

ENVIRONMENTAL SUSTAINABILITY



Sembcorp Marine is working with SP Group to develop and install what will be the largest single solar rooftop at a Southeast Asian shipyard

Sembcorp Marine is committed to reducing the impact of its business on the environment. The Group's Environmental Policy guides the monitoring, management and reduction of operational impact on the environment. It addresses group-wide leadership and accountability, communication, legislative and regulatory documentation, risk and change management as well as performance review of environment-related topics.

Each Sembcorp Marine facility adopts an Environmental Management System implemented and enforced by committees comprising representatives from health, safety and environment (HSE), facilities management, as well as business excellence teams.

The Group's yards undergo annual internal and external audits under the ISO 9001 Quality Management and OHSAS 18001 Occupational Health and Safety Management Systems. Tuas Boulevard Yard and Admiralty Yard, jointly accounting

for approximately 70% of the Group's operational land area in 2017, are additionally certified to ISO 14001 Environmental Management and SS 577 Water Efficiency Management Systems. The buildings and workshops at Sembcorp Marine's flagship Tuas Boulevard Yard carry the Singapore Building and Construction Authority's Greenmark certification.

The Group complies with a wide range of regulations, such as the national Environmental Protection and Management Act (EPMA); Environmental Public Health Act (EPHA); the Maritime and Port Authority of Singapore's (MPA) Prevention of Pollution of the Sea Act as well as the Hazardous Waste (Control of Export, Import and Transit) Act which conforms to the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal.

To enhance its water management, Sembcorp Marine requires all its yards in Singapore to be managed by Water Efficiency Managers by the end of 2018. All Water Efficiency Managers are to be certified based on the national Public Utilities Board's curriculum.

Environmental sustainability forms an underlying foundation to various aspects of Sembcorp Marine's business. More information can be found at:

Products and solutions – Innovation and Solutions Development, page 106
 Responsible procurement practices – Value Chain Management, page 111
 Framework and systems – www.sembmarine.com/sustainability/environment
 Operational innovation – www.sembmarine.com/sustainability/case-study-features

ENERGY CONSUMPTION AND GREENHOUSE GAS EMISSIONS

Cutting and welding activities in the shipyards utilise gas fuels such as natural gas (NG), liquefied petroleum gas (LPG) and acetylene as well as carbon dioxide as a shielding gas. Electricity from the national grid continues to be the primary source of energy for operations, supplemented by diesel for portable generators and vehicles. According to the Energy Market Authority of Singapore, electricity from the national grid was generated from 95.2% natural gas, 1.1% coal, 0.8% petroleum products (mainly diesel and fuel oil) and 3.0% from other sources such as solar and biomass¹. This translates to approximately 0.42 kilogrammes of carbon dioxide per kilowatt-hour produced by the grid.

In 2017, more diesel generators and compressors at Sembcorp Marine's Singapore yards were phased out as operational activities were increasingly consolidated at the Tuas Boulevard Yard. This flagship yard is designed to be energy-efficient, equipped with integrated high-capacity compressors running on electricity instead of diesel.



Trained managers monitor and assess energy consumption in the shipyards

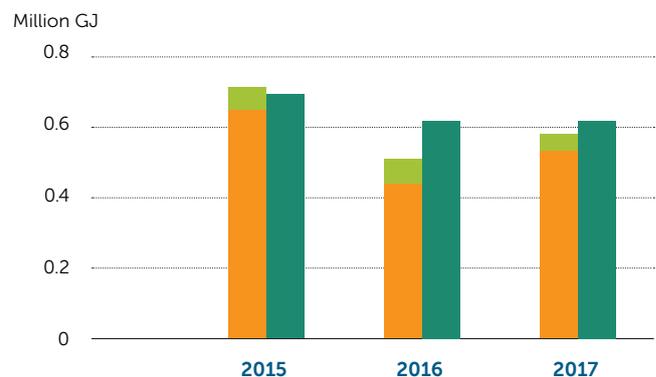
In exploring the use of cleaner and renewable sources of energy with reduced carbon footprint, Sembcorp Marine signed an agreement with the SP Group in November 2017 to develop a Digital Energy-saving System that harnesses solar energy from 4.5 megawatt-peak rooftop solar panels. To be installed at the Tuas Boulevard Yard's state-of-the-art steel fabrication workshop, the solar rooftop will reduce this workshop's reliance on the national grid by as much as 30% during peak load. The digital energy-saving system will also feature energy storage capabilities, energy sensors and a real-

time digital platform to optimise energy usage throughout the yard.

