Assertion Report of GHG Emission for Financial Year 2017-2018

The Great Eastern Shipping Co. Ltd.

Chapter 1 – Organization Profile

1.1 History of Organization

THE GREAT EASTERN SHIPPING COMPANY LTD., incorporated in 1948, has expanded steadily first under the leaderships of Late Vasant J. Sheth, Mr. K.M. Sheth and now Mr B.K. Sheth to become India's largest shipping company in the private sector.

Although established in 1948, the Company traces its roots back to the First World War.

During World War 1, the firm of Jagjiwan Ujamshi Mulji was set up in Bombay by Chunilal, Maneklal and Jagjiwan, the three sons of Ujamshi Natalia. The firm operated as a trader in various commodities for 15 years, until the Great Depression of the late 1920s. In 1929, the brothers joined forces with Sir Dossabhai Bhiwandiwalla, and set up the firm of A.H. Bhiwandiwalla & Co. (AHB as the firm came to be popularly known).

In 1948, AHB acquired a cargo vessel, the Fort Ellice, renamed Jag Vijay. This was meant to be an adjunct to the trading operations: however, it soon became clear that a capital intensive business like shipping needed an autonomous Company.

The Great Eastern Shipping Company Ltd. was, therefore, set up with 40% of its equity subscribed to by Shree Changdeo Sugar Mills, and the rest by the Sheth-Mulji and Bhiwandiwalla families. The operations of the Company were left to Vasant J. Sheth, youngest son of Jagjiwan Ujamshi Mulji, one of the founders of the original trading firm.

During the late 1970s, the Bhiwandiwallas retired from the business, selling their interest in AHB (by now an incorporated Company) to their partners.

Given the cyclic nature of the shipping industry, the need for diversification was always in the mind of the management. When the government decided to throw open the area of offshore supply vessels to the private sector, The G E Shipping was the first to take the plunge in 1982, at the initiative of Mr. K.M. Sheth.

From the very beginning, The G E Shipping has been on the leading edge. The company has not been afraid to try out new technologies, not worried about going against the tide. Not surprisingly the Company has an impressive history of firsts to its credit, e.g. in 1956, the company acquired its first oil tanker – it was also India's first. It proved so successful that Company's tanker fleet has just kept growing. In the same year German ship building company Blohm & Voss produced a revolutionary "pioneer" type of ship. The G E Shipping was the first company in the world to opt for it, and there after ordered four more ships in India, to that design. In 1962, the company was the first shipping company to start regular liner services to carry general cargo from the Pacific coast of the US and Canada to India.

The fleet now comprises tramp ships which includes oil tankers, chemical tankers, gas carriers and bulk carriers. The company's operations are global.

The Company has at its helm the Executive Chairman Mr. K. M. Sheth and the Deputy Chairman and Managing Director Mr. Bharat Sheth. Under their stewardship Company continues to perform and deliver results in an increasingly competitive environment duly deserving the honour of India's premier shipping organization.

1.2 Brief Description of present activities

G E Shipping enjoys a formidable presence in the international maritime industry. The shipping business operates under two main sectors: dry bulk carriers and tankers (oil, chemical and gas). The tankers enjoy approvals from oil giants like SHELL, BP, EXXONMOBIL, CHEVRON TEXACO, TOTALFINA to name a few. As of 31st March 2018 the fleet consisted of 47 vessels (32 Tankers and 15 Bulk Carriers) totalling 3.88 million Deadweight Tonnes with an average age of 10.37 years.

Backed by an enviable clientele comprising industry leaders, international oil companies and governments who vouch for its services, the division has earned the status of being the most preferred shipping service provider. With a pulse on the global market and a thorough understanding of the ever-evolving market needs, the division is well-equipped to anticipate the demands of its clients and to deliver on its commitments, successfully and satisfactorily.

The Company operates its vessels on voyage charter (spot) as well as period charter (time).

The company management system is certified to ISO 9001: 2008, ISO 14001: 2004 and OHSAS 18001: 2007 standards by DNV-GL. Certification audit to upgraded standards of ISO 9001: 2015, ISO 14001: 2015 and ISO 45001: 2018 is scheduled in August 2018.

1.3 Objective of this report

The objective of this report is to capture and quantify GHG emission from our owned vessels in a transparent and standardized manner for the information of stakeholders of the Company on a voluntary basis. G. E. Shipping is committed to reduce GHG emission from its vessels and has been taking several measures to do so by way of retrofitting vessels with energy saving devices, better hull surface management, close monitoring of fuel efficient operation of vessels and quantification and reporting of GHG emission from its vessels to facilitate taking informed decisions with respect to further enhancing energy efficiency of ships.

The GHG emission quantification and reporting is done taking into account:

- ISO 14064-1 (2006) "Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals, and
- The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard (Revised edition) published by World Business Council for Sustainable Development and World Resources Institute.

1.4 Roles and responsibilities of Vessel Performance Management Department

Vessel Performance Management Department was established in early 2014 with following responsibilities:

- Fuel Efficiency Performance monitoring of vessels
- Establishing and monitoring related Operational KPIs
- Providing MIS to Management (Quarterly, Annually)
- Identification and review of Energy Saving Technologies
- Preparation / presentation of decision support documents for Management approval;
- Enhancing Fuel Efficiency of Vessels through retrofitment of Energy Saving Devices / Operational Measures in co-ordination with Technical / Operation / IT Depts.;
- Training / Awareness building on Energy Efficiency of Personnel ashore and onboard vessels
- Quantification and reporting of GHG inventory.

The Head of Department reports to Executive Director and President (Shipping).

1.5 Management System and Policies

1.5.1 Mission Statement

Consistent with the Company's policy and philosophy of maintaining professional excellence in all spheres of activity involving marine bulk transportation service, including Quality, Heath, Safety, Security Environment (QHSSE) and Social Responsibility, our mission shall be:

• To own, operate and manage ships with zero spills to sea, zero incidents, zero tolerance to drugs and alcohol, while protecting the lives of shipboard personnel, cargo and company's own assets and reducing environmental emissions by employing best management practices;

• To provide a highly efficient and competitive marine bulk transportation service of quality, cost, reliability delivery and security;

• To achieve excellence in our management systems and standards through continual improvement and by employing best practices through an efficient and responsive management and an empowered and highly motivated work force;

• To create enhanced value for our shareholders and other stake holders.

1.5.2 COMPANY POLICY

With utmost consideration for the Safety of Life and Property and the Protection of Environment, the Company dedicates itself to meet the expectations of its Customers and the aspirations of its Stakeholders by ensuring that an effective Integrated Management System is in place that complies with the relevant National and International Codes, Standards, Statutory and Regulatory requirements.

In line with our strategy to be a market leader, an Organization caring for the environment and society, and a preferred safe and secure service provider, we shall monitor and ensure the effectiveness and continual improvement of our systems, leading to excellence.

With our firm belief in team success, we shall achieve our objectives by providing training and adequate resources to a highly motivated and an empowered workforce with due regard to their health, safety, security and welfare.

We commit to fulfil our social responsibility with conviction and determination, for the betterment of society at large.

