Assertion Report of GHG Emission for Financial Year 2019-2020

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 2020, the fleet consisted of 46 vessels (33 Tankers and 13 Bulk Carriers) totalling 3.7 million Deadweight Tonnes with an average age of 11.77 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: 2015, ISO 14001: 2015 and ISO 45001: 2018 standards by DNV-GL.

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 Our Vision

- To lead our industry in Safety Standards, Environmental Protection, Energy Optimization and Quality of Operations.
- To be the provider of choice of our customers.

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 efficient 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, by employing best practices through an efficient, responsive management and 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 overall 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 safety, environmental, 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 ensuring safe, secure and healthy working environment to personnel ashore and on board ships by employing best management practices;
- Identifying all relevant hazards to safety, health and security, assessing risks and establishing safeguards against all identified hazards;
- Safeguarding all IT and OT assets ashore and on board our ships from cyber-attacks by continuously mitigating cyber risks;
- 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 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 all personnel ashore and on-board ships have appropriate experience and training relevant to their roles. 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 and conscientious effort in reduction of use of fossil fuel with a view to reduction of Green House Gas emission;
- 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 2019-2020 i.e. 1st April 2019 to 31st March 2020. 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 2019 the fleet size was 48 vessels and 3.92 million Deadweight Tonnes. During the reporting period Jag Vishnu and Jag Lakshita were sold making the total fleet size as 46 vessels and 3.7 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)

- emissions from consumption of purchased electricity used at Ocean House, the Head Office of the Company located at Worli, Mumbai, Maharashtra, Training and Assessment Department located at Kakad chambers, Worli, Mumbai and Great Eastern Institute of Maritime Studies, the training academy of the Company located at Lonavala, Maharashtra.

2.2 Description of Assets

2.2.1 Assets in FY 2019-2020

Table 2.2.1 – Assets (FY 2019-2020)

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-10	157671.70
JAG LAKSHYA	9516117	Oil Tanker	05-Jan-11	157641.60
JAG LAADKI	9194983	Oil Tanker	03-Aug-00	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-11	105525.20
JAG LAXMI	9568196	Oil Tanker	05-Jan-12	105525.20
LR2				
Jag LOKESH	9390599	Oil Tanker	05-Jan-09	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-05	47999.00

Name of Vessel	IMO No.	Type of Vessel	Date of Built	Deadweight (DWT)
JAG POOJA	9310692	Oil Tanker	25-Jun-05	48539.00
JAG PUNIT	9709984	Oil Tanker	01-Apr-16	49717.40
JAG PAVITRA	9387956	Oil Tanker	24-Dec-08	51463.00
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	26897.00
JAG VIRAAT	9307762	Gas Carrier	25-July-2007	54450.00
JAG VAYU	9108099	Gas Carrier	29-May-1996	38518.00
JAG VASANT	9307750	Gas Carrier	30-Nov-2006	54478.00
Capesize				
JAG ANAND	9463308	Bulk Carrier	09-Jun-11	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 AJAY	9723849	Bulk Carrier	30-Jun-16	82094.20
JAG AALOK	9706566	Bulk Carrier	29-Jul-16	82022.60
JAG AKSHAY	9706554	Bulk Carrier	29-Aug-16	82044.30
JAG AMAR	9723851	Bulk Carrier	11-Jan-17	82083.80
Supramax				
JAG ROOPA	9317145	Bulk Carrier	19-Sep-06	52454.00
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-09	58133.00
JAG ROHAN	9324631	Bulk Carrier	20-Jan-06	52450.00

2.2.2 Assets acquired and sold in FY 2019 - 2020

Name of Vessel	IMO No.	Type of Vessel	Date of Built	Deadweight	Vessel Sold on
Jag Vishnu	9052331	Gas Carrier	25-Mar-1994	49353.00	08-May-2019
Jag Lakshita	9208057	Oil Tanker	22-May-00	52179.79	23-December-2019

No vessel was acquired during the year.

2.2.3 Vessels operated on Time Charter in FY 2019 – 2020

Nil

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 ±1.68% 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 ±0.50%.
3. Total uncertainty is thus considered to be sum of paras 2.3.1.1 and 2.3.1.2 < ±2.20%.

2.3.1.1 Completeness of data

In Live Vessel Information System (LIVIS) a Vessel Report Checklist is incorporated which identifies status of Noon, Arrival and Departure Reports received from vessels for any selected period. Safety feature also exist which prevents sending Noon Report for a day without sending Noon Report of the preceding day. This ensures completeness of data. Quantity and grade of bunker received at any port is reported in Departure Reports and the changes in bunker quantity remaining on board is reflected in Noon Reports.