The shipyards have certified Energy Managers responsible for monitoring and analysing energy usage and the impact of emitted greenhouse gases. Working together with management, employees and related parties, these managers oversee the development and implementation of energy efficiency and reduction initiatives.

In 2017, the Group's diesel consumption increased by 21% and there was a 34% decrease in gas-related energy consumption. These can be attributed largely to 1) an increase in customer vessels with high-power requirements at a yard with infrastructural restrictions; and 2) several newbuild projects moving out of the steel fabrication stage of construction.

Energy Consumption



	2015	2016	2017
Direct Energy (Gases)	0.062	0.071	0.047
Direct Energy (Diesel)	0.646	0.440	0.534
Indirect Energy (Electricity)	0.689	0.622	0.625
Total Energy	1.398	1.133	1.205

■ Direct Energy (Gases) ■ Indirect Energy (Electricity)
 ■ Direct Energy (Diesel)

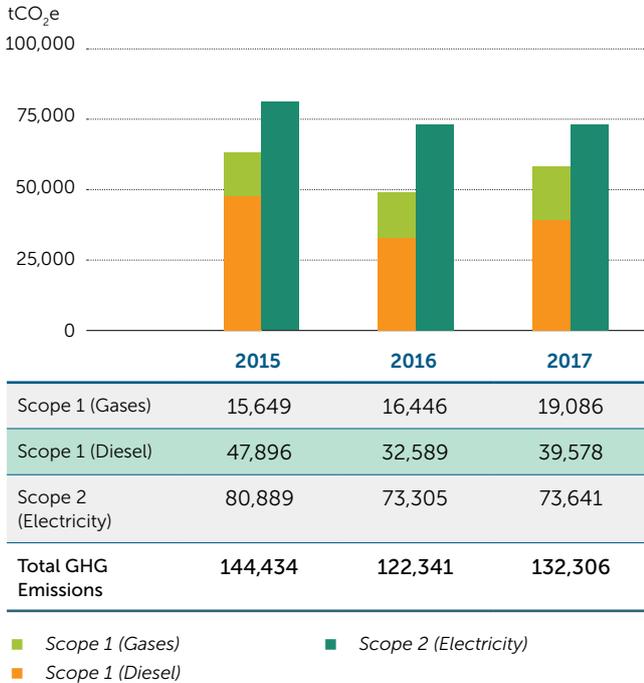
Notes:

To ensure better standardisation of calculation methodologies, the acetylene calorific value has been aligned with the CDP Guidance methodology for estimation of scope 3 category 11 emissions for oil and gas companies (2016). Historical figures for Direct Energy (Gases) have been restated accordingly.

1. Latest figures at time of print from "Singapore Energy Statistics 2017", page 30, Table 2.2 Annual Fuel Mix for Electricity Generation by Energy Product, Research and Statistics Unit, Energy Market Authority, Republic of Singapore.

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Greenhouse Gas Emissions



Notes:
 Scope 2 historical data for electricity has been restated in alignment with a new Grid Emission Factor issued by the Energy Market Authority in July 2017.



Fuel gases are used to cut and weld steel and other materials

AIR QUALITY

The Group implements several practices to control air quality during operations.

To mitigate the impact of yard activities on air quality, all yards carry out blasting and painting works in enclosures with advanced filtration systems. Additionally, the Admiralty and Tuas Boulevard yards monitor airborne particulate matter (PM2.5) levels at the boundaries to ensure that these remain within acceptable limits.

The Group is expanding the use of more environmentally-friendly processes like hydro-blasting, and materials such as steel grit to replace conventional copper grit. This reduces airborne particulate matter during the grit blasting process when steel surfaces are primed for production.

WATER

The Group consumes two types of water supplied by the Singapore Public Utilities Board (PUB) – potable water and reclaimed NEWater. These are derived from local catchment water, imported water, desalinated water and reclaimed water.