1.5.3 INTEGRATED MANAGEMENT SYSTEM POLICY

Recognizing that achieving excellence in respect of Quality, Health, Safety, Security, Environment and Social Responsibility is paramount to the success of our business, we give highest importance to these aspects. Accordingly, we commit ourselves to:

- Understanding the requirements of our customers and striving to exceed their expectations;
- Building mutually beneficial relationships with service providers and company personnel;
- Improving operational, technical and commercial performance of ships operated by us;
- Complying with applicable Flag and Port State legislations and other requirements, as applicable;
- Maintaining an optimum spare parts inventory based on critical equipment and system redundancy identified on all vessels;
- Providing for safe practices in ship operation and a safe and healthy working environment;
- Identifying all relevant hazards to the safety, health and security, assessing the risks and establishing safeguards against all identified hazards;
- Ensuring that adequate attention is paid towards selection and career development of shore-based and shipboard personnel, with a view to ensure that all responsible persons are fully competent to perform the task with which they are entrusted;
- Continually enhancing the safety management skills of personnel ashore and on-board ships, including preparing for emergencies related to safety, protection of environment and security;
- Establishing and monitoring the health standards of employees working in the shore-based offices and on-board the ships;
- Continually improving the performance and effectiveness of our integrated management system;
- Preventing all types of pollution of sea by oil, garbage, sewage and other harmful substances;
- Reducing air pollution and reducing-recycling-reusing all types of waste;
- Preventing injury, accidents, illnesses, damages, losses and deficiencies in our service;
- Following and enforcing a zero tolerance policy towards drugs and alcohol;
- Conserving all types of natural resources including energy, and committing to fulfill our social responsibility with conviction and determination for the betterment of society at large.

It shall be ensured that senior officers have appropriate experience and training on their particular type and size of ship. Company provides career development for junior officers and aims to recruit senior officers from within the company where possible. Senior officers are encouraged and appraised to always lead by example in safety related issues.

Company commits itself to providing adequate resources and training to its personnel, whether shore-based or on board ships, to meet the requirements of this policy. It shall be ensured that all personnel understand the policy and endeavor their utmost to implement the same at all times.

1.5.4 Policy on Conservation of Energy

As a part of Company's policy for conservation of natural resources and protection of environment, the Company lays importance on conservation of energy. The Company is aware that we all depend

on natural resources for all our energy requirements and the Company considers these resources as treasure.
The Company is concerned about the challenges presented by earth's diminishing natural resources and global warming in general and energy supply in particular.

To make our existing energy resources last longer and reduce green house gas emission, the Company is committed to:

- Making a sincere, controlled and conscientious effort in use of available resources (fossil fuel) with a view to deal with availability and crisis;
- Putting limits wherever practicable, on use of facilities with a view to reduce consumption;
- Avoiding inefficient and improper use of resources thus controlling waste of energy;
- Adopting better methods in work area such as proper and timely maintenance of ship and her machinery and equipment.

1.5.5 Corporate Social Responsibility Vision Statement and Objective

For Great Eastern, CSR means responsible business policies that are ethical, equitable, environmentally conscious, gender sensitive, and sensitive towards the differently abled. This policy, which has been formulated in alignment with the vision of the company, lays down guidelines and mechanisms to be adopted by the Company in order to carry out CSR Projects/Programs.

The objectives of this policy are to–

- Demonstrate commitment to the common good through responsible business practices and good governance.
- Actively support the state's development agenda to ensure sustainable and equitable change.
- Set high standards of quality in the delivery of services in the social sector by creating robust processes and replicable models.
- Engender a sense of empathy and equity among employees of GES to motivate them to give back to the society.

The structure for identification of these causes, and the modalities of the investment in these causes, are spelled out in detail in the following sections.

1.5.5.1 Focus Area

The Company's CSR efforts will be focused in the areas of:
a. Promoting education and knowledge enhancement, including but not limited to:
i) Establishment and management of educational and knowledge enhancement infrastructure;
ii) Provision of financial or other assistance to the needy and/or deserving students;
iii) Providing financial assistance to any Agency involved in education, knowledge enhancement and sports;
iv) Contribution to technology incubators located within academic institutions which are approved by the Central Government.
b. Eradicating hunger, poverty, and malnutrition

c. Promoting health care and sanitation

1.5.6 Overall strategy on energy saving and pollution prevention

The Company has established, implemented and maintains procedure(s) to identify the environmental aspects of its ship and shore-based operations defined within the scope of the environmental management system that it can control and those it can influence, taking into account planned or new developments or new or modified activities and services. The Company determines which environmental aspects have or can have a significant impact on the environment. The Company has documented this information and keeps it up-to-date. Proactive steps are taken to not only ensure compliance with statutory requirements but to stay ahead of the regulatory curve.

The Company ensures that the significant environmental aspects are taken into account in establishing, implementing and maintaining its environmental management system.

1.5.7 Reporting Period

This assertion report is for Financial Year 2017-2018 i.e. 1st April 2017 to 31st March 2018. The first year of GHG emission accounting as per ISO 14064-1 standard was Financial Year 2015-2016.

Chapter 2 – Scope and Boundary of GHG Reporting

2.1 Description of GHG emissions

2.1.1 Organizational Boundary

The organizational boundary for accounting of GHG emission is taken as vessels owned and managed by G.E. Shipping, electricity consumption at its Registered Office in Ocean House, Mumbai and electricity consumption at training academy of the Company known as Great Eastern Institute of Maritime Studies at Lonavala in Maharashtra.

On 31st March 2017 the fleet size was 44 vessels and 3.69 million Deadweight Tonnes. During the reporting period Jag Lokesh, Jag Pavitra, Jag Vijaya, Jag Rohan were acquired and Jag Rahul was sold making the total fleet size as 47 vessels and 3.88 million Deadweight Tonnes.

Since this reporting is being voluntarily made for the stakeholders, the **control approach** is the most appropriate since the Company can be held accountable for vessels under their ownership and technical management only. It is to be also borne in mind that responsibility for ensuring compliance with international regulatory requirements for a vessel rests with ship owner and technical manager. Ships are generally employed under either “Voyage Charter” or “Time Charter”.

A voyage charter can be defined as the hire contract for a vessel for one or a specified number of voyages to carry specified cargo/es at stipulated freight rates (or lumpsum) on agreed terms and conditions between designated load and discharge ports, port ranges or regions. The shipowner pays for all fuel the vessel consumes.

A time charter can be defined as the hire contract of a vessel for a specific period of time; the owner still manages the vessel but the charterer selects the ports and directs the vessel where to go. The charterer pays for all fuel the vessel consumes. The Charterers pay a daily hire for the vessel.

G E Shipping charters out its owned vessels either on Voyage Charter or on Time Charter depending on the nature of charter that will provide best commercial benefit for a vessel at a given point in time. During the financial year, for all completed voyages, the number of sailing days of the fleet vessels was broadly 60% under Voyage Charter and 40% under Time Charter.

G. E. Shipping occasionally, to supplement its owned fleet, hires vessels under time charter over which it has no technical management control and as such these vessels are excluded from boundary of reporting under Scope 1 and Scope 2.

Greatship (India) Limited (GIL), wholly owned subsidiary (WOS) of G. E. Shipping is one of India's largest offshore oilfield services providers by way of owning and operating fleet of vessels. It is a separate company operated by its own Board of Directors and hence it is not included within the scope of this assertion report.

2.1.2 Operational Boundary

G E Shipping accounts for and reports its emissions of all applicable Kyoto GHGs (i.e. carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and hydrofluorocarbons (HFCs) from all direct sources of emissions.