2.3.2 Materiality threshold

Materiality threshold for omissions of individual sources of emission is considered to be 1.0% and overall materiality threshold is considered to be 5.0%.

2.4 Inclusion / exclusion of assets and emissions

MARPOL Annex V Garbages in categories "C" (Domestic waste), "D" (Used cooking oil) and "F" (Operational waste) – Quantity of such garbage incinerated on board are reported by vessels and the aggregate quantity is found to be 144.01 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 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 company's business is outsourced, sub-contracted or franchised.

2.5 Listing of all GHG emission sources and sub-systems

Sources of emissions onboard ships are main engines, auxiliary engines, boilers, inert gas generators (fitted on some of the tankers), auxiliary engines for Framo pumps (fitted on some of the tankers) emergency generator, lifeboat engines and incinerators.

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 Fifth 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 Fifth Assessment Report: Climate Change 2014)

Table 2.7

Refrigerant	CO_{2e}
R-22	1760
R404a	3922*
R407c	1774*

(*Based on manufacturer's declaration)

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.308(73) – 2018 Guidelines on the Method of Calculation of the Attained Energy Efficiency Design Index (EEDI) for New Ships.

With effect from 1st January 2020, Regulation 14.1.3 of MARPOL Convention, Annex VI mandates cap on sulphur content of fuel oil to ≤ 0.50% m/m unless the vessel is provided with an approved exhaust gas cleaning system. Such fuel oils fall under "Light Fuel Oil" types. Until this regulation came into force ships could burn fuel oil with sulphur content ≤ 3.50% m/m (Heavy Fuel Oil) with lower Carbon Emission Factor but higher SOx emission.

Vessels fitted with exhaust gas cleaning system can continue to burn fuel oil with sulphur content > 0.50% m/m. Such fuel oils fall under "Heavy Fuel Oil" type.

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
Light Fuel Oil	ISO 8217 Grades RMA through RMD	0.8594	3.151
Heavy Fuel Oil (HFO)	ISO 8217 Grades RME and RMG	0.8493	3.114

3.3 Method used for quantification of GHG emission

Emission from combustion of fuel are determined from fuel consumed over the measurement period, which simply put, is the fuel at the beginning of the period, plus deliveries during the period, minus fuel available at the end of the period on respective ships. Fuel (Metric Tonnes) remaining onboard at the beginning and end of reporting period are collected from Daily Noon Reports and bunker supplied (Metric Tonnes) are collected from Departure Reports. Bunker supplied in a port is reflected in Bunker Delivery Notes and the data is reported in port Departure Report. In the rare event of debunkering, amount of any fuel oil (Metric Tonnes) offloaded is subtracted from the fuel oil consumption of that reporting period. This information is collected from Daily Noon Report. All these reports sent by vessels are available in GE Nautical platform.

The key assumption associated with this approach is that all fuel purchased and determined from the stocktakes of the fuel tanks at the beginning and end of reporting period will be fully consumed. It does not take into account any differential between volume of fuel purchased and the actual volume of fuel consumed. There may be differences in the two quantities due to:
1. sludge and water removed from the fuel following on-board fuel treatment processes, and
2. Bunker Delivery Note (BDN) accuracy.

*(*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 5, Global Warming Potential (CO_{2e}) for CH_4 is 28 and for N_2O is 265. 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	28
N_2O	0.00016	0.00015	265

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)	3.114
	Light Fuel Oil (LFO)	3.151
	Marine Diesel Oil (MDO)	3.206
	Low Sulphur Marine Gas Oil (LSMGO)	3.206
Auxiliary Engine	Heavy Fuel Oil – High Sulphur (HSFO)	3.114
	Light Fuel Oil (LFO)	3.151
	Marine Diesel Oil (MDO)	3.206
	Low Sulphur Marine Gas Oil (LSMGO)	3.206
Boiler	Heavy Fuel Oil – High Sulphur (HSFO)	3.114
	Light Fuel Oil (LFO)	3.151
	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

3.5 Quality assurance and control of data

Mass of fuel on board at the beginning and end of reporting period is determined by the stock-take of fuel tanks on-board. As per company procedure these measurements are taken at noon.

Measurements are taken by locally using dip tapes and soundings, or remotely by using automated systems, as applicable.

It uses tank tables relevant to each fuel tank to determine the volume at the time of the fuel tank reading. Volume of fuel is converted into mass using appropriate temperature and density correction.

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 Back up 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 2019-2020 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)
Bunker supplied not reported in Departure report but reflected in Noon Reports	23	16952
Interchanged reporting of bunker received values between fuel type category	22	Nil
Other errors*	10	1175

*Error which did not fall under missed reporting in Departure Report or interchange error.

