ENVIRONMENTAL SUSTAINABILITY

Sembcorp Marine's philosophy of environmentally-responsible operations aligns with several of the United Nation's Sustainable Development Goals. The Group strives to improve operational efficiency as well as product development through the responsible consumption of resources, proactive management of water systems and sanitation, efficient production as well as the adoption of new technology for sustainable infrastructures.

73%
OF TOTAL WASTE IS RECYCLED

Sembcorp Marine's environmental policies, procedures and processes are incorporated into a management system which is implemented by facilities management, business excellence representatives as well as health, safety and environment teams.

To identify, assess and control operational impact on the environment and community, an Environment Aspect and Impact Assessment tool is used. Assessment templates are customised to specific work groups and evaluations are performed on work environments, job scopes, materials and protocols. Environmental aspects such as emission levels, energy and resources consumption, water discharge, as well as types and volumes of wastes are assessed against potential risks such as resource depletion, global warming, and pollution.

Tuas Boulevard Yard and Admiralty Yard, two of the Group's largest yards which account for approximately 73% of its total operational area in Singapore, have systems which are certified to ISO 14001 Environmental Management standard.

The Group abides by a strict set of national guidelines such as the Singapore Environment Protection and Management Act (EPMA); the Environmental Public Health Act (EPHA); the Maritime and Port Authority of Singapore's (MPA) Prevention of Pollution of the Sea Act; and the Hazardous Waste (Control of Export, Import and Transit) Act which aligns with the International Basel Convention on the control of transboundary movements of hazardous wastes and their disposal.

Through a holistic system of control processes and regulations, outreach activities, awareness campaigns and training, the Group inculcates in employees, contractors, customers and other onsite stakeholders the importance of mitigating the impact of business operations on the environment. Outreach initiatives in 2018 included the Kaombo Sul "Beat the Plastic, Save our Environment" campaign, the E4Rs (Eliminate, Reduce, Reuse, Recycle, Recover) initiative as well as a coastal clean-up exercise with the local community.

Sembcorp Marine is committed to the Singapore Climate Action Pledge and is also a member of the World Ocean Council. Championing environmental responsibility, sustainable ocean

More information on how Sembcorp Marine manages environmental sustainability holistically can be found here:

- Products and solutions – Innovation and Solutions Development, pages 118 - 122
- Responsible procurement practices – Value Chain Management, pages 123 - 129
- Community outreach programmes – Community Engagement, pages 159 - 160
- Framework and systems – www.sembmarine.com/sustainability/environment
- Operational innovation – www.sembmarine.com/sustainability/case-study-features

Sembcorp Marine's 4.5 megawatt-peak solar harvesting panels and digital energy-saving system will come fully online in 2019. The harvested energy will be fed into the yard's digital energy-saving system which will manage and monitor the facility's power usage

development as well as the adoption of greener practices, the Group organises the annual Green Wave Environmental Care Competition that brings together school children and youths to apply their creative talent in developing innovative solutions for environmental issues.

ENERGY CONSUMPTION AND GREENHOUSE GAS EMISSIONS

The Group's yards are managed by Energy Managers who are trained and certified to work with employees, contractors, management and stakeholders to manage and track energy usage. They also implement policies to increase efficiency and reduce wastage. Ministries and other stakeholders are engaged regularly to compare and benchmark yard energy consumption, as well as explore ways to reduce consumption inefficiency.

Sembcorp Marine consumes energy for two primary purposes:

1. Powering buildings, equipment and generators:
   - Electricity – Procured from the national grid. In 2018, this was generated from 95.0% natural gas, 1.3% coal, 0.7% petroleum products (mainly diesel and fuel oil) and 3.0% from other sources such as solar and biomass[1].
   - Diesel – Used for generators when working in locations not accessed by electricity lines such as in vessel tanks or during the commissioning of certain vessel equipment; as well as for fueling vehicles such as forklifts and cranes in the yard.
2. Cutting and welding activities:
   - Gas fuels – These consist of natural gas (NG), liquefied petroleum gas (LPG) and acetylene as well as carbon dioxide as a shielding gas. These gas fuels are used during the cutting and welding of metals and parts and are purchased from nationally certified vendors.