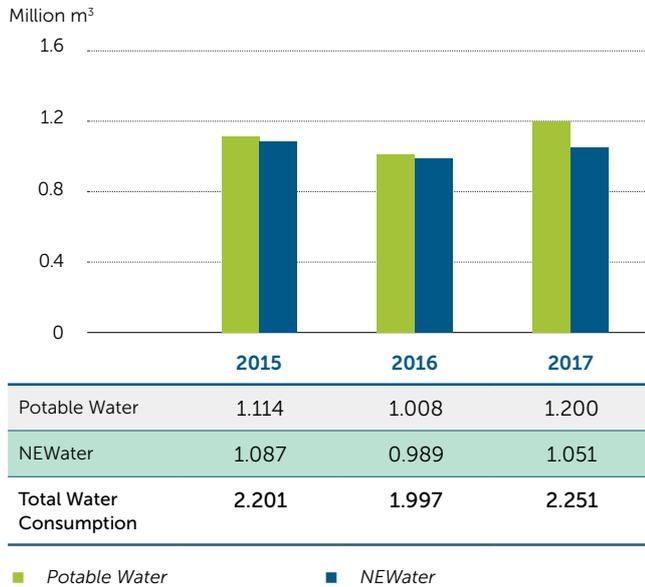
Water is a significant part of Sembcorp Marine’s operations. Aside from consumption in the corporate offices and canteens, water is utilised for cleaning pipes, tanks and equipment of customer vessels that arrive at the yards for repair and maintenance works. The Group’s efforts to replace copper grit blasting with hydro-blasting have also resulted in a higher water consumption intensity in recent years. To manage the consumption of this resource, the shipyards use reclaimed water (NEWater) where feasible. In 2017, reclaimed water accounted for approximately 47% of the Group’s total water consumption.

Sembcorp Marine’s appointed water managers monitor and audit water usage in the shipyards. Leak checks are performed regularly on water piping systems to mitigate water loss.

Water conservation awareness is continuously championed in company facilities and dormitories. Employees are provided with direct communication access to building supervisors and encouraged to provide feedback and report water leaks.

In 2017, the Group’s consumption of potable water and NEWater increased, largely due to an increase in hydrojetting activities at a yard where supply is infrastructurally restricted to potable water.

Water Consumption



MATERIALS MANAGEMENT

The construction, repair and upgrading of drilling rigs, offshore structures and vessels require substantial use of steel. Steel constitutes an approximate 71% of projects undertaken by Sembcorp Marine yards.

Two main types of steel – raw steel plates and steel pipes – constitute a large majority of raw material and semi-manufactured parts most widely used in the business. This amounted to 115,982 MT of total steel consumed by Sembcorp Marine in 2017. To improve the quality of reporting, steel pipes were included in the Group’s steel consumption data in 2017. For steel plates, there was a 17% decrease compared to 132,884 MT in 2016. This was largely attributed to several newbuild projects progressing out of the structural fabrication stage.

Copper grit is used as an abrasive to prepare surfaces for painting and other works. It is the most significant process material used in the Group’s operations. Some 69,184 MT of copper grit was consumed in 2017 – an 8% decrease from the previous year.

WASTE MANAGEMENT

Sembcorp Marine has a strict policy on waste management, in compliance with national EPMA, EPHA and toxic industrial waste regulations. The collection, treatment, and disposal of the Group’s hazardous, non-hazardous and recycled waste are managed by service providers with nationally certified permits. Group-wide policy and regulations provide guidance on material procurement, classification and handling, as well as workplace safety and health training, emergency response procedures and disposal behaviour for all employees, suppliers, customers and other stakeholders operating within the yards.

Chemicals in the yards are categorised by code according to the Globally Harmonised System (GHS). Non-hazardous waste and treated hazardous waste are sent for incineration at waste-to-energy facilities. This method provides energy creation opportunities and minimises landfill requirement.

Hazardous waste disposed from Sembcorp Marine’s yards mainly consists of oily water and sludge removed from customers’ vessels when they arrive for repair or maintenance works. Other contributors include chemical cleaners and paint packaging.