3.5.1 GHG reporting roles and responsibilities

Chief Engineers of vessels are responsible for reporting of fuel related data 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 2019-2020 and earlier years.

4.1.1 Energy Saving Devices FY 2019-2020

During FY 2019-2020 following Energy Saving Devices (ESDs) were retrofitted for reducing fuel consumption of main propulsion system:

Jag Amisha and Jag Pahel were retrofitted with Propeller Boss Cap Fins (PBCF), 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 PBCF break up this vortex, thereby reducing the loss of energy.

Jag Aparna and Jag Lokesh were retrofitted with Mewis Duct, a device which improves the flow of water on to propeller and thus its efficiency.

Total cost incurred on above four ships: USD 535,357.

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
2018-2019	16,550 MT
2019-2020	18,800 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 (SEEMP) 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.

As per new regulation 22A of Chapter 4, Annex VI of MARPOL Convention with effect from 1st January 2019 all ships of 5,000 GT and above are required to report their annual fuel oil consumption data along with distance travelled and sailing hours to their respective flag states. Flag states following satisfactory verification of the same are required to submit the data to IMO. IMO would be using that data for a better understanding of the energy efficiency of world fleet and would help IMO to identify further possible measures to improve efficiency and reduction of GHG emission.

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. In case of new acquisition, it is important to determine and understand the ship’s status of energy usage. The target KPI (i.e. the EEOI) for the vessel’s SEEMP is determined after the baseline is established. 12 months data is required to establish the baseline. 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 6 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. EEOI of a vessel depends on its commercial utilization in terms of cargo weight, load factor and speed. These aspects are controlled by the Charterer of the vessel and outside the control of shipowner.

3. Moreover, fuel consumption of a ship varies based on weather condition (specifically wind force and wave). All these factors, beyond the control of shipowner. influence the EEOI value of a ship.

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.

IMO Goals for reduction of Green House Gas emissions from international shipping

Maritime Environmental Protection Committee (MEPC) on 13th April 2018 adopted a comprehensive Initial Strategy for significant reduction of Green House Gas (GHG) emissions from international shipping. The Strategy includes ambitious carbon reduction targets up to year 2050, with the clear vision of achieving carbon-free transportation at sea within this century.

The ambitious IMO strategy is to cut the total greenhouse gas emissions of shipping by at least 50% by 2050, compared to 2008 – with an agreed efficiency goal, as an average for the sector, for a 40% improvement by 2030 compared to 2008, and a 70% improvement by 2050 – so that the entire sector will be in a position to decarbonise completely, consistent with achieving the 1.5 degree climate change goal identified by the United Nation.

G. E. Shipping is fully cognisant of the above aspiration and committed to achieving the goals.

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 Framo 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 2019-2020 (All figures are in MT)

Vessels	HSFO	LFO	MDO	LSMGO	Total CO_2
Suezmax					
Jag Lakshita	7716.35	2.78	0.00	7.67	24062.06
Jag Lateef	9863.07	3497.37	0.00	44.90	41877.76
Jag Lok	9092.29	3292.63	0.00	217.14	39384.62
Jag Lalit	9963.22	3957.52	0.00	151.57	43981.55
Jag Leena	9381.66	4236.70	0.00	283.10	43471.95
Jag Lakshya	7944.89	3611.11	0.00	473.00	37635.43
Jag Laadki	8324.68	3024.10	0.00	76.57	35697.48
Aframax					
Jag Lavanya	4301.24	2829.18	0.00	1123.74	25911.52
Jag Lata	4118.45	1792.68	0.00	919.21	21420.58
Jag Lyall	6246.25	123.50	0.00	1485.01	24600.91
Jag Leela	5809.00	2053.61	0.00	1718.57	30069.89
Jag Laxmi	3318.90	2959.06	0.00	3055.34	29454.47
LR1					
Jag Aabha	4610.21	1855.42	0.00	528.66	21897.51
Jag Aparna	5482.64	2298.42	0.00	702.99	26569.05
Jag Amisha	5037.50	1593.15	0.00	498.39	22304.63
Jag Aanchal	5156.53	1547.82	0.00	1172.6	24693.97
LR2					
Jag Lokesh	7805.66	127.00	0.00	1047.49	28065.26
MR					
Jag Pranav	3612.75	917.11	0.00	452.75	15591.43
Jag Pranam	2486.88	704.23	0.00	182.51	10548.30
Jag Prabha	2978.39	957.85	0.00	120.78	12680.11
Jag Pushpa	3121.72	1329.52	0.00	406.47	15213.50
Jag Prerana	4058.18	1615.74	0.00	265.99	18581.13
Jag Prakash	2822.44	1238.08	0.00	354.07	13825.42
Jag Pankhi	3586.77	1507.28	0.00	233.57	16667.47
Jag Pahel	3824.00	1008.93	59.6	347.55	16392.40
Jag Padma	4523.55	1333.69	19.47	60.44	18544.98
Jag Pooja	4826.61	1559.76	0.00	242.48	20722.26
Jag Punit	2893.20	610.27	0.00	1010.22	14171.15
Jag Pavitra	3946.11	1238.36	0.00	405.80	17491.25