Sulphur Hexafluoride SF6

Sulphur hexafluoride (SF_6) is a colourless, odourless, non-toxic, non-flammable gas that has a high dielectric strength. It has been used as a dielectric in microwave frequencies, as an insulating medium for the power supplies of high-voltage machines on board ships. The use of SF_6 in electrical switchgear in general (all land, air and sea installations) is primarily (90%) concentrated on the high-voltage segment (>36 kV) and the remaining 10% for the medium (1 kV–36 kV) voltage segment (Schneider 2003). None of the G E Shipping vessels have such high voltage installations and consequently SF_6 emission is not applicable.

Perfluorocarbons (PFCs)

Several binary and ternary blends of various HFC, HCFC, PFC and hydrocarbon refrigerants have been developed to address continuing service demand for CFC-12. These blends are tailored to have physical and thermodynamic properties comparable to the requirements of the original CFC-12 refrigerant charge. In shipping industry this refrigerant is used for deep-freezing purposes (-40°C to -70°C) on reefer vessels and fishing vessels. None of our fleet vessels has such deep freezers and consequently use of PFCs is not applicable.

Scope 1 (Direct GHG emissions)

- Emission resulting from combustion of fuel oils in company owned and managed vessels' main engines, auxiliary engines, boilers, inert gas generators (fitted on some of the tankers) and auxiliary engines for Framo hydraulic power units (fitted on some of the tankers).

- Emission resulting from unintentional releases of hydrofluorocarbon (HFC) used as refrigerants for air conditioning and provision refrigeration plants on company owned and managed vessels.

Scope 2 (Indirect GHG emissions from electricity consumption)

- Emission from generation of purchased electricity consumed at Ocean House, Head Office of G E Shipping based in Mumbai and training academy of the Company known as Great Eastern Institute of Maritime Studies at Lonavala in Maharashtra.

2.2 Description of Assets

2.2.1 Assets in FY 2017-2018

Table 2.2.1 – Assets (FY 2017-2018)

Name of Vessel	IMO No.	Type of Vessel	Date of Built	Deadweight (DWT)
Suezmax				
JAG LAKSHITA	9208057	Oil Tanker	22-May-00	147079.56
JAG LATEEF	9208069	Oil Tanker	31-Jul-00	147079.56
JAG LOK	9293507	Oil Tanker	01-Mar-05	158145.20
JAG LALIT	9297905	Oil Tanker	19-May-05	158344.00
JAG LEENA	9516105	Oil Tanker	09-Feb-2010	157671.70
JAG LAKSHYA	9516117	Oil Tanker	05-Jan-2011	157641.60
JAG LAADKI	9194983	Oil Tanker	03-Aug-2000	150284.00
Aframax				
JAG LAVANYA	9237412	Oil Tanker	19-Jan-04	105010.40
JAG LATA	9237618	Oil Tanker	19-May-03	105716.00
JAG LYALL	9308443	Oil Tanker	02-Jan-06	110530.80
JAG LEELA	9568184	Oil Tanker	23-Sep-2011	105525.20
JAG LAXMI	9568196	Oil Tanker	05-Jan-2012	105525.20
LR2				
Jag LOKESH	9390599	Oil Tanker	05-Jan-2009	105599.00
LR1				
JAG AABHA	9388948	Oil Tanker	03-Nov-08	74867.70
JAG APARNA	9388936	Oil Tanker	09-Jun-09	74859.30
JAG AMISHA	9388924	Oil Tanker	03-Apr-09	74889.20
JAG AANCHAL	9390161	Oil Tanker	05-Dec-08	74811.16
MR				
JAG PRANAV	9281932	Oil Tanker	05-Jan-05	51383.00
JAG PRANAM	9310680	Oil Tanker	13-Dec-04	48694.00
JAG PRABHA	9270749	Oil Tanker	28-Oct-04	47999.00
JAG PUSHPA	9315733	Oil/Chemical Tanker	27-Apr-07	47848.00
JAG PRERANA	9321952	Oil/Chemical Tanker	04-Oct-07	47824.23
JAG PRAKASH	9315721	Oil/Chemical Tanker	28-Mar-07	47848.23
JAG PANKHI	9258686	Oil Tanker	21-May-03	46272.70
JAG PAHEL	9289506	Oil Tanker	12-Oct-04	46319.30
JAG PADMA	9325348	Oil Tanker	27-Sep-2005	47999.00
JAG POOJA	9310692	Oil Tanker	25-Jun-2005	48539.00
JAG PUNIT	9709984	Oil Tanker	01-Apr-2016	49717.40
JAG PAVITRA	9387956	Oil Tanker	24-Dec-2008	51463

Gas Carrier				
JAG VISHNU	9052331	Gas Carrier	25-Mar-1994	49353.00
JAG VIDHI	9115303	Gas Carrier	31-Jan-1996	49849.00
JAG VIJAYA	9139696	Gas Carrier	30-July-1997	26897
Capesize				
JAG ANAND	9463308	Bulk Carrier	09-Jun-2011	179250.00
Kamsarmax				
JAG ARNAV	9705354	Bulk Carrier	03-Jun-15	81732.00
JAG AARATI	9478200	Bulk Carrier	25-Feb-11	80325.20
JAG ADITI	9478195	Bulk Carrier	01-Apr-11	80325.20
JAG ARYA	9491288	Bulk Carrier	01-Jan-11	80480.40
JAG AJAY	9723849	Bulk Carrier	30-Jun-2016	82094.20
JAG AALOK	9706566	Bulk Carrier	29-Jul-2016	82022.60
JAG AKSHAY	9706554	Bulk Carrier	29-Aug-2016	82044.30
JAG AMAR	9723851	Bulk Carrier	11-Jan-2017	82083.80
Supramax				
JAG ROOPA	9317145	Bulk Carrier	19-Sep-06	52454.00
JAG RATAN	9222613	Bulk Carrier	20-Jul-01	52179.79
JAG RANI	9456355	Bulk Carrier	08-Jul-11	56718.80
JAG RISHI	9456343	Bulk Carrier	01-Mar-11	56718.80
JAG RADHA	9496135	Bulk Carrier	27-Nov-2009	58133.00
JAG ROHAN	9324631	Bulk Carrier	20-Jan-2006	52450.00

2.2.2 Assets acquired and sold in FY 2017 - 2018

Name of Vessel	**IMO No.**	**Type of Vessel**	**Date of Built**	**Deadweight**	**Vessel Acquired on**
Jag Rohan	9324631	Bulk Carrier	20-Jan-2006	52450	02-May-2017
Jag Pavitra	9387956	Oil Tanker	24-Dec-2008	51463	15-Jun-2017
Jag Vijaya	9139696	Oil Tanker	30-July-1997	26897	25-Sep-2017
Jag Lokesh	9390599	Oil Tanker	05-Jan-2009	105599	27-Sep-2017

Name of Vessel	**IMO No.**	**Type of Vessel**	**Date of Built**	**Deadweight**	**Vessel Sold on**
Jag Rahul	9254484	Bulk Carrier	08-Jan-03	52364.00	22-Feb-2018

2.2.3 Vessels operated on Charter in FY 2017 – 2018

Name of Vessel	**IMO No.**	**Type of Vessel**	**Date of Built**	**Deadweight**	**Period during which Vessel was on Charter in FY 2017-2018**
Erviken	9274812	Oil Tanker	15-Jun-2004	152146.5	01-Apr-2017 to 31-May-2017

2.3 Uncertainty assessments and materiality threshold

2.3.1 Uncertainty Assessment

There are a few known sources of uncertainty in our assessment and these are as follows:

1. Accuracy margin of ±0.5% of the fuel flow meters in use on board ships. The fuel flow meters are calibrated against fuel tank soundings for each voyage as per procedure documented in Fleet Operation Manual para 7.7.1.5.
2. Procedure for calculation of mass of fuel consumed from fuel flow meter readings is given in Fleet Operation Manual para 7.7.1.4. Uncertainty due to human error in incorrect use of the procedure is estimated to be ±0.5%.
3. Total uncertainty is thus considered to be ±1.0%.