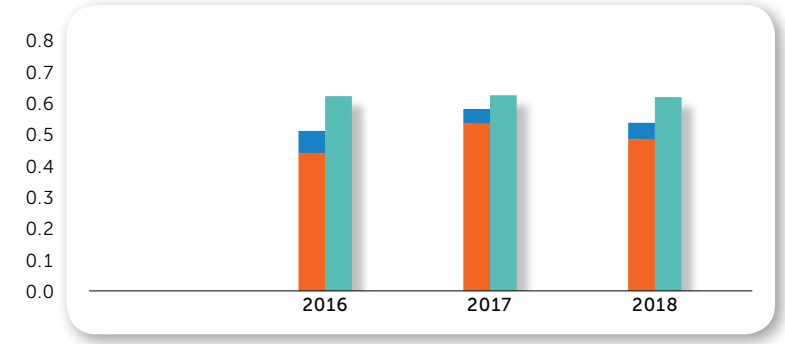
In 2018, several large projects progressed into the next stages of construction, resulting in an increase in welding and cutting activities, as well as the consumption of associated gases. To reduce reliance on carbon fuel and lower emission of greenhouse gases, the use of diesel-powered compressors were replaced where practicable with electricity compressors.

1 *Latest figures at time of print from "Singapore Energy Statistics 2018", page 21, Table 2.2 Annual Fuel Mix for Electricity Generation by Energy Product, Research and Statistics Unit, Energy Market Authority, Republic of Singapore.*

ENVIRONMENTAL SUSTAINABILITY

Energy Consumption

Million GJ

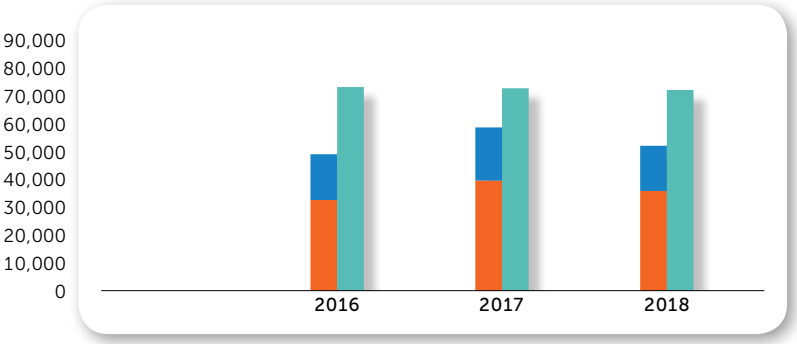


	2016	2017	2018
Direct Energy (Gases)	0.071	0.047	0.053
Direct Energy (Diesel)	0.440	0.534	0.484
Indirect Energy (Electricity)	0.622	0.625	0.619
Total Energy	**1.133**	**1.205**	**1.156**

DIRECT ENERGY (GASES) DIRECT ENERGY (DIESEL) INDIRECT ENERGY (ELECTRICITY)

Greenhouse Gas Emission

tCO_2e



	2016	2017	2018
Scope 1 (Gases)	16,446	19,086	16,227
Scope 1 (Diesel)	32,589	39,578	35,843
Scope 2 (Electricity)	73,184	72,739	72,129
Total Emissions	**122,220**	**131,403**	**124,200**

SCOPE 1 (GASES) SCOPE 1 (DIESEL) SCOPE 2 (ELECTRICITY)

Note: Scope 2 historical data for electricity has been restated in alignment with new Grid Emission Factors issued by the Energy Market Authority in July 2018.

The Group's 4.5 megawatt-peak solar farm will become fully operational in 2019, enabling its flagship Tuas Boulevard Yard to replace part of its electricity consumption with renewable solar power. A digitalised system equipped with a one megawatt battery and energy sensors will further enhance the capacity management efficiency of the yard's electricity network. An estimated reduction of 2,500 tonnes of carbon emissions at peak load is expected per year.

AIR QUALITY

Sembcorp Marine's commitment to air quality standards is reflected in its operational protocols. All copper grit blasting, a common yard activity for cleaning or priming metal surfaces, are performed in localised enclosures where practicable with advanced filtration systems. The airborne particulate matter (PM2.5) levels within the immediate and extended boundaries of the yards are monitored regularly to ensure compliance with air quality standards.

Additionally, the yards advocate that customers use environmentally friendlier processes, such as hydro-blasting and steel grit-blasting, where feasible to minimise the impact on air quality.

Regular leak checks are conducted on utility pipelines to eliminate wastage of resources

WATER

As a small island nation with limited natural resources, Singapore is ranked as one of the world's most water stressed countries (World Resources Institute, 2015). Sembcorp Marine recognises water as a valuable resource and is committed to managing it responsibly.