Vessels	HSFO	LFO	MDO	LSMGO	Total CO_2
Gas Carrier					
Jag Vishnu	712.62	0.00	7.10	0.00	2241.86
Jag Vidhi	5641.50	2272.32	0.00	69.73	24951.27
Jag Vijaya	3720.38	1401.90	0.00	70.89	16229.92
Jag Viraat	5125.49	1909.65	0.00	51.12	22141.97
Jag Vayu	5001.52	1972.40	0.00	71.88	22020.21
Jag Vasant	6544.21	2096.97	0.00	54.90	27162.23
Capesize					
Jag Anand	5999.11	2510.71	0.00	642.69	28652.94
Kamsarmax					
Jag Arnav	4665.80	989.22	0.00	464.36	19135.07
Jag Aarati	4497.32	2229.60	0.00	180.73	21609.54
Jag Aditi	4737.71	2091.20	0.00	255.15	22160.61
Jag Ajay	4384.21	1475.04	0.00	394.92	19566.39
Jag Aalok	3885.75	1316.53	0.00	588.40	18135.02
Jag Akhsay	4495.62	1765.18	0.00	164.51	20088.86
Jag Amar	3879.21	1069.34	0.00	598.56	17368.33
Supramax					
Jag Roopa	3199.85	958.16	0.00	246.33	13773.23
Jag Rani	2996.09	1456.04	0.00	197.00	14549.39
Jag Rishi	2868.67	1213.47	0.00	182.78	13342.68
Jag Radha	3393.24	1073.19	0.00	390.36	15199.67
Jag Rohan	3143.22	923.50	0.00	208.29	13365.71
				Total	**1063222.94**

Emission of CH_4 and N_2O from combustion of above fuel is derived from Table 3.4 and given in Table 5.2 below in CO_2e.

Table 5.2 – CO_2e from emission of CH_4 and N_2O from fuel burnt during FY 2019-2020

Type of Fuel	Mass of Fuel (MT)	CO_2e of CH4 (MT)	CO_2e of N2O (MT)	Total CO_2e (MT)
Total HFO (HSFO + LFO)	317,291.95	533.12	13,453.18	13,986.30
Total MDO (MDO + LSMGO)	22,507.35	37.80	893.05	930.85
			Total	**14,917.15**

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	219.5	386.32
R 404a	1211	4749.54
R 407c	203	360.12
	Total	**5495.984**

Total Scope 1 CO2e emission from all sources Table 5.1 + Table 5.2 + Table 5.3 = **10,83,636.07 MT**

Scope 2 Emission

- Emission from consumption of purchased electricity used at Ocean House, the Head Office of the Company located at Mumbai, Maharashtra, Training and Assessment Department located at Kakad Chambers, Worli, Mumbai Great Eastern Institute of Maritime Studies, the training academy of the Company located at Lonavala, Maharashtra.

Table 5.4 - Electricity Consumed and CO_2e Emission during FY 2019-2020

Purchased and consumed electricity				
At Ocean House, Head Office of G E Shipping and T & D Dept at Kakad Chambers, Worli, 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 15.0, December 2019) published by Government of India**	**Total CO_2e (MT)**
887.914	501.318*	1389.232	0.83	1153.062

*Please see Table 5.4.1

- During the year 300 KW Solar power plant has been installed and commissioned at GEIMS in Lonavala with effect from September 2020. The roof top Solar power plant consists of 858 panels with a combined generating capacity of 350 KW. The DC power produced by Photo Voltic cells is converted to AC power with the help of Inverters. The AC power output is 3 phase 440 V 50 Hz which is fed to the local substation. The generated power is fed to the Maharashtra State Electricity Distribution Company Ltd. transmission Grid under a Net Metering arrangement. The excess power generated during daylight is exported to the Grid while importing power when there is no generation e.g. at night and during cloud cover.