2.3.1.1 Completeness of data
In Live Vessel Information System (LIVIS) a Vessel Report Checklist has been incorporated which identifies status of Noon Report received from vessels for any selected period. Safety feature has been also incorporated which prevents sending Noon Report for a day without sending Noon Report of the preceding day. This ensures completeness of data.

2.3.2 Materiality threshold
Materiality threshold is considered to be 1% and all emissions aggregated to that amount are not considered.

2.4 Inclusion / exclusion of assets and emissions

Emission from incineration of oil residue / sludge on board vessels – *MEPC.1/Circ.642 – 2008 Revised guidelines for systems for handling oily wastes in machinery spaces of ships incorporating guidance notes for an integrated bilge water treatment system (IBTIS)* defines Oil Residue (Sludge) as follows:
Oil residue (sludge) means the residual waste oil products such as those resulting from the purification of fuel or lubricating oil from main or auxiliary machinery or separated waste oil from bilge water separators, oil filtering equipment or oil collected in drip trays, and waste hydraulic and lubricating oils.

The volume of Oil Residue (sludge) (M^3) incinerated for the entire fleet for FY 2017-2018 was 2155.17 M^3. It is to be noted that the sludge consists of mixture of water, fuel oil and to certain extent used lubricating oils with constituents varying in uncertain proportions. This makes assessment of carbon content and CO_2 emission factor most uncertain. The sludge generated during the reporting year constituted about 0.69% of total fuel burnt under scope 1.

MARPOL Annex V Garbages in categories "C" (Domestic waste), "D" (Used cooking oil) and "F" (Operational waste) – Quantity of such garbages incinerated on board are reported by vessels and the aggregate quantity is found to be 104.88 M^3 for the entire fleet during the reporting period. It is to be noted that the garbage burnt is a mixture of various constituents making it very uncertain to establish carbon content and the GHG emission.

Since the total sludge and garbage quantity incinerated falls below Material Threshold limit, it is excluded.

Scope 3
An emission under this head has not been considered. Scope 3 emissions for G E Shipping are as follows:
- Commuting and business travel by employees;
- Fuel used by inchartered vessels;
- Transportation of purchased fuel in bunker barge or road tankers;
- Disposal of waste generated in operation;
- Supply of electricity to vessel during dry docking etc.

The followings are not applicable to the activities of G E Shipping:

- Transportation of an organization's product and materials – G E Shipping transports commodities between different locations and thereby emissions arising from consumption of fuels for propulsion and operation of vessels are included within Scope 1 emission. It does not manufacture or process any product, hence this is not applicable.
- Outsourced activities, contract manufacturing and franchises – None of companies business is outsourced, sub-contracted or franchised.

2.5 Listing of all GHG emission sources and sub-systems

Emissions from combustion of fuel are found from individual vessel's Noon Reports.

Emissions from Main engines, auxiliary engines, boilers, inert gas generators (fitted on some of the tankers), auxiliary engines for Frame pumps (fitted on some of the tankers) have been considered. Emissions from other energy-consuming sources (e.g. emergency generator, lifeboat engines etc.) were omitted because the contribution falls below Material Threshold limit.

2.6 Method for estimation for non-combustion emissions (Refrigerants, halogenated hydrocarbons)

R-22, R404a and R407c are used on board vessels for air conditioning and provision cooling purposes.

All these refrigerants have significant Global Warming Potential (GWP). The GWP is reported as CO_2 equivalent (CO_2e): this describes the equivalent amount of CO_2 that would be needed to achieve the same warming effect. The numerical values of GWP for different substances used in this report were taken from the IPCC Fourth Assessment Report and are based on the latest IPCC estimate of CO_2 concentration in the atmosphere.

2.7 Global warming potential of refrigerant emission from ships

The GWP100 is described relative to CO_2 warming potential (IPCC Fourth Assessment Report: Climate Change 2007)

Table 2.7

Refrigerant	CO_{2e}
R-22	1810
R404a	3922
R407c	1774

Chapter 3 – Methodology for GHG quantification

3.1 Consolidation Approach

The organizational boundary for accounting of GHG emission is taken as vessels owned and managed by G.E. Shipping. Since this reporting is being voluntarily made for the stakeholders, the control approach is the most appropriate since the Company can be held accountable for vessels under their technical management only.

Emission, for vessels that have been sold or acquired during a specific financial year, have been reported for the period the vessels were under the ownership of the Company.

3.2 Type of Fuel Consumed on fleet vessels and Conversion Factor

Emission Factors are taken from MEPC.281(70) – Amendment 2016 Guidelines on the Method of Calculation of the Attained Energy Efficiency Design Index (EEDI) for New Ships.

Table 3.2

Type of Fuel	Reference	Carbon content	Emission Factor (t-CO2 / t-Fuel)
Diesel / Gas Oil	ISO 8217 Grades DMX through DMB	0.8744	3.206
Heavy Fuel Oil (HFO)	ISO 8217 Grades RME and RMG	0.8493	3.114

3.3 Method used for quantification of GHG emission

Engineers onboard ships quantify volume (M^3) of fuel used in main engines, auxiliary engines and boilers by taking fuel flow meters readings every noon. Some oil tankers are additionally fitted with Inert Gas Generators for supplying inert gas into cargo oil tanks for fire safety. Volume (M^3) of gas oil used in IGGs is quantified from gauging of gas oil tanks every noon. On oil tankers where Framo Pumps (submerged cargo pumps) are used fuel oil used in auxiliary engines for Framo hydraulic power units are quantified from gauging of fuel oil tanks every noon. These readings are recorded in vessel's log book.

Volume (M^3) of different grades of fuel consumed is converted on daily basis into mass (Tonnes*) of fuel at reference temperature of 15^0C by multiplying with appropriate density and application of temperature correction factor. The relevant procedure is given in para 7.7.1.4 of Fleet Operation Manual. The daily consumption figures are reported ashore through GE Nautical platform.

*(*Tonne - a metric system unit of mass equal to 1,000 kilograms (2,204.6 pounds) or 1 megagram (1 Mg). To avoid confusion with the smaller "short ton" and the slightly larger "long ton", the tonne is also known as a "metric ton"; in this report, the tonne is distinguished by its spelling.)*

At the end of financial year quantities of different grades of fuel consumed on each vessel are collated from GE Nautical platform and multiplied by applicable Emission Factor to arrive at CO_2 emission from combustion of fuels. The same is shown in Table 5.1.