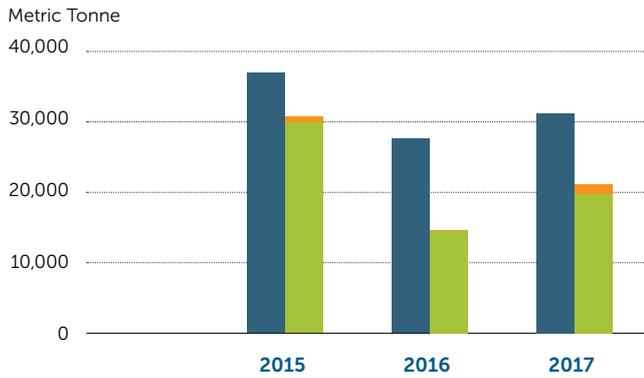
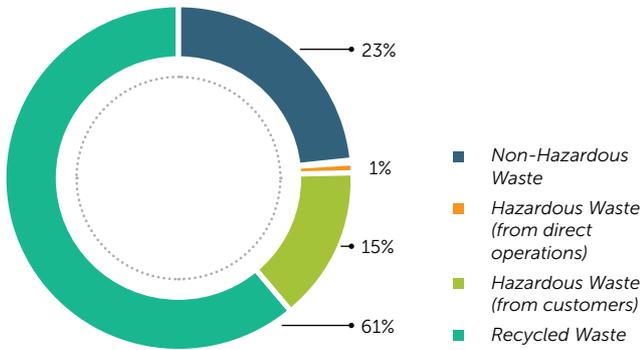
A waste water treatment plant was set up in late 2016 at the Tuas Boulevard Yard, involving a four-level filtration system that extracts water and treats it for safe discharge into the national network. The remaining solid matter is compacted and sent for incineration. The treatment plant has since reduced hazardous liquid waste volumes from the Tuas Boulevard Yard by more than 75%.

Sembcorp Marine water quality management procedures and oil spill response guidelines have been developed with reference to local and international standards such as Singapore’s EPMA, EPHA, MPA’s Prevention of Pollution of the Sea Act and US Environmental Protection Agency’s (EPA) Oil Pollution Act. No significant spills were noted in 2017.

Production processes are designed with technology that maximises materials efficiency. The Group also practises a policy of recycling or repurposing retrieved steel scraps and spent copper grit. In 2017, this amounted to 36,728 MT of steel scrap and 38,979 MT of copper grit which constituted 94% of total waste recycled by Sembcorp Marine. The remaining 6% of total recycled materials consisted of items such as packaging wood and paper.

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Types of Waste



	2015	2016	2017
Non-Hazardous Waste	36,713	27,657	31,056
Hazardous Waste	30,557	14,748	20,883
(from customers)	29,676	14,558	19,552
(from direct operations)	881	190	1,331
Recycled Waste	303,185	132,241	80,779



DATA AND REPORTING

Environmental data disclosed in this report is consolidated from the Group's yards within its operational control in Singapore.

As reported on pages 76 - 77, two yards ceased operation in 2017.

To improve the quality of reporting the Group's consumption of significant materials and resources, the Environmental Committee has included the consumption of steel pipes as an indicator from 2017.

The below details sources of conversion factors used in the chapter:

- Gas fuels included in the calculation of direct energy consumption and Scope 1 emissions consist of acetylene, liquefied petroleum gas and natural gas used for welding and cutting.
- Energy consumption conversion methodologies are applied from the Carbon Disclosure Project's (CDP) 2016 publication of Technical Note: Conversion of fuel data to MWH.
- Calorific values of fuels are sourced from Greenhouse Gas (GHG) Protocol's Emission Factors from Cross-Sector Tools (2017); except for acetylene which is provided by CDP's Guidance methodology for estimation of scope 3 category 11 emissions for oil and gas companies (2016). Historical figures for Direct Energy (Gases) have been restated accordingly.
- Emission factors for acetylene and carbon dioxide (used as shielding gas) are sourced from the US EPA Shipbuilding Inventory Tool (version 2.1); carbon dioxide (CO₂) is the only greenhouse gas included in this calculation.
- Emission factors for all other Scope 1 emissions are sourced from the World Resources Institute's GHG Protocol tools for stationary combustion (version 4.1) and for transport or mobile sources (version 2.6). The greenhouse gases included in this calculation are CO₂, methane (CH₄) and nitrous oxide (N₂O).
- Emission factors for Scope 2 are guided by the Energy Market Authority of Singapore. Electricity emission for the current reporting year is an estimate as it applies the latest available factor at the time of report preparation, which is often the previous year's emission factor. The only greenhouse gas included in this calculation is CO₂.
- Scope 2 figures for 2015 and 2016 have been restated due to revision of emission factors by the Energy Market Authority in 2017. Changes to figures are less than 2.5%.
- Water consumption is consolidated from utility invoices.
- Waste disposal information is provided by waste disposal contractors.