

In addition to safety and environmental regulations, Sembcorp Marine is also cognisant of the need to secure solutions and protect assets from cyberspace threats. To this end, we have developed competencies in implementing cybersecurity requirements, including the Cyber Manage Prepared (CMP) notation from Bureau Veritas which we have done for a newbuild LNG carrier to meet the IMO’s Resolution MSC (98).

BUILT TO THE WORLD’S STRICTEST REQUIREMENTS

West Linus
Built in compliance with PSA Framework Regulation 3, NMA and DNV GL rules
First vessel directly from yard to operation on the Norwegian continental shelf

Pacific Class (PC) 400 Rig
Sembcorp Marine is the first company to be awarded the ABS Cybersecurity-Ready (CSR) Notation on an offshore asset, a jack-up drilling rig that was built based on the Group’s proprietary Pacific Class 400 design

Noble Lloyd Noble
Designed in compliance with dual regulatory requirements (UK and Norway) as well as DNV GL rules.
Awarded the technical part of the Safety Case before leaving the yard
World’s tallest jack-up with leg length of 214 metres

Johan Castberg
Hull and Living Quarters (LQ) designed according to PSA Framework Regulation §24, DNVGL rules and Equinor standards (Under construction)

Other vessels with stringent requirements
2020 – 3 x Ropax ferries (Norway)
2019 – Helix Q7000 (UK-Worldwide)
2016 – Ivar Aasen Drilling & LQ topsides (Norway)
2016 – Maersk Highlander (UK)
2015 – Safe Zephyrus (UK-Norway)
2015 – Safe Boreas (UK-Norway)
2011 – West Elara (Norway)
2010 – Ekofisk LQ