3.4 Estimation of emissions factors

Emission Factors (EFs) for CH_4 and N_2O are obtained from Table 34 – Emissions factors for top-down emissions from combustion of fuel given in Third IMO GHG Study 2014. The estimation was also compared against Annex 6, Table 22 – Baseline Emission Factors given in the same study derived from bottom-up approach. Some differences with respect to some of the gases were noted however these were not significant in nature. Also as per IPCCC Assessment Report 4, Global Warming Potential (CO_{2e}) for CH_4 is 25 and for N_2O is 298. The emission factors used are as follows:

Table 3.4a

Emission substance	Marine HFO emission factor g/g fuel	Marine MDO emissions factor (g/g fuel)	CO_{2e}
CH_4	0.00006	0.00006	25
N_2O	0.00016	0.00015	298

Table 3.4b – Emission sources, type of fuel consumed and conversion factors.

Source	Type of fuel oil	Emission Factor ($t\text{-}CO_2$ / t-Fuel)
Main Engine	Heavy Fuel Oil – High Sulphur (HSFO)	3.114400
	Heavy Fuel Oil – Low Sulphur (LSFO)	3.114400
	Marine Diesel Oil (MDO)	3.206000
	Low Sulphur Marine Gas Oil (LSMGO)	3.206000
Auxiliary Engine	Heavy Fuel Oil – High Sulphur (HSFO)	3.114400
	Heavy Fuel Oil – Low Sulphur (LSFO)	3.114400
	Marine Diesel Oil (MDO)	3.206000
	Low Sulphur Marine Gas Oil (LSMGO)	3.206000
Boiler	Heavy Fuel Oil – High Sulphur (HSFO)	3.114400
	Heavy Fuel Oil – Low Sulphur (LSFO)	3.114400
	Marine Diesel Oil (MDO)	3.206000
	Low Sulphur Marine Gas Oil (LSMGO)	3.206000
Inert gas generators	Marine Diesel Oil (MDO)	3.206000
	Low Sulphur Marine Gas Oil (LSMGO)	3.206000
Auxiliary engines for Frame pumps	Marine Diesel Oil (MDO)	3.206000
	Low Sulphur Marine Gas Oil (LSMGO)	3.206000

3.5 Quality assurance and control of data

Fuel consumption data is recorded manually on board either from fuel flow meters or tank soundings in absence of flow meters. There can be errors in measured fuel consumption values due to various reasons, namely human error (during reading, measuring, recording), inaccuracy of measuring devices (mostly stated by the manufacturer: precision, drift, bias, non-linearity). However, since we have aggregated the data to yearly total for each vessel this process of aggregation reduces the uncertainty in daily observations.

Several procedures are in place to ensure accuracy of data. Chief Engineers and Second Engineers are specifically briefed during their pre-joining briefing on the importance of accuracy in reporting of speed and fuel consumption values for meaningful fuel efficiency performance evaluation of vessels. Method for calculation of fuel oil consumption has been standardized through documented procedure given in Fleet Operation Manual Section 7.7.1.4. Procedure of periodical calibration of fuel flow meters has been introduced in the same Manual in Section 7.7.1.5.

Vessels report the data in electronic form daily to the office in standardized formats (Arrival, Departure and Noon Reports). The data is then stored, processed, and analyzed ashore. Data is stored for at least 5 years.

Backup Servers will occur every day after regular business hours. Full Backup includes all the source files. Only one full backup is done every fourth day. Incremental Backups includes only files that have

changed since the last full backup. The next time an incremental backup is done, files that have not been modified since previous backup are skipped.

Back up data are tested every 6 weeks by IT Department.

Apart from storage in backup server of the Company data it is also replicated in 3rd Party Data centre in Hyderabad (different location) in Disaster Recovery Server.

If required by any Department, backup data is retrieved by IT Department assigned personnel and provided to the concerned Department. Password for access is retained within IT Department.

For the FY 2016-2017 the number and types of errors found in the fuel consumption data is shown in Table 3.5 below. All errors were corrected prior to quantification.

Table 3.5

Types of errors	Number of cases	Difference in fuel oil quantity accounting for the year (Tonnes)
Error with placement of decimal point	6	14.67
Interchanged reporting of fuel consumption values between main engines and auxiliary engines i.e. aux engine consumption is reported as main engine consumption and main engine consumption is reported as aux engine consumption.	84	Nil
Other errors*	446	7581.15

*Missing data which were later on filled in and incorrect data (higher or lower values and anything which didn't fall under decimal error or interchange error)

3.5.1 GHG reporting roles and responsibilities

Chief Engineers of vessels are responsible for reporting of fuel consumption values in GE Nautical IT platform as per Company procedures given in Fleet Operation Manual.

Head of Information technology Division is responsible for maintaining IT platform for storing and transmission of data ashore.

Shore Based Personnel:

Data Analyst - Vessel Performance Management Cell is responsible for

- accurate quantification of GHG emission ensuring that all sources of emissions are accounted for;
- Indexing and retention of all relevant supporting records in easily retrievable condition.

Manager – VPM Cell is responsible for

- Uncertainty assessment of fuel flow meters and fuel measurement procedure and documentation of the data.

Head – Vessel Performance Management Cell is responsible for

- developing and maintaining documented procedure for quantification and reporting of GHG emission taking into account GHG reporting principles of "relevance", "completeness", "consistency", "transparency" and "accuracy";
- reviewing and approving GHG emission report;
- Co-ordination with 3rd Party Verification Bodies

Chapter 4 – Energy Saving Initiative

4.1 Description of energy saving initiatives implemented in FY 2016-2017 and earlier years.

4.1.1 Energy Saving Devices FY 2017-2018

During FY 2017-2018 following Energy Saving Devices (ESDs) were retrofitted for reducing fuel consumption of main propulsion system:

Jag Aparna, Jag Rishi, Jag Prakash, Jag Pushpa, Jag Prerana, Jag Aanchal were retrofitted with ECO-Cap, a device which improves propulsive efficiency. The propeller's rotational motion forms a strong vortex at the center, which causes overall loss of propulsive efficiency. The finned features of an ECO-Cap break up this vortex, thereby reducing the loss of energy.

Total cost incurred on above six ships: USD 354,293.

4.1.2 Year wise cumulative savings

Table 4.1.4

Financial Years	Estimated Reduction of CO_2 emission due to retrofitment of Energy Saving Devices and application of superior antifouling hull coatings
2014-2015	7008 MT
2015-2016	13,900 MT
2016-2017	13,973 MT
2017-2018	15,771 MT

4.2 GHG Reduction strategy and target

4.2.1 Mandatory Requirements

Ships on international trade are subjected to mandatory requirement of reduction / control of GHG emission since 1st January 2013 as per Chapter 4, Annex VI of MARPOL Convention. The technical requirements aimed to reduce GHG emissions from ships include two types of measures:

.1 Energy Efficiency Design Index (EEDI) for new ships;
.2 Ship Energy Efficiency Management Plan (SEMP) for all ships

The intent of EEDI is to set a mandatory benchmark for the efficient design i.e. fuel consumption and thereby give an indication of its carbon dioxide emissions, of new ships. The formula is targeted at creating a benchmark level for emissions from ship types and size ranges by way of giving an indication of the grammes of CO2 emitted per tonne mile of cargo moved. The benchmark level is lowered in a phased manner as technology and design improvements make vessels more efficient.

SEEMP is a system for monitoring, recording and reporting of ship performance, which will be used by ship operators to enhance the energy efficiency and the emissions performance of their ships by applying technical and operational measures to improve fuel efficiency.