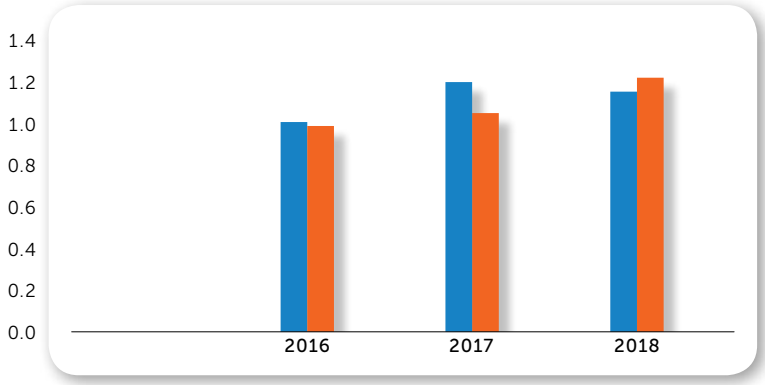
The Group draws its water from sources managed by the Singapore Public Utilities Board (PUB). This consists of potable water and reclaimed NEWater supplied from four nationally managed sources – local catchments such as reservoirs and storm drains, desalinated seawater, imported water, and reclaimed water.

Water Efficiency Managers at the yards monitor and audit water withdrawal, consumption, discharge and efficiency programmes. Water consumption is mapped across the yards and reported annually to the ministry in charge. Aside from withdrawal of water for building activities such as office pantries, toilets and canteens, the yards also use water for its operations. Activities which utilise large volumes of water include hydro-blasting as well as cleaning pipes, tanks and equipment from customer vessels that arrive at the yards for repair and maintenance. NEWater, water reclaimed by PUB from used water, is used as much as possible in the yards to reduce the stress on potable water from national resources.

Sembcorp Marine also works with national water management bodies to discuss needs and concerns; and to develop and deploy water-related measures. Water conservation activities are organised to engage employees, contractors, customers and stakeholders. These include regular leak checks, joint inspections, leak report hotlines, positive behaviour visual reminders and awareness campaigns.

The integrity of Singapore's water source and drainage system is heavily regulated by national regulations such as the Environment Protection and Management Act, Singapore Sewerage and Drainage Act, Code of Practice on Sewerage and Sanitary Works, and Sewerage and Drainage (Sanitary Works and Sewerage Works) Regulation. Sembcorp Marine yards are required to maintain government-regulated approvals so that any discharge into the watercourse is in accordance with Singapore's Environmental Protection and Management (Trade Effluent) Regulation.

Water Consumption
Million m^3



	2016	2017	2018
Potable Water	1.008	1.200	1.154
NEWater	0.989	1.051	1.221
Total Water Consumption	**1.997**	**2.251**	**2.375**

POTABLE WATER NEWATER

Total water consumption increased by 6% in 2018, in line with the work scope required by the Group's projects. In 2018, NEWater accounted for 51% of total water withdrawal.

MATERIALS MANAGEMENT

The Group's progress at automating its production processes has yielded meaningful reductions in materials wastage. Increased precision and new technology have resulted in more accurate and efficient material management in facilities such as the Group's largest steel fabrication workshop in the Tuas Boulevard Yard. Marine superstructures and semi-manufactured parts require steel which continues to be the primary raw material consumed by the Group. The consumption of steel plates and pipes rose to 1,638,735 MT in 2018, compared to 115,982 MT in 2017. This increase is attributed to several large projects progressing further into their fabrication stages.

Steel and steel pipes are a significant construction material used for vessels and offshore facilities

ENVIRONMENTAL SUSTAINABILITY

Copper grit, an abrasive byproduct used to strip and prime metal surfaces, is another key raw material consumed in the Group's operations. However, its usage marked a slight downward trend due to the nature of work in 2018 as well as progressive efforts to replace copper grit where practicable with steel grit (which has a higher reuse rate), resulting in less airborne particles. A total of 60,585 MT of copper grit was consumed in 2018, a 12% decrease from 69,184 MT in 2017.