Table 5.4.1 - Details of Electricity consumed at GEIMS, Lonavala FY 2019-2020

	MWh
Electricity imported from MSEDCL	571.054
Electricity exported to MSEDCL (from the installed solar panels)	69.736
Net electricity consumed from MSEDCL	501.318

Total Scope 2 CO_2e emission from all sources Table 5.4 = **1135.06 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
2019-2020 (1st April 2019 – 31st March 2020)	**10,83,636.07 MT**	**1153.06 MT**

Chapter 8 - References

- MEPC.308(73) – 2018 Guidelines on the Method of Calculation of the Attained Energy Efficiency Design Index (EEDI) for New Ships.
- Third IMO GHG Study 2014
- IPCC Fifth Assessment Report: Climate Change 2014

Chapter 9 -Abbreviations

CSR – Corporate Social Responsibility

CFC - Chlorofluorocarbons

EF – Emission factor

EEDI – Energy Efficiency Design Index

GHG – Green House Gas

GWP – Global Warming Potential

HFC – Hydrofluorocarbons

HCFC – hydrochlorofluorocarbons

HFO – Heavy fuel oil

HSFO – High sulphur fuel oil

IT – Information Technology

IMO – International Maritime Organization

IPCC – Intergovernmental Panel on Climate Change

ISO – International Organization for Standardization

KPI – Key Performance Indicator

LSMGO – Low sulphur marine gas oil

LFO – Light fuel 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

Recalculation of GHG Inventory of previous 3 years

Following publication of GHG Assertion Report for FY 2018-2019 it was recognized that certain quantities of fuel oil consumption reported in Arrival Reports of vessels were not being captured in our report. Until then fuel consumption reported in daily Noon Reports alone were being captured.

It was decided to the correct the same in not only in next annual GHG Assertion Report but also recalculate the inventory for FY 2017, FY 2018 and FY 2019 and include the revised inventories as Annexures in GHG Assertion Report for FY 2020.

To negate any possibility of missing out any fuel consumption data it was decided to change the methodology for quantification of fuel oil consumption.

Until FY 2019 annual fuel oil consumption data for each vessel was computed from the sum of daily fuel oil consumption data of all relevant fuel oil consuming processes on board measured by flow meters. We find computation of fuel oil consumption data from fuel available at the beginning of the period, plus deliveries during the period, minus fuel available at the end of the period on respective vessels gives a fool proof method. Further detail is given under Section 3.3 of the Report. This methodology has been used for recalculating GHG inventories for FY 2017, FY 2018 and FY 2019 and are reported hereunder.

Revised Scope 1 emission for FY 2016-2017

Table I.1.1 - FY 2016-2017 (All figures are in MT)

Vessels	HSFO	LSFO	MDO	LSMGO	Total CO_2
Suezmax					
Jag Lakshita	11940.82	0.00	0.00	11.50	37220.58
Jag Lateef	11256.73	0.01	0.00	68.80	35274.06
Jag Lok	9247.37	0.00	0.00	706.17	31060.29
Jag Lalit	10850.75	0.00	0.00	557.48	35576.52
Jag Leena	289.29	0.00	0.00	0.95	903.89
Jag Lakshya	5.00	0.00	0.00	20.00	79.69
Jag Laadki	620.16	0.00	0.00	141.80	2385.79
Aframax					
Jag Lavanya	9646.49	0.00	7.30	564.84	31873.45
Jag Laxmi (sold)	1030.25	0.00	0.00	0.00	3207.24
Jag Lata	7310.70	0.00	0.00	19.00	22826.43
Jag Lyall	9630.02	0.00	0.00	92.52	30284.5
Jag Leela	2220.86	0.00	0.00	0.75	6918.16
Jag Laxmi (new)	1773.10	0.00	0.00	2.20	5528.49
LR1					
Jag Aabha	7427.80	0.00	0.00	1685.55	28534.04
Jag Aparna	7801.21	0.00	0.00	193.38	24912.94
Jag Amisha	7027.15	0.00	295.69	54.80	23006.22
Jag Aanchal	8418.37	0.00	76.90	1028.05	29757.27