All our new buildings are built in compliance with EEDI requirements and existing ships are provided with SEEMP and issued with International Energy Efficiency Certificates as per MARPOL Convention.

4.2.2 Company GHG reduction strategy

G E Shipping, as a strategy, believes in maintaining its ships in as fuel efficient condition as possible for following reasons:

1. To maintain competitive advantage for its vessels in chartering market;
2. To reduce its carbon footprint for environmental benefit and as a fight against climate change;
3. To remain prepared for any future regulatory requirement related to GHG reduction and climate change;
4. Sustainability of business.

The Company has a strategy of replacing its older tonnage with younger and more fuel efficient ships as well as enhancing the energy efficiency of individual identified vessels through technological retrofits.

4.2.3 Setting GHG reduction target

G E Shipping is tracking energy efficiency intensity of its vessels as per "MEPC.1/Circ.684 - Guidelines for voluntary use of the Ship Energy Efficiency Operational Indicator (EEOI)" since 2010 and have been setting EEOI reduction targets against Baseline Average EEOI (Loaded voyages) values established during 2010-2011 for individual vessels based on their operational profiles for each biennial starting from 2012-2013. The intent of EEOI is to provide a measure of how efficiently a given ship is operated, i.e. how much cargo it moves for the fuel used. It works by calculating cargo, fuel and distance for each voyage leg, averaged over a period (usually 12 months) as it will provide a standardized way of communicating a ship's energy performance in operation. While some ships met the target some could not. Company found several limitations in setting a reduction target based on EEOI due to following reasons:

1. The speed of a ship varies in accordance with the prevailing charter hire rate and bunker price. These two elements, in varying degrees, influence a vessel's speed and consequently fuel consumption. These in turn create difficulty in trying to establish a fuel efficiency standard for the existing ships since a ship's speed is not constant over time.

2. It is also a fact that in a depressed freight market the fuel efficiency values of the individual ships (e.g. kg/nm, gm/t-nm) would remain low but with an improved freight market and/or with lower bunker cost the ships will increase their speeds resulting in higher fuel consumption and consequently kg/nm and gm/t-nm values. This phenomenon was noted following world economic meltdown in 2008 and reduced trading activity when slow steaming was resorted to

by the world fleet to reduce operational cost. This resulted in lower EEOI values. However, with crash of oil price since end-2014 with improved oil trading activity at least the oil tankers' operational speed had gone up and this had resulted in higher EEOI values for such types of vessels.

3. Moreover, fuel consumption of a ship (considering the machineries are in efficient condition) varies based on quantity of cargo carried, trim, weather condition (specifically wind force and wave) and hull roughness. All these factors influence the fuel efficiency of a vessel. Without carrying out detailed calculations normalizing the effects of all these factors it is futile trying to establish a fuel efficiency standard of ships.

However, a good correlation between the Energy Efficiency Design Index (EEDI) and the EEOI across different ship sizes were noted.

Notwithstanding above, in absence of any other internationally recognized energy efficiency matrix EEOI is continued to be used as a measure for GHG reduction for individual vessels after establishing Baseline EEOI (Loaded voyages) values for the vessels based on one or two years of operations. The reduction targets are set based on operating profiles of individual vessels.

G E Shipping is committed on continuous improvement in energy saving and reduction of GHG emission from ships. Towards this end we as a leading stakeholder actively contribute in development of international regulatory regimes and guidelines related to reduction of GHG emission from international shipping at Marine Environment Protection Committee of International Maritime Organization.

Chapter 5 – GHG Disclosure

Scope 1 emission

- Emission resulting from combustion of fuel oils in company owned and managed vessels' main engines, auxiliary engines, boilers, inert gas generators (fitted on some of the tankers) and auxiliary engines for Frame pumps (fitted on some of the tankers).

- Emission resulting from unintentional releases of hydrofluorocarbon (HFC) used as refrigerants for air conditioning and provision refrigeration plants on company owned and managed vessels.

Table 5.1 - FY 2017-2018 (All figures are in MT)

Vessels	HSFO	LSFO	MDO	LSMGO	Total CO_2
Suezmax					
Jag Lakshita	11370.35	0.31	0.00	21.70	35482.35
Jag Lateef	11752.25	0.00	0.00	8.10	36627.18
Jag Lok	10473.30	0.00	0.00	298.70	33575.68
Jag Lalit	11596.39	0.00	0.50	152.70	36606.96
Jag Leena	12392.70	10.10	0.00	459.20	40099.48
Jag Lakshya	9590.55	0.00	1.30	890.88	32729.14
Jag Laadki	9061.21	0.00	0.00	199.29	28859.16
Aframax					
Jag Lavanya	8437.75	0.00	14.10	104.50	26658.76
Jag Lata	6623.69	0.00	0.00	30.10	20725.32
Jag Lyall	7278.30	0.00	0.00	201.00	23312.26
Jag Leela	9015.14	3.08	3.53	1359.09	32454.90
Jag Laxmi	8681.56	0.00	0.40	1199.15	30884.57
LR1					
Jag Aabha	7193.73	0.00	2.00	865.53	25185.45
Jag Aparna	7287.50	0.00	4.33	574.50	24551.92
Jag Amisha	6085.23	0.90	185.46	124.75	19949.18
Jag Aanchal	6072.85	0.20	103.28	254.92	20069.73
LR2					
Jag Lokesh	4564.60	0.00	0.00	75.58	14458.30

Vessels	HSFO	LSFO	MDO	LSMGO	Total CO_2
MR					
Jag Pranav	4862.41	0.00	269.41	0.00	16007.22
Jag Pranam	5180.40	2.33	0.00	45.00	16285.36
Jag Prabha	4265.97	2.90	13.40	158.60	13846.40
Jag Pushpa	4222.41	0.00	344.22	20.70	14320.21
Jag Prerana	5395.46	0.00	94.77	290.95	18040.24
Jag Prakash	4357.38	0.00	103.90	172.10	14455.48
Jag Pankhi	4024.28	0.80	0.00	217.18	13231.99
Jag Pahel	4916.22	0.00	19.40	289.85	16302.53
Jag Padma	4325.27	0.00	2.00	60.79	13671.93
Jag Pooja	5183.42	0.20	15.50	709.68	18468.79
Jag Punit	4028.65	0.00	0.00	1367.82	16932.06
Jag Pavitra	4623.91	8.45	21.73	269.58	15360.96
Gas Carrier					
Jag Vishnu	5720.80	0.00	128.68	0.00	18229.41
Jag Vidhi	6811.33	0.80	6.80	64.80	21445.25
Jag Vijaya	1993.49	1.80	82.60	13.75	6523.03
Capesize					
Jag Anand	9890.90	0.00	0.00	395.05	32070.75
Kamsarmax					
Jag Arnav	5470.41	0.50	9.21	345.43	18175.58
Jag Aarati	5710.31	0.00	0.40	715.25	20078.56
Jag Aditi	5611.78	0.00	0.00	48.60	17633.14
Jag Arya	4873.33	0.00	0.00	227.62	15907.25
Jag Ajay	6012.31	0.00	0.00	372.27	19918.24
Jag Aalok	5331.77	4.40	0.00	112.93	16981.02
Jag Akhsay	4554.62	0.00	0.00	384.71	15418.29
Jag Amar	4766.19	0.10	0.00	388.71	16090.34
Supramax					
Jag Roopa	3494.55	0.20	0.60	320.08	11912.15
Jag Ratan	3480.37	5.10	0.40	156.17	11357.11
Jag Rahul	3363.32	0.00	190.61	0.00	11085.82
Jag Rani	4680.90	0.00	0.20	244.21	15361.77
Jag Rishi	3894.27	3.50	0.50	193.20	12760.22
Jag Radha	3994.99	427.52	0.00	188.17	14376.74
Jag Rohan	3924.70	2.99	1.90	194.78	12862.95
				Total	**977341.11**

Emission of CH4 and N2O from combustion of above fuel is derived from Table 3.4 and given in Table 5.2 below in CO2e.