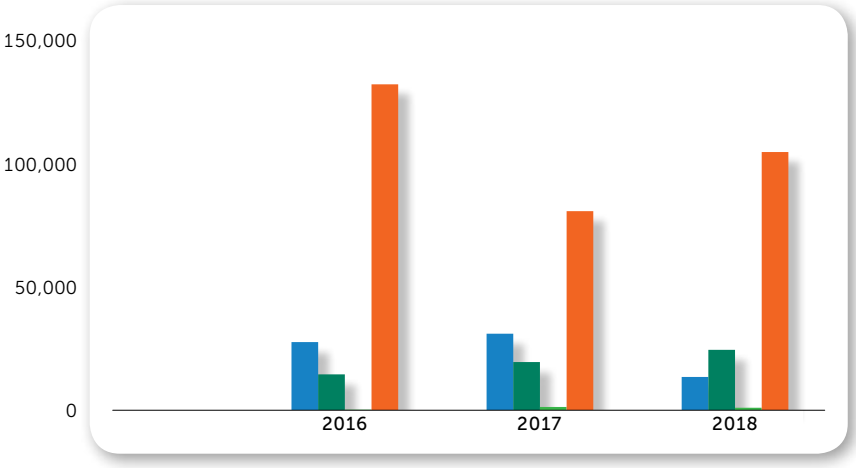
WASTE MANAGEMENT

The collection, treatment, and disposal of the Group's hazardous, non-hazardous and recycled waste are managed by service providers with nationally regulated permits. Group-wide policy, regulations, and codes of conduct provide guidance on material procurement, classification, handling and disposal, training and emergency response procedures for all employees, suppliers, customers and other stakeholders within the yards' boundaries. Awareness programmes which reward positive behaviours inculcate a mindset to reduce waste as well as maximise the reuse, recycling and recovery of materials.

Company operations produce three main types of waste:

- **Recycled waste:** The Group's policies and initiatives advocate the repurposing of waste materials. In addition to well-established programmes for recycling steel, spent copper grit, wood and paper with external recycling business partners, Sembcorp Marine's facility management identifies opportunities to maximise material efficiencies by reusing waste or scrap between departments in the Group. These include product packaging and spent copper grit.

Types of Waste
Metric Tonne



	2016	2017	2018
Non-Hazardous Waste	27,657	31,056	13,506
Hazardous Waste	14,748	20,883	25,525
(from customers)	*14,558*	*19,552*	*24,510*
(from direct operations)	*190*	*1,331*	*1,015*
Recycled Waste	132,241	80,779	104,770

NON-HAZARDOUS WASTE
HAZARDOUS WASTE (FROM CUSTOMERS)
HAZARDOUS WASTE (FROM DIRECT OPERATIONS)
RECYCLED WASTE

- **Non-hazardous waste:** Non-hazardous waste is removed by certified vendors who sort the material for recycling or waste-to-energy incineration. Examples of such waste include general rubbish and food waste from company operations or removed from vessels on behalf of customers.
- **Hazardous waste:** Transported and processed only by nationally certified handlers, all hazardous waste is sent for recovery where feasible; or for disposal of remaining matter through waste-to-energy incineration. This includes chemical substances categorised by Globally Harmonised System of Classification and Labelling of Chemical (GHS) codes, spent paint drums, solvents from cleaning equipment, as well as oily sludge which is a byproduct of cleaning customer vessel pipes and tanks.

In 2018, recycled waste volume rose largely due to more steel scrap and spent copper grit sent for reclamation and upcycling purposes. The nature of work scope in 2018 also led to more hazardous waste removed on behalf of customers.

Sembcorp Marine's latest yard at Tuas South Boulevard utilises closed loop systems in its major workshops, which enable the Group to strictly regulate the impact of chemical washing when servicing customers' equipment. The waste water from these workshops is channeled to an onsite waste water treatment plant. Together with oily sludge removed from vessels, the waste materials undergo a four-level filtration system at an onsite treatment facility, resulting in water safe for release into the national drainage system, and compacted sludge waste which is sent for waste-to-energy incineration.

Regular assessments conducted in the yards include integrity checks of pipe systems, bulk storage tanks and silos. Storage tanks containing diesel oil, sewage and oily wastewater-sludge are installed with secondary spill containment systems to mitigate leakage impact. Oil spill kits and oil dispersion kits are located at various points across the yards and employees are trained to immediately deploy them in response to any emergency. Sembcorp Marine's management procedures and spill response guidelines are aligned with global and national standards, including Singapore's EPMA, EPHA, MPA's Prevention of Pollution of the Sea Act and the US Environmental Protection Agency's (EPA) Oil Pollution Act. No significant spills were recorded in 2018.

Emergency response exercises ensure employees, contractors and other onsite stakeholders are equipped with the knowledge and equipment to react quickly and efficiently

DATA AND REPORTING

The environmental report collates data from the Group's Singapore yards where it has operational control. These yards account for the most significant contribution to Sembcorp Marine's operations. More details can be found on page 343.

The following details are sources of conversion factors and data used in this chapter of the Sembcorp Marine 2018 Sustainability Report:

- 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 (CO_2) 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 CO_2, methane (CH_4) and nitrous oxide (N_2O).
- 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 CO_2.
- The Energy Market Authority of Singapore issued a revision of emission factors for 2016 and 2017 ("Singapore Energy Statistics 2018", page 103, Table 7.1 Electricity Grid Emission Factor and Upstream Fugitive Methane Emission Factor, Research and Statistics Unit, Energy Market Authority, Republic of Singapore). The Group has adjusted its Scope 2 figures for 2016 and 2017 accordingly. Changes to figures are less than 2%.
- Water withdrawal is consolidated from utility invoices.
- Waste disposal information is provided by waste disposal contractors.