Vessels	HSFO	LSFO	MDO	LSMGO	Total CO_2
MR					
Jag Pranav	3745.43	0.00	437.62	0.00	13066.28
Jag Pranam	5614.38	0.00	0.00	357.09	18628.01
Jag Prabha	3756.34	0.00	47.70	454.48	13307.23
Jag Pushpa	4680.72	0.00	250.60	0.00	15379.19
Jag Prerana	5651.53	0.00	473.97	33.85	19226.94
Jag Prakash	5483.32	0.00	95.10	146.33	17849.08
Jag Pankhi	5242.34	0.00	0.00	569.62	18150.85
Jag Pahel	5383.06	1.00	290.03	37.13	17814.87
Jag Padma	5702.96	0.00	0.00	91.40	18052.05
Jag Pooja	3640.28	0.00	23.10	91.90	11704.52
Jag Punit	4391.47	0.00	124.12	161.33	14590.19
Gas Carrier					
Jag Vishnu	5976.61	0.00	101.10	45.80	19082.12
Jag Vidhi	6152.27	0.00	0.00	67.50	19374.57
Capesize					
Jag Anand	6602.26	0.00	0.00	12.37	20599.10
Kamsarmax					
Jag Arnav	4527.11	0.00	188.85		14702.87
Jag Aarati	5337.57	0.00	0.00	419.34	17965.60
Jag Aditi	5922.77	0.00	0.00	125.08	18844.51
Jag Arya	5142.41	0.00	197.17	0.00	16645.59
Jag Ajay	4282.54	0.00	1.60	336.32	14419.20
Jag Aalok	3601.58	0.00	8.50	259.18	12073.50
Jag Akhsay	3303.52	0.00	1.00	387.50	11532.69
Jag Amar	1368.50	0.00	6.00	16.20	4332.68
Supramax					
Jag Roopa	4548.18	0.00	30.70	189.75	14869.80
Jag Ratan	4596.73	0.00	2.96	13.14	14365.83
Jag Rahul	3634.97	0.00	93.30	0.00	11618.42
Jag Rani	3404.17	0.00	45.80	215.08	11436.97
Jag Rishi	4557.81	0.00	6.20	104.93	14549.32
Jag Radha	1336.60	0.01	0.01	19.05	4223.31
				Total	**767,754.86**

Table I.1.2 – CO_2e from emission of CH_4 and N_2O from fuel burnt during FY 2016-2017

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)	234,084.52	396.06	9,924.25	10,320.31
Total MDO (MDO + LSMGO)	12,107.18	20.34	481.24	501.58
			Total	**10,821.89**

Table I.1.3 – Emission of refrigerant and its CO_2e

Type of refrigerant	Mass in Kgs.	CO_2e (MT)
R 22	237.0	428.97
R 404a	759.8	3227.02
R 407c	4.0	7.10
	Total	**3,663.09**

Total Scope 1 CO_2e emission from all sources for FY 2016-2017: Table I.1.1 + Table I.1.2 + Table I.1.3 = **7,82,239.758 Tonnes**

Revised Scope 1 emission for FY 2017-2018

Table I.2.1 - FY 2017-2018 (All figures are in MT)

Vessels	HSFO	LSFO	MDO	LSMGO	Total CO_2
Suezmax					
Jag Lakshita	11755.61	0.31	0.00	18.80	36667.24
Jag Lateef	14263.29	0.00	0.00	30.60	44513.99
Jag Lok	11047.15	0.00	0.00	340.89	35493.72
Jag Lalit	12264.32	0.00	0.00	193.87	38812.64
Jag Leena	12531.05	10.10	0.00	563.45	40828.11
Jag Lakshya	9890.29	0.00	0.00	950.25	33844.86
Jag Laadki	9536.20	0.00	0.00	804.59	32275.24
Aframax					
Jag Lavanya	8617.21	0.00	16.30	0.00	27239.55
Jag Lata	7484.37	0.00	0.00	67.50	23522.73
Jag Lyall	8201.47	0.00	0.00	205.40	26197.89
Jag Leela	9446.83	0.00	0.00	1356.44	33766.18
Jag Laxmi	8880.14	0.00	0.00	1183.59	31447.35
LR1					
Jag Aabha	7247.84	0.00	0.00	1132.53	26200.66
Jag Aparna	7522.07	0.00	0.00	568.32	25245.76
Jag Amisha	6668.30	0.90	263.93	108.82	21960.12
Jag Aanchal	6704.07	0.20	112.98	295.93	22187.44
LR2					
Jag Lokesh	4801.65	0.00	0.00	104.58	15287.62
MR					
Jag Pranav	5057.92	0.00	298.59	0.00	16707.64
Jag Pranam	6291.05	2.33	0.00	47.45	19742.45
Jag Prabha	4642.91	2.90	14.70	113.9	14870.31
Jag Pushpa	4352.13	0.00	404.85	0.00	14850.48
Jag Prerana	5527.75	0.00	112.25	230.01	18310.70
Jag Prakash	4467.51	0.00	5.00	232.89	14674.50
Jag Pankhi	4896.72	0.80	0.00	268.73	16109.93
Jag Pahel	5229.71	0.00	29.50	336.80	17459.67
Jag Padma	4725.90	0.00	0.00	61.24	14912.78
Jag Pooja	5174.36	0.20	13.70	768.30	18620.05
Jag Punit	4157.63	0.00	0.00	1373.43	17350.08
Jag Pavitra	4826.34	8.45	53.34	309.35	16192.01
Gas Carrier					
Jag Vishnu	5749.65	0.00	140.41	0.00	18354.56
Jag Vidhi	7055.61	0.00	0.00	69.30	22193.35
Jag Vijaya	2066.00	0.00	0.00	54.52	6608.32
Capesize					
Jag Anand	9877.97	0.00	0.00	420.08	32106.78