Table 5.2 – CO_2e from emission of CH_4 and N_2O from fuel burnt during FY 2017-2018

Type of Fuel	Mass of Fuel (MT)	CO_2e of CH4 (MT)	CO_2e of N2O (MT)	Total CO_2e (MT)
Total HFO (HSFO + LSFO)	296919.40	445.38	14157.12	14602.50
Total MDO (MDO + LSMGO)	16411.52	24.62	733.59	758.21
			Total	**15360.71**

Emission of refrigerants from Provision cooling plants and Air conditioning plants of individual vessels were recorded from Monthly EMS data sent from ships. Total emission from refrigerants during the Reporting period and its CO_2e is given in Table 5.3 below. Emission Factors are taken from Table 2.7.

Table 5.3 – Emission of refrigerant and its CO2e

Type of refrigerant	Mass in Kgs.	CO_2e (MT)
R 22	516.0	933.96
R 404a	1064.7	4175.75
R 407c	68.0	120.63
	Total	**5230.35**

Total Scope 1 CO2e emission from all sources Table 5.1 + Table 5.2 + Table 5.3 = **997932.17 MT**

Scope 2 Emission

- Emission from generation of purchased electricity consumed at Ocean House, Head Office of G E Shipping based in Mumbai and training academy of the Company known as Great Eastern Institute of Maritime Studies at Lonavala in Maharashtra.

Table 5.4 - Electricity Consumed and CO_2e Emission during FY 2017-2018

Purchased and consumed electricity				
At Ocean House, Head Office of G E Shipping in Mumbai (MWh)	**At Great Eastern Institute of Maritime Studies at Lonavala in Maharashtra (MWh)**	**Total (MWh)**	**CO_2 emission Factor as per CO2 Baseline Database for the Indian Power Sector (Version 11.0, April 2016) published by Government of India**	**Total CO_2e (MT)**
947.36	763.83	1711.19	0.82	**1403.17**

Total Scope 2 CO_2e emission from all sources Table 5.4 = **1403.17 Tonnes**

Chapter 6 – Calculation Errors

While preparing this assertion report, error in calculation of Electricity consumption for FY 2015-2016 and FY 2016-2017 in Ocean House have been detected. The corrected consumption figures and consequential corrected GHG emission values for respective Financial Years are as follows:

Financial Year 2015-2016

Electricity Consumed and CO_2e Emission during FY 2015-2016

Purchased and consumed electricity				
At Ocean House, Head Office of G E Shipping in Mumbai (MWh)	At Great Eastern Institute of Maritime Studies at Lonavala in Maharashtra (MWh)	Total (MWh)	CO_2 emission Factor as per CO2 Baseline Database for the Indian Power Sector (Version 11.0, April 2016) published by Government of India	Total CO_2e (MT)
885.340	807.111	1692.45	0.82	1387.81

Total Scope 2 CO_2e emission from all sources = 1387.81 Tonnes

Financial year (Base Year)	Scope 1	Scope 2
2015-2016 (1st April 2015 – 31st March 2016)	636105.48 MT	1387.81 MT

Financial Year 2016-2017

Electricity Consumed and CO_2e Emission during FY 2016-2017

Purchased and consumed electricity				
At Ocean House, Head Office of G E Shipping in Mumbai (MWh)	At Great Eastern Institute of Maritime Studies at Lonavala in Maharashtra (MWh)	Total (MWh)	CO_2 emission Factor as per CO2 Baseline Database for the Indian Power Sector (Version 11.0, April 2016) published by Government of India	Total CO_2e (MT)
883.9	842.672	1726.57	0.82	1415.79

Total Scope 2 CO_2e emission from all sources = 1415.79 Tonnes

Financial year	Scope 1	Scope 2
2016-2017 (1st April 2016 – 31st March 2017)	738153.488 MT	1415.79 MT

Chapter 7 – Report Conclusion

G E Shipping is committed to low carbon shipping for sustainable development.

G E Shipping has been taking proactive steps for reduction of GHG emission from its vessels for past many years and has been monitoring GHG emission per unit of transport work for fleet vessels since 2010 for bench marking its performance. In order to ensure that the quantification and reporting of GHG emission from fleet vessels is done as per recognized international standard duly verified by third party, G E Shipping has decided to follow ISO 14064-1 and is publishing this report for all its stakeholders.

Financial year	Scope 1	Scope 2
2017-2018 (1st April 2017 – 31st March 2018)	**997932.17 MT**	**1403.17 MT**

Chapter 8 - References

- MEPC.281(70) – Amendment 2016 Guidelines on the Method of Calculation of the Attained Energy Efficiency Design Index (EEDI) for New Ships.
- Third IMO GHG Study 2014
- IPCC Fourth Assessment Report: Climate Change 2007

Chapter 9 -Abbreviations

CSR – Corporate Social Responsibility

CFC - Chlorofluorocarbons

HFC – Hydrofluorocarbons

HCFC – hydrochlorofluorocarbons

HFO – Heavy fuel oil

EF – Emission factor

HSFO – High sulphur fuel oil

GHG – Green House Gas

IT – Information Technology

IMO – International Maritime Organization

KPI – Key Performance Indicator

GWP – Global Warming Potential

IPCC – Intergovernmental Panel on Climate Change

ISO – International Organization for Standardization

LSFO – Low sulphur fuel oil

LSMGO – Low sulphur marine gas oil

MIS – Management information system

MARPOL - International Convention for the Prevention of Pollution from Ships

MEPC – Marine Environment Protection Committee

MDO – Marine diesel oil

Annexure I

Conversion Factors

1. The various conversion factors / emission factors used in this assertion Report are as follows:

1.1 Global warming potential of refrigerant emission from ships

The GWP100 is described relative to CO_2 warming potential (IPCC Fourth Assessment Report: Climate Change 2007)

Refrigerant	CO_{2e}
R-22	1810
R404a	3922
R407c	1774

1.2 Type of Fuel Consumed on fleet vessels and Conversion Factor

Type of Fuel	Reference	Carbon content	Emission Factor (t-CO2 / t-Fuel)
Diesel / Gas Oil	ISO 8217 Grades DMX	0.8744	3.206
Heavy Fuel Oil (HFO)	ISO 8217 Grades RME and RMG	0.8493	3.114