Vessels	HSFO	LSFO	MDO	LSMGO	Total CO_2
Kamsarmax					
Jag Arnav	5659.87	0.50	0.00	386.15	18862.83
Jag Aarati	5932.25	0.00	0.40	777.30	20965.05
Jag Aditi	6018.49	0.00	0.00	43.63	18881.46
Jag Arya	6079.69	0.00	0.00	308.16	19920.12
Jag Ajay	6225.26	0.00	0.00	421.26	20736.02
Jag Aalok	5378.85	4.40	0.00	115.9	17121.31
Jag Akhsay	4757.98	0.00	0.00	495.96	16406.40
Jag Amar	5096.59	0.10	0.00	403.71	17165.08
Supramax					
Jag Roopa	3545.00	0.10	0.60	329.95	12097.26
Jag Ratan	3636.97	5.10	0.00	180.18	11903.18
Jag Rahul	3591.44	0.00	188.89	0.00	11789.33
Jag Rani	4895.17	0.00	2.60	244.8	16036.72
Jag Rishi	4063.64	0.00	0.00	195.93	13282.33
Jag Radha	4114.83	500.00	0.00	203.36	15041.05
Jag Rohan	4128.24	0.00	0.00	201.53	13501.44
				Total	**1,038,264.31**

Table I.2.2 – 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 CH_4 (MT)	CO_2e of N_2O (MT)	Total CO_2e (MT)
Total HFO (HSFO + LSFO)	314,585.39	528.50	13,337.45	13,865.95
Total MDO (MDO + LSMGO)	18,286.62	30.756	726.895	757.651
			Total	**14,623.60**

Table I.2.3 – Emission of refrigerant and its CO_2e FY 2017-2018

Type of refrigerant	Mass in Kgs.	CO_2e (MT)
R 22	516.00	933.96
R 404a	1064.70	4175.75
R 407c	68.00	120.63
	Total	**5,230.35**

Total Scope 1 CO_2e emission for FY 2017-2018 from all sources: Table I.2.1 + Table I.2.2 + Table I.2.3 = **10,58,118.26 Tonnes**

Revised Scope 1 emission for FY 2018-2019

Table I.3.1 - FY 2018-2019 (All figures are in MT)

Vessels	HSFO	LSFO	MDO	LSMGO	Total CO_2
Suezmax					
Jag Lakshita	10292.17	0.00	0.00	363.80	33216.15
Jag Lateef	9972.77	0.79	0.00	406.34	32357.93
Jag Lok	12005.89	0.00	0.00	387.73	38629.40
Jag Lalit	11453.42	0.00	0.00	268.24	36525.93
Jag Leena	12711.98	0.00	0.00	518.58	41247.67
Jag Lakshya	10260.77	0.00	0.00	1154.00	35651.76
Jag Laadki	11191.42	0.00	0.00	291.10	35783.35
Aframax					
Jag Lavanya	9474.59	0.00	0.00	41.26	29636.15
Jag Lata	7215.81	0.70	0.00	482.90	24018.21
Jag Lyall	8896.10	0.00	0.00	1141.17	31361.05
Jag Leela	5949.56	0.01	0.01	3492.92	29725.29
Jag Laxmi	5470.57	0.00	00.00	2611.88	25409.04
LR1					
Jag Aabha	7424.12	0.00	0.00	644.34	25184.46
Jag Aparna	7509.25	0.20	0.00	519.99	25050.89
Jag Amisha	6805.11	0.00	0.00	250.40	21993.89
Jag Aanchal	5673.36	0.00	203.96	225.98	19045.23
LR2					
Jag Lokesh	11734.86	0.00	0.00	289.89	37471.74
MR					
Jag Pranav	5350.58	0.00	201.46	154.60	17803.23
Jag Pranam	5125.07	0.00	0.00	68.92	16180.43
Jag Prabha	4952.59	0.00	0.00	157.88	15928.53
Jag Pushpa	5590.83	0.00	9.50	314.16	18447.50
Jag Prerana	5437.61	0.00	0.00	263.82	17778.52
Jag Prakash	4765.43	0.00	0.00	300.39	15802.60
Jag Pankhi	4154.08	0.00	0.00	256.34	13757.63
Jag Pahel	4738.70	0.00	52.86	274.10	15804.55
Jag Padma	5855.71	0.00	0.38	148.60	18712.31
Jag Pooja	5655.21	0.00	0.00	178.60	18182.92
Jag Punit	4029.08	0.00	0.00	784.28	15060.96
Jag Pavitra	4226.46	0.00	0.00	389.60	14410.25
Gas Carrier					
Jag Vishnu	6929.79	0.20	74.30	0.00	21817.57
Jag Vidhi	9186.64	0.80	0.00	94.53	28910.26
Jag Vijaya	5219.30	0.01	0.00	77.37	16500.95
Jag Viraat	7148.53	0.00	0.00	68.66	22480.65
Jag Vayu	3502.48	0.00	0.00	191.60	11520.99
Jag Vasant	4869.83	0.00	0.00	228.56	15897.41

Vessels	HSFO	LSFO	MDO	LSMGO	Total CO_2
Capesize					
Jag Anand	8412.75	0.00	0.00	1166.55	29937.26
Kamsarmax					
Vessels	**HSFO**	**LSFO**	**MDO**	**LSMGO**	**Total CO_2**
Jag Arnav	5594.52	0.00	0.00	472.01	18934.60
Jag Aarati	4572.63	0.00	0.00	287.63	15161.31
Jag Aditi	6340.62	0.00	0.00	201.55	20390.86
Jag Arya	4164.71	0.00	0.00	253.86	13782.78
Jag Ajay	4795.46	0.00	0.00	459.68	16406.80
Jag Aalok	5575.02	0.00	0.00	519.18	19025.10
Jag Akhsay	4788.97	0.10	0.00	491.26	16487.83
Jag Amar	5797.34	0.00	0.00	28.68	18144.86
Supramax					
Jag Roopa	4688.74	0.01	0.00	276.29	15486.52
Jag Ratan	918.45	0.00	0.00	69.23	3082.00
Jag Rani	4745.87	0.00	47.17	138.51	15373.93
Jag Rishi	4150.77	0.00	0.00	209.48	13597.09
Jag Radha	4971.14	0.00	0.00	167.05	16015.69
Jag Rohan	4368.65	0.00	0.00	289.77	14532.98
				Total	**1,083,665.058**

Table I.3.2 – CO_2e from emission of CH_4 and N_2O from fuel burnt during FY 2018-2019

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)	324,665.32	545.412	1,3765.69	14,311.12
Total MDO (MDO + LSMGO)	22,662.90	38.052	900.735	938.787
			Total	**15,249.907**

Table I.3.3 – Emission of refrigerant and its CO_2e

Type of refrigerant	Mass in Kgs.	CO_2e (MT)
R 22	337.00	593.12
R 404a	1037.20	4067.90
R 407c	123.00	218.20
Total		**4879.22**

Total Scope 1 CO_2e emission from all sources for FY 2018-2019: Table I.3.1 + Table I.3.2 + Table I.3.3 = **11,03,794.18 MT**

Annexure II

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 Fifth Assessment Report: Climate Change 2014)

Refrigerant	CO_{2e}
R-22	1760
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
Light Fuel Oil	ISO 8217 Grades RMA through RMD	0.8594	3.151
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
	Light Fuel Oil (LFO)	3.151
	Marine Diesel Oil (MDO)	3.206
	Low Sulphur Marine Gas Oil (LSMGO)	3.206
Auxiliary Engine	Heavy Fuel Oil – High Sulphur (HSFO)	3.114
	Light Fuel Oil (LFO)	3.151
	Marine Diesel Oil (MDO)	3.206
	Low Sulphur Marine Gas Oil (LSMGO)	3.206
Boiler	Heavy Fuel Oil – High Sulphur (HSFO)	3.114
	Light Fuel Oil (LFO)	3.151
	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

Source	Type of fuel oil	Emission Factor (t-CO_2 / t-Fuel)
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	28
N_2O	0.00016	0.00015	265

1.4 CO_{2e} emission Factor for unit of electricity consumed

As per CO2 Baseline Database for the Indian Power Sector (Version 15.0, December 2019) published by Government of India, Ministry of Power, Central Electricity Authority CO_{2e} emission factor for every MWh electricity consumed: 0.83.

Table S-1: Weighted average emission factor, simple operating margin (OM), build margin (BM) and combined margin (CM) of the Indian Grid for FY 2018-19 (adjusted for cross-border electricity transfers), in t CO_2/MWh

Average	OM	BM	CM
0.83	0.97	0.88	0.92

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 III

Trend Charts