1.2.1 Sources of emission, types of fuels used and their conversion factors

Source	Type of fuel oil	Emission Factor ($t\text{-}CO_2$ / t-Fuel)
Main Engine	Heavy Fuel Oil – High Sulphur (HSFO)	3.114
	Heavy Fuel Oil – Low Sulphur (LSFO)	3.114
	Marine Diesel Oil (MDO)	3.206
	Low Sulphur Marine Gas Oil (LSMGO)	3.206
Auxiliary Engine	Heavy Fuel Oil – High Sulphur (HSFO)	3.114
	Heavy Fuel Oil – Low Sulphur (LSFO)	3.114
	Marine Diesel Oil (MDO)	3.206
	Low Sulphur Marine Gas Oil (LSMGO)	3.206
Boiler	Heavy Fuel Oil – High Sulphur (HSFO)	3.114
	Heavy Fuel Oil – Low Sulphur (LSFO)	3.114
	Marine Diesel Oil (MDO)	3.206
	Low Sulphur Marine Gas Oil (LSMGO)	3.206
Inert gas generators	Marine Diesel Oil (MDO)	3.206
	Low Sulphur Marine Gas Oil (LSMGO)	3.206
Auxiliary engines for Framo pumps	Marine Diesel Oil (MDO)	3.206
	Low Sulphur Marine Gas Oil (LSMGO)	3.206

1.3 Estimation of emissions factors

Emission Factors (EFs) are obtained from Table 34 – Emissions factors for top-down emissions from combustion of fuel given in Third IMO GHG Study 2014. The estimation was also compared against Annex 6, Table 22 – Baseline Emission Factors given in the same study derived from bottom-top approach. Some differences with respect to some of the gases were noted however these were not significant in nature. The emission factors used are as follows:

Emission substance	Marine HFO emission factor g/g fuel	Marine MDO emissions factor (g/g fuel)	CO_{2e}
CO_2	3.11400	3.20600	1
CH_4	0.00006	0.00006	25
N_2O	0.00016	0.00015	298

1.4 CO_2e emission Factor for unit of electricity consumed

As per CO2 Baseline Database for the Indian Power Sector (Version 11.0, April 2016) published by Government of India, Ministry of Power, Central Electricity Authority CO_2e emission factor for every MWh electricity consumed : 0.82.

Table S-1: Weighted average emission factor, simple operating margin (OM), build margin (BM) and combined margin (CM) of the Indian Grid for FY 2014-15 (adjusted for cross-border electricity transfers), in t CO_2/MWh

Average	OM	BM	CM
0.82	0.99	0.93	0.96

Average is the average emission of all stations in the grid, weighted by net generation.

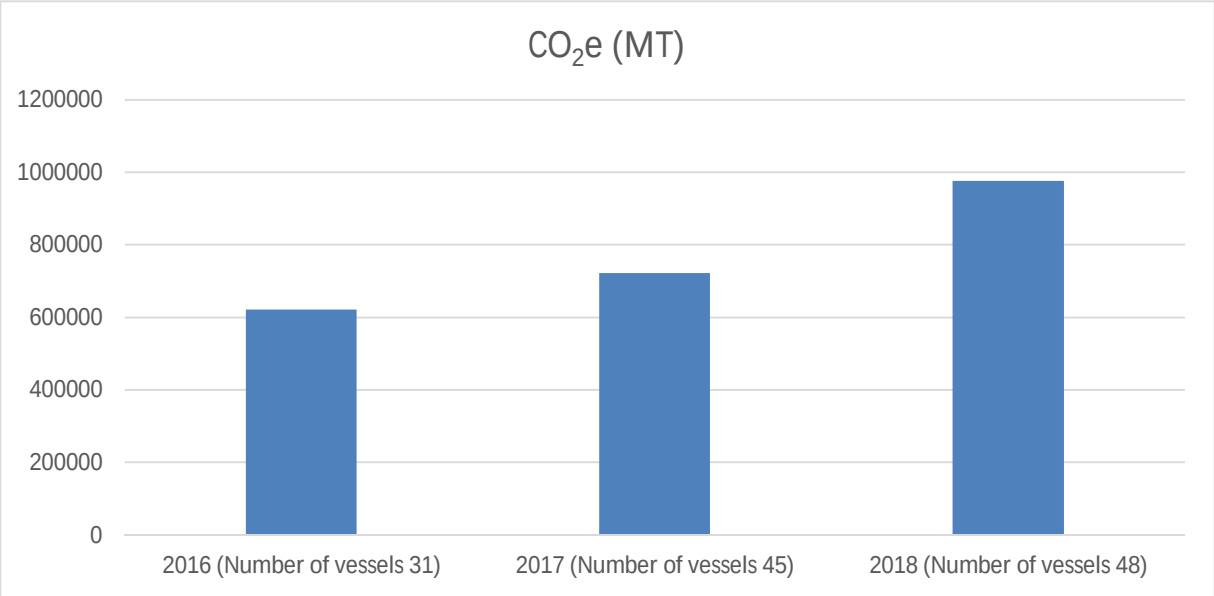
OM is the average emission from all stations excluding the low cost/must run sources.

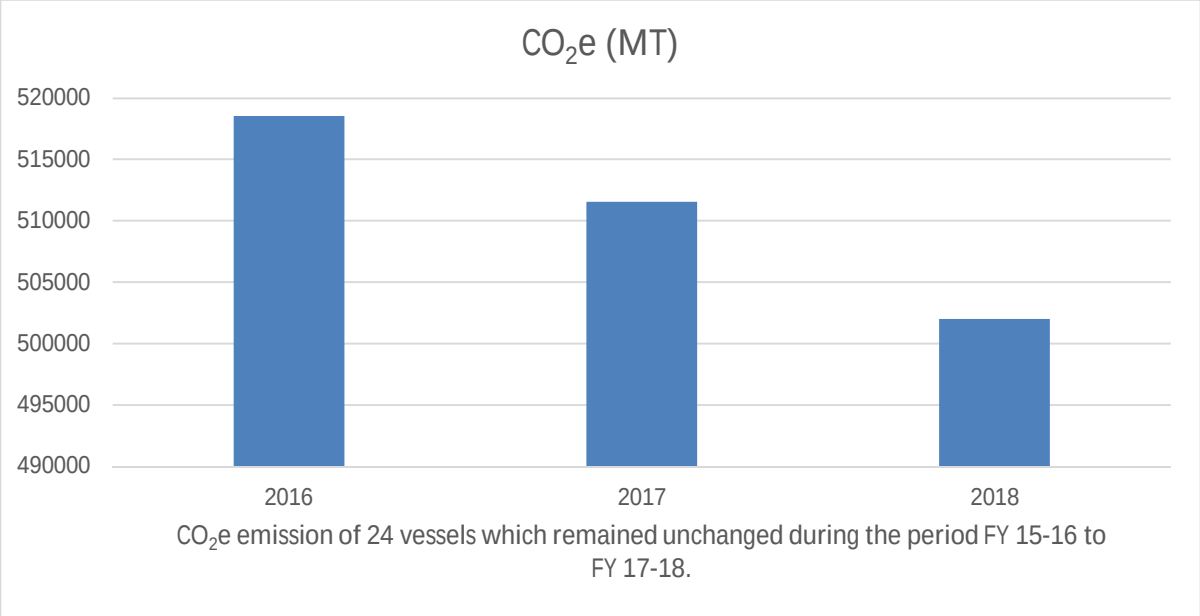
BM is the average emission of the 20% (by net generation) most recent capacity addition in the grid.

CM is a weighted average of the OM and BM (here weighted 50 : 50).

Annexure II

Trend Charts





CO_2e emission of 24 vessels which remained unchanged during the period FY 15-16 to FY 17